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Impact of land use on spatial distribution of soil nutrients in Akure north and Akure south local government areas of Ondo state, South west Nigeria

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ABSTRACT

Land use has great impacts on the distribution of nutrients in soils, *Anthropogenic* activities and recorded increase in population density in the study area is expected to lead to great changes in the soil spatial nutrients distribution, data on the spatial distribution of nutrients in Akure North and South Local Government Area (LGA) of Ondo state is scarce, therefore it is important to fill this knowledge gap. This study shows the distribution of major soil nutrients and their spatial distribution in relation to land use in Akure North and South LGA of Ondo State, South Western Nigeria. Nature and *Anthropogenic* activities coupled with land use have affected soil nutrients changes in the area therefore to study these activities major nutrients parameter determined (pH, OM, N, P, and K) were interpolated using ArcGIS Version 10.3, Microsoft Office, Erdas Imagine 2014. The study was conducted within A and B horizons of soil pedons. The soil pH ranged between very strongly acidic (4.70) to slightly acidic (6.71) in the topsoil (A1) and from very strongly acidic (4.81) to moderately acidic (5.77) in the subsoil. This distribution spanned over wide range of land area in the two LGA's. High Organic Carbon (OC) concentration was found distributed along FECA and Iju axis. Soil Organic Carbon (SOC) in the topsoil ranged from very low (0.95 %) to high (3.04 %), and from very low (0.15 %) to moderate (2.84 %) in subsoil. Nitrogen concentrations in the study area fall sharply with depth from A1 to Btg2. Phosphorous, and Potassium were widely distributed in the study area. Integrated nutrient management system suggested in the study area.

1.0 Introduction

The survival, maintenance of all terrestrial ecosystems and prosperity of humanity depend on Land. (FAO/UNEP, 1997) and currently, land resources are clearly under stress; 16 percent of arable land is degraded and the percentage is increasing (FAO, 1997). Meanwhile, traditional systems of land management are either breaking down or are no longer appropriate. Akure being an agrarian community sandwiched with developments has two local government areas. The change in Land development in Akure is rapid because of population increase of the city Gbiri, and Adeoye, (2019). Owoeye and Ibitoye, 2016). Oyinloye and Popoola (2015) modelled its Akure growth in urban set up. Depletion of Agricultural landuse changes of Akure was study by Balogun *et al.,* (2011) he inferred that serious anthropogenic activities are fast depleting our agricultural land and soil were been lost at alarming rate. In all, there is an agreement that Akure and environ is fast developing and changes are noticeable with time taken into consideration other environmental factors (Mengistu and Salami, 2007). Remote sensing and (GIS) Geographical information System provide a synergy use to obtain information about an Akure land. The study locations lie within latitude 7° 15' 2.7756'' and longitude 5° 12' 36.9576''. Akure North with a population of 131,587.00, land mass of 660 km² and Land to man ratio of 0.50 km²/person. The south L.G.A has population of 353,211.00, land mass of 991 km² and land to man of 0.28 km²/person. The metropolis is located on a gentle undulating terrain surrounded by isolated hills and inselbergs. Topographic elevations vary between 260 and 470m above sea level (Owoyemi, 1996). The climate of the study areas is hot and humid, influenced by rain bearing Southwest monsoon winds from the ocean and dry Northwest winds from the Sahara desert. The raining season lasts from April to October with rainfall of about 1524mm annually (Ogunrayi, *et al.,* 2016).Temperatures vary from $28^{\circ}C$ to $31^{\circ}C$ with mean annual relative humidity of about 80 %

1.1 Land Use and spatial nutrients distribution of Akure North and South L.G.A

Soil Survey of South-Western Nigeria was conducted by Smyth *et al.,* 1962 with the use of parallel traverse grid. He was able to identify differences in soil associations as conditioned by topography. Aerial photographs were used to show the extent of influence of parent material on soil characteristics Adekayode, (2003). Nutrients distribution in soil is important for proper delineation Adesemuyi *et al.,* 2018 and Adekayode, (2006) concluded that the spatial distribution had added advantages of ease of sampling and quick results with higher degree of accuracy in the research conducted on the application of GIS in mapping of soils of Owena forest reserve, Southwest Nigeria, Landuse and nutrient distribution study allows farmer and policy makers to study soil biodiversity and its sustainability. The conversion of agricultural land to other forms of landuse can increase soil erosion and this in turn lead soil nutrient leaching, reduction in soil organic matter and modification of soil structure (Dorioz, 1993) and Chen, *et al*., 2001). Poor economic factor is directly related to poor soil management. Amana, *et al.,* 2012. Landuse changes are known to result in changes in soil biological chemical and physical (Houghton, 1999) these landuse, also the effects of landuse activities also provide essential information for assessing sustainability and environmental impact (Amana, *et al*., 2012). The soil mapping shows different land use and the distribution of the specific soil nutrients. Land use changes can lead to the changes of soil nutrients properties and productivity. The concentrations of the soil nutrients with depth are control by soil parent material (Islam *et al*., 2000 and Wang *et al.,* 2009). The data on the landuse and land evaluation is essential for determining the origin and fertility of the soils and how it is distributed in the study area (Nuga, *et al*., 2011). The objective of the study is to provide updated information on soil pH, organic carbon, soil nitrogen, phosphorous, potassium, which varies with depth. Also presentation of detailed spatial digital soil maps, and text narratives that can be used in Agricultural and Non- agricultural land-planning programs.

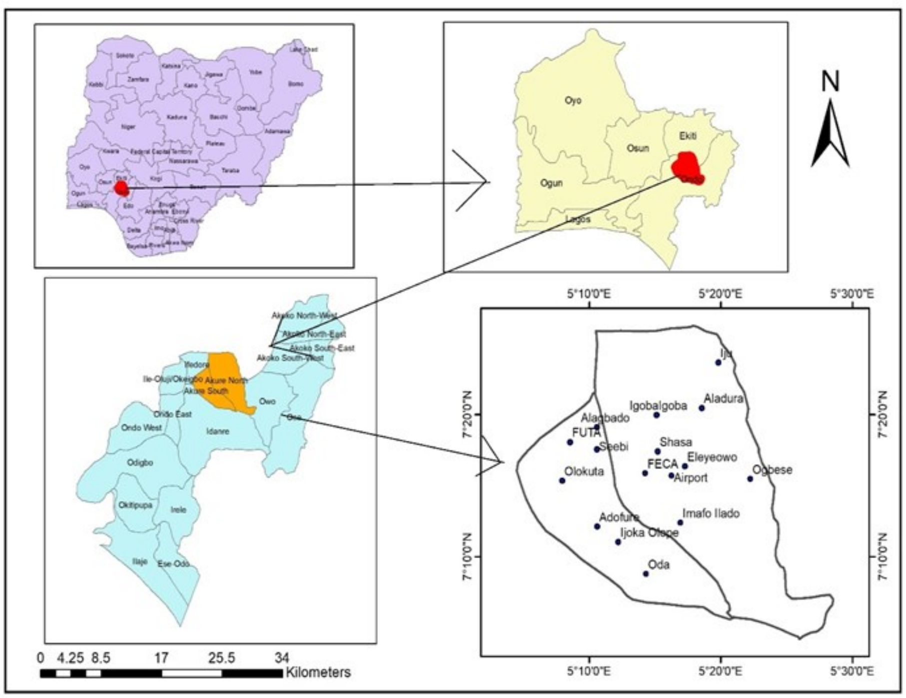

Plate 1: Map of Akure South and North Local Government Area of Ondo State

2.0 Field Studies, Sampling Techniques and Laboratory Analysis

The sites were divided into Map Grids and pedon established within the grids. Sixteen Pedons (1.5 m wide x 1.0 m long x 1.5 m deep) were established. Nine pedon in North L.G. A and Seven pedon in South L.G.A. The pedon locations were Geo-referenced with Global Positioning System (GPS). Horizons were designated, 500 g soil representative sample were collected from each of the designated horizon. The Soil samples were air-dried, gently ground in a mortar and sieved with a 2 mm sieve. They were packed into polythene bags, neatly labelled and taken to the laboratory for nutrients analysis. Soil pH was determined using a glass electrode in 1:2 soils: water ratio (Thomas, 1996). Organic matter was determine using Walkley-Black wet oxidation method (Walkley, 1947) and Organic matter estimated by multiplying with a factor of 1.724 as described by Sommers (1996). Total Nitrogen was determined by Kjeldahl digestion procedure (Bremner, 1996). Available phosphorus was determined using the Bray-1 method and potassium by flame photometry as described by McLean, (1965). GIS of the study area and remote sensing were developed with ArcGIS 10.3 and soil positioning taken by Land meter NF-198. The images were enhanced, georeferenced, classified and digitized. Resulting nutrient for samples were used to generate spatial distribution maps on the scale of 1: 250,000 for the study area using interpolation technique.

2.1 Land-Use Changes of Akure North and South L.G.A

Akure had a basement complex, migmatite gneiss (Geological Survey Division, 1974). Akure covers a total area of 14,793 Km^2. Plate 2 revealed the Landuse map of Akure in 1987. Five landuse types were identified within Akure which includes Built Up, Bare Surface Light Vegetation, Dense Vegetation and Rock Outcrop. Built Up covers an area of 12.68km^2 which is 1.3 % of the total area, Bare surface covers an area of 2.23Km^2 which is 0.2% of the total area, Light Vegetation covers an area of 434.68Km^2 which is 43.2 % of the total area, Dense Vegetation covers an area of 443.92Km^2 which is 44.1% of the total area and Rock outcrop covers an area of 113.27 km^2 which is 11.3% of the total area. Plate 3 revealed the Landuse map of Akure in 2002. Five landuse types were identified within Akure Built Up covers an area of 37.92Km^2 which is 3.8 % of the total area, Bare surface covers an area of 2.07 Km^2 which is 0.2% of the total area, Light Vegetation covers an area of 432.34 Km^2 which is 42.9% of the total area, Dense Vegetation covers an area of 423.75 km^2 which is 42.1% of the total area and Rock outcrop covers an area of 110.70Km^2 which is 11.0% of the total area. Plate 4 revealed the landuse map of Akure in 2017. Five landuse types were identified within Akure which includes Built Up, Bare Surface Light Vegetation, Dense Vegetation and Rock Outcrop. Built Up covers an area of 86.32 km^2 which is 8.57 % of the total area, Bare surface covers an area of 3.65 km^2 which is 0.36 % of the total area, Light Vegetation covers an area of 510.21 km^2 which is 50.68% of the total area, Dense Vegetation covers an area of 337.96 km^2 which is 33.57 % of the total area and Rock outcrop covers an area of 68.64 km^2 which

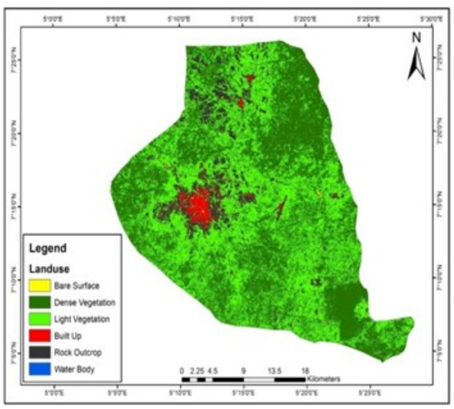

Plate 2: Akure North and South L.G.A Landuse Map for 1987

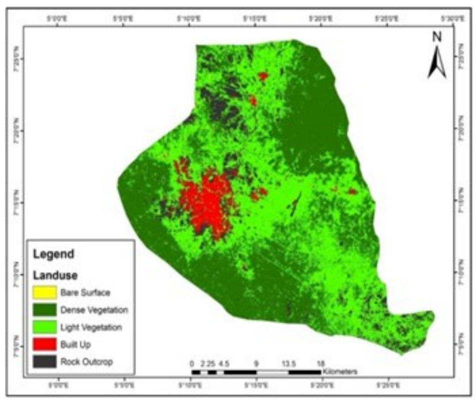

Plate3: Akure North and South L.G.A Landuse Map for 2002

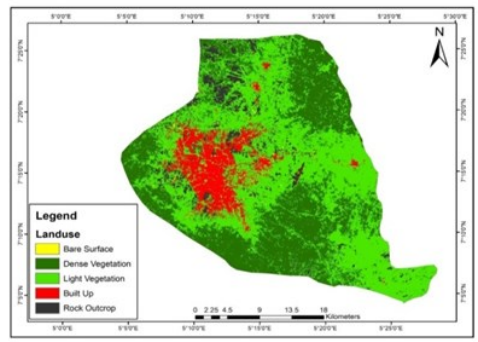

Plate4: Akure North and South L.G.A Landuse Map for 2017

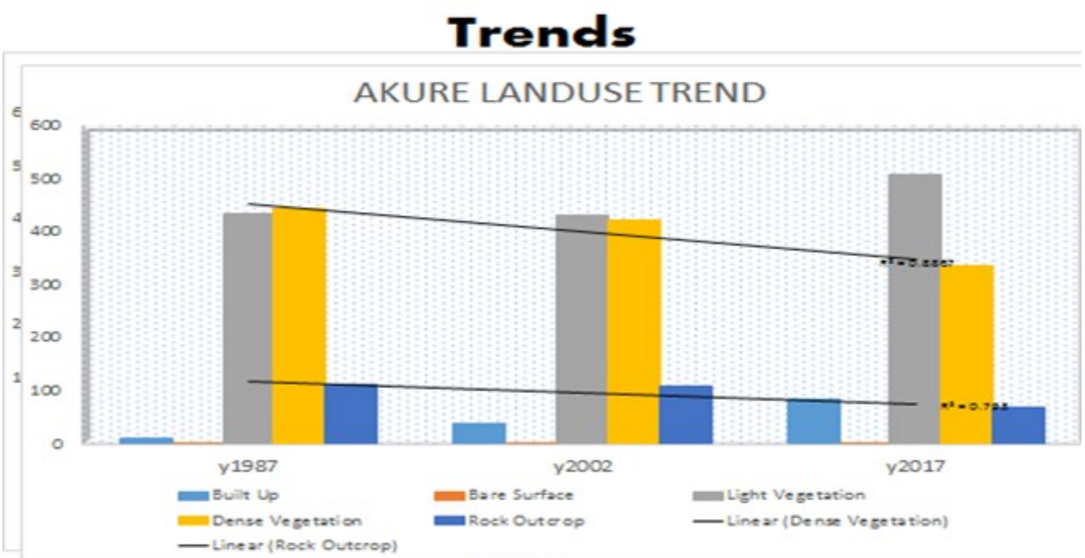

Plate 5: Trend of Landuse change of Akure North and South L.G.A from 1987 to 2017

Table 2: Landuse change of Akure North and South L.G.A 1987-2017

Landuse Type	1987		2002		2017	
	(km^2)	%	(km^2)	%	(km^2)	%
Built Up	12.68	1.3	37.92	3.8	86.32	8.57
Bare Surface	2.23	0.2	2.07	0.2	3.65	0.36
Light Vegetation	434.68	43.2	432.34	42.9	510.21	50.68
Dense Vegetation	443.92	44.1	423.75	42.1	337.96	33.57
Rock Outcrop	113.27	11.2	110.7	11	68.64	6.82

2.2 Agricultural Use and Non- Agriculture land area

Land use in Akure was further separated to agriculture Land area and non- agriculture land area (Table 4) In 1987 the total land area for agricultural use (Light Vegetation and Dense vegetation) was 678.60 km^2 (87.30 %), in 2002 it has reduced to 856.09 km^2 (85.00 %) while in 2002 it was 848.17km^2 (84.32 %). Non- agriculture land area (Bare Surface, rock outcrop , Built Up) was considered as non –agricultural land area in 1987 was 128.16 km^2 (12.70 %), 2002 was 150.69 km^2 (15.00 %), and in 2017 it has increased to 158.61 km^2 (15.75 %).

2.3 Agricultural Land correlation analysis

Linear correlation analysis between agricultural use and non - agriculture land area from 1987 to 2017 were presented in table 3. The coefficient of regression for agricultural land is 0.0958 while that of non - agricultural land is 0.0366. Table, 4 and 5 shows correlation of agricultural land negative correlation was observed in land use per years. There was significant negative correlation of -.948* for light vegetation and -0.82 for dense vegetation to non-agricultural land area shows negative correlation to the land use per years. This revealed the rate at which agricultural land was being depleted.

Table 3: Land correlations and regression equation of Akure North and South L.G.A

Land Use	1987		2002		2017		Regression equation	Coefficient
	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)		
Agriculture Land area	878.60	87.30	856.09	85.00	848.17	84.25	y = -70.292x + 719.26	0.0958
Non-Agriculture land area	128.18	12.70	150.69	15.00	158.61	15.75	y = -7.4317x + 106.17	0.0366

Table 4: Agricultural Use and Non- Agriculture land area of Akure North and South L.G.A

Land area	Landuse Type	1987		2002		2017	
	Land Use	(Km^2)	%	(Km^2)	%	(Km^2)	%
Agriculture Land area	Light Vegetation	434.68	43.2	432.34	42.9	510.21	50.68
	Dense Vegetation	443.92	44.1	423.75	42.1	337.96	33.57
		878.6	87.3	856.09	85	848.17	84.25
Non- Agriculture land area	Bare Surface	2.23	0.2	2.07	0.2	3.65	0.36
	Rock Outcrop	113.27	11.2	110.7	11	68.64	6.82
	Built Up	12.68	1.3	37.92	3.8	86.32	8.57
		128.18	12.7	150.69	15	158.61	15.75

Table 5: Land correlations and regression equation

Lands Area	Land use	1987	2002	2017
		(km^2)	(km^2)	(km^2)
Agricultural Land	Light Vegetation	-.981**	-.982**	-.948*
	Dense Vegetation	-0.84	-0.83	-0.82
Non- Agricultural	Bare Surface	1.00	.998**	.936*
	Rock outcrop	.998**	1.00	.952*
	Built up	.936*	.952*	1.00

* Correlation is significant at the 0.05 level ** Correlation is significant at the 0.01 level

Table 4, was the computation of the landuse change for 1987 to 2017. Agricultural land has reduced from 87.3 % to 84.25 % in 2017. Plate 5, revealed the trends of Landuse change from 1987 to 2017. The graph indicates that built up was increasing from 1987 to 2017. Bare surface was relatively low from 1987 to 2017. It slightly decreased between 1987 and 2002 and increased between 2002 and 2017. Light vegetation slightly decreased between 1987 and 2002 and there was a sharp increase between 2002 and 2017. Dense vegetation continuously decreased from 1987 to 2017. Rock Outcrop continuously decreased from 1987 to 2017. Land use/land changes the study are a reflection of increasing anthropogenic pressure and rapid population growth remained the major causes in changes of land use Awonira *et al.,* (2014). More people are getting engaged in agriculture this can lead to increase in food production and food security our land need government policy for avoidable encroachment for sustainable agriculture.

3.0 Nutrients Mapping and Distribution

3.1 Soil pH

Map a-d in Plate 6, shows the soil pH map distribution at horizon A1, A2, BTg1 and BTg2 in Akure. The Soil pH expresses the activity of the hydrogen ions in the soil solution. It affects the availability of mineral nutrients to plants as well as many soil processes (FAO, 1976). The pH value ranges from 4.70 to 6.71 for A1. The map indicates that pH at FUTA, Olokuta, Seebi, Alagbado, Igoba, FECA, Ijoka, Ogbese are acidic ditto for Saasa , pH at Adofure, pH at Iju, Aladura, Eleye-owo, Airport, Imafo-Ilado and Oda are is moderately acidic. For A2, pH values ranges from 0 to 6.79. The map indicates that pH at Saasa, Eleyo-owo and Airport are acidic, pH at Igoba is low, pH at FECA is fairly acidic, while pH at Alagbado, FUTA, Seebi, Olokuta, Adofure and Ogbese are high, and PH at Ijoka, Oda, Imafo-Ilado, Aladura and Iju are moderately acidic. The pH value ranges from 4.81 to 6.75 for BTG1. The map indicates that pH at FUTA, Alagbado, Seebi, Igoba and Ijoka are acidic, pH at Saasa and Ogbese are very acidic for the horizon, while pH at Adofure, Iju and Airport moderate, pH and pH at Aladura, Eleyo-Owo, Imafo-Ilado and Oda are also moderately acidic. The pH value ranges from 0 to 6.77 for BTg2. The map indicates that pH at Aladura and Airport are acidic, pH at Olokuta and Seebi are moderately acidic, pH at FUTA, Alagbado, Igoba, FECA, Ijoka, Adofure and Ogbese are acidic and pH at Iju, Saasa, Eleyo-Owo, Imafo-Ilado and Oda are moderately acidic.

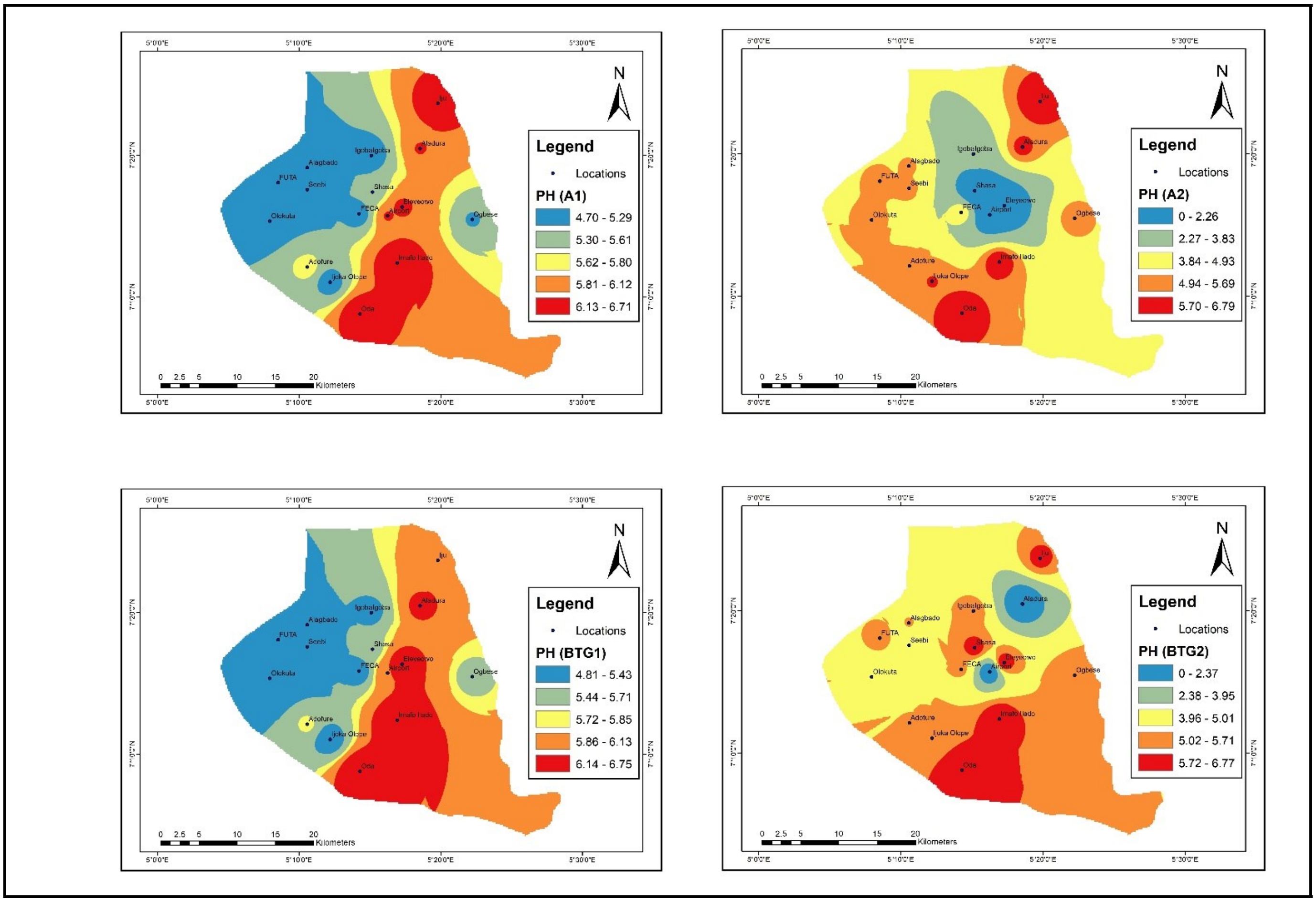

Plate 6: Soil pH spatial distribution of Akure North and South L.G.A

3.2 Organic Carbon (OC)

Map e-h in Plate 7 shows the soil OC distribution; at A1, A2, Btg1 and Btg2 in Akure. The OC value ranges from 0.95 % to 3.04 % for A1. The map indicates that OC at FUTA, Alagbado, Seebi, Aladura, Iju, Airport, Imafo-Ilado and Oda are very low, OC at Eleyo-Owo and Ogbese are high, and OC at Igoba, Saasa, FECA, Adofure, Ijoka and Olokuta are very high. For A2, OC values ranges from 0 to 3.45. The map indicates that OC at Saasa, Eleyo-Owo, Airport and Seebi are very low, OC at Igoba, Aladura and Iju is low, OC at Alagbado, Imafo-Ilado, Olokuta and Ijoka is moderate, OC at FUTA, Oda and Ogbese are high, and OC at Adofure and FECA are very high. The OC value ranges from 0.15 % to 2.84 % for Btg1. The map indicates that OC at Olokuta, Alagbado, Seebi, Aladura, Iju, Oda and Imafo-Ilado are very low, OC at Eleyo-Owo, FUTA, Ogbese and Ijoka moderate, OC at Igoba is high, and PH at Adofure, FECA and Saasa are very high. The OC value ranges from 0 to 2.71 for Btg2. The map indicates that OC at Iju, Aladura, Airport, Imafo-Ilado, Ijoka and Oda are very low, OC at Eleyo-Owo and Ogbese are low. OC at FUTA is moderate and OC at Igoba, Seebi, Saasa, FECA and Adofure are very high.

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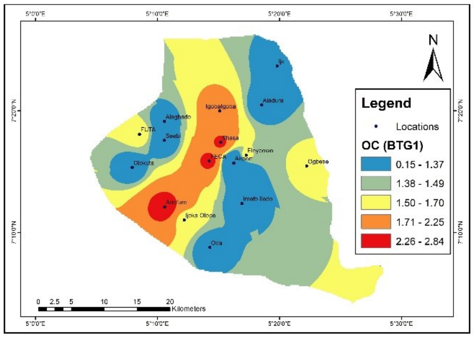

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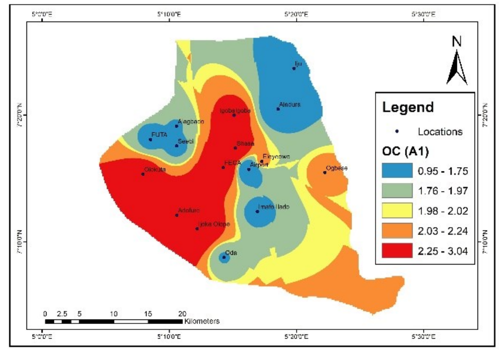

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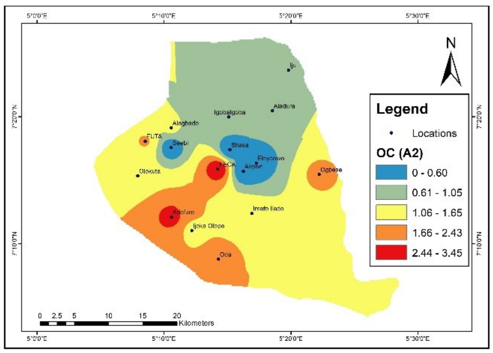

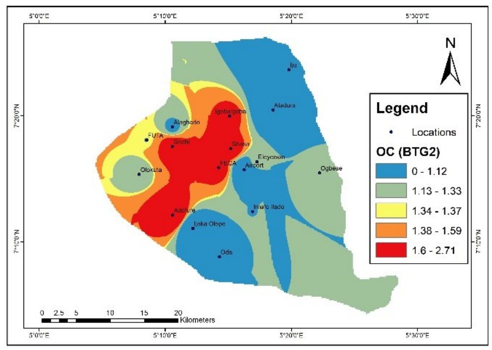

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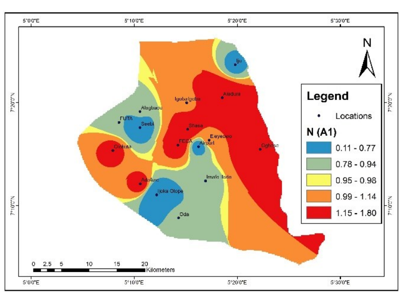
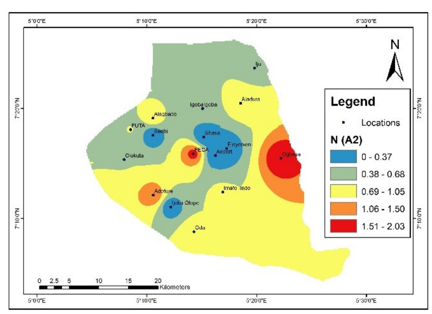
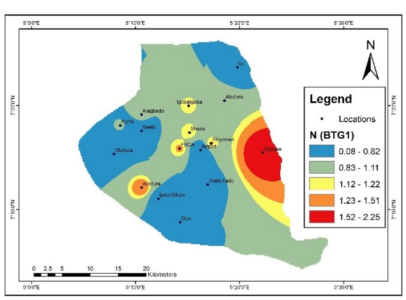
Plate 7: Soil Organic Carbon spatial distribution of Akure North and South L.G.A

3.3 Nitrogen (N): Map (I-L) in Plate 8 shows the soil N properties distribution at A1, A2, Btg1 and Btg2 in Akure. The N value ranges from 0.11% to 1.80 % for A1. The map indicates that N at Iju, Seebi, Airport and Ijoka are very low, N at FUTA, Alagbado, Imafo-Ilado and Oda is low, N at Eleyo-Owo and Igoba are high, and N at Aladura, Saasa, FECA, Ogbese, Adofure and Olokuta. For A2, N values ranges from 0 % to 2.03 %. The map indicates that N at Seebi, Saasa, Eleyo-Owo and Ijoka are very low, N at Iju, Igoba and Olokuta are low, N at Aladura, Alagbado, FUTA and Oda are moderate, N at Adofure is high, and N at Ogbese and FECA are very high. The N value ranges from 0.08 % to 2.25 % for Btg1. The map indicates that N at Seebi, Olokuta, Iju, Airport, Imafo-Ilado, Ijoka and Oda are very low, N at FUTA, Alagbado and Aladura are low, N at Igoba, Saasa and Eleyo-Owo are moderate, N at Adofure and FECA are high, and N at Ogbese is very high. The N value ranges from 0 % to 2.46 % for Btg2. The map indicates that N at Aladura and Airport are very low, N at Iju, FUTA, Alagbado, Seebi, Olokuta, Imafo-Ilado and Oda are low, and N at Saasa, FECA and Ijoka are moderate. N at Igoba, Eleyo-Owo and Adofure are high and N at Ogbese is very high.







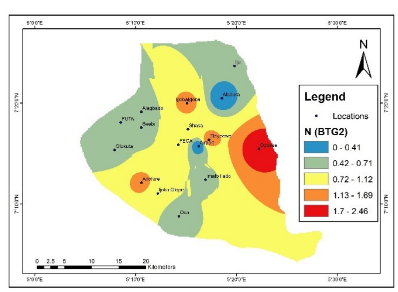


Plate 8: Soil Nitrogen spatial distribution of Akure North and South L.G.A

3.4 Phosphorous (P)

Map m-p in Plate 9 shows the soil Phosphorous distribution in the study site at A1, A2, Btg1 and BTG2 in Akure. The P value ranges from 0.04 mg/kg to 22.09 mg/kg for A1. The map indicates that P at FUTA, Alagbado, Seebi, Olokuta, Adofure, Ijoka, Imafo-Ilado, Ogbese, Eleyo-Owo, Airport, FECA and Igoba are very low, P at Oda is low, P at Iju and Aladura are moderate, and P at Saasa is very high. For A2, P values ranges from 0 to 1.27 mg/kg. The map indicates that P at FUTA, Olokuta, Alagbado, Saasa, FECA, Airport, Eleyo-Owo, Imafo-Ilado and Ogbese are very low, P at Adofure is low, P at Igoba and Ijoka are high, and P at Iju, Aladura, Seebi and Oda are very high. The P value ranges from 0.04 mg/kg to 23.99 mg/kg for BTG1. The map indicates that P at FUTA, Olokuta, Seebi, Alagbado, Adofure, Ijoka, Imafo-Ilado, Ogbese, Eleyo-Owo, Airport and FECA are very low, P at Aladura is low, P at Oda is Moderate, and P at Saasa is very high. The P value ranges from 0 mg/kg to 29.24 mg/kg for BTG2. The map indicates that P at FUTA, Olokuta, Adofure, Ijoka, Seebi, Alagbado, Igoba, Aladura, Ogbese, Eleyo-Owo, Airport and Imafo-Ilado are very low, P at Iju is low, and P at Oda is moderate. P at FUTA, P at Saasa is very high.

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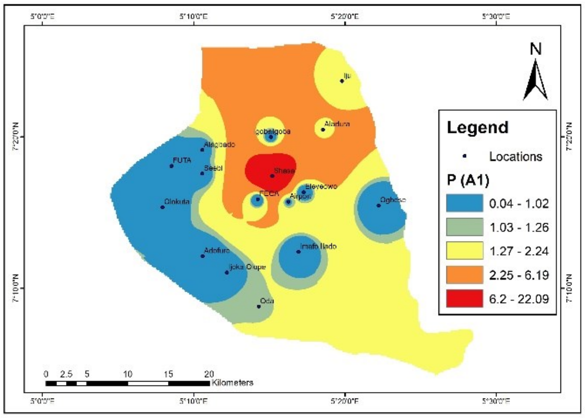

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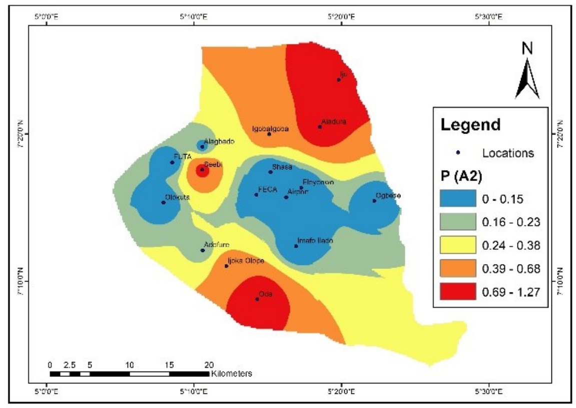

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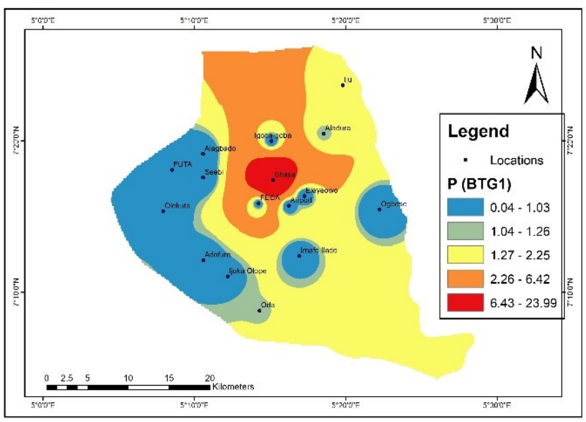

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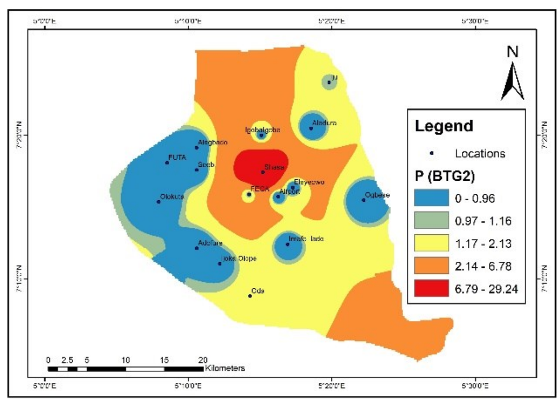

Plate 9 Soil Available Phosphorous spatial distribution of Akure North and South L.G.A

3.5 Potassium

Map q-v, Plate 10 shows the soil K properties distribution at A1, A2, Btg1 and Btg2 in Akure. The K value ranges from 0.18 cmol/kg to 2.69 cmol/kg for horizon A1. The map indicates that K at Iju, Ijoka, Oda, Imafo-Ilado and Oda are very low, K at Airport, Igoba and Seebi are low, K at Ogbese, Eleyo-Owo, Saasa and Adofure are moderate, and K at FUTA, Alagbado, Olokuta and FECA, and K at Aladura are very high. For A2, K values ranges from 0 cmol/kg to 2.62 cmol/kg. The map indicates that K at Olokuta, Igoba, Saasa, Eleyo-Owo, Airport, Imafo-Ilado and Oda are very low, K at Adofure and Ijoka-Olope are low, K at Alagbado, Seebi, Ogbese and Iju moderate, K at FUTA and FECA are high, and K at Aladura is very high. The K value ranges from 0.19 cmol/kg to 2.50 cmol/kg for Btg1. The map indicates that K at Alagbado, Airport, Ijoka, Oda and Imafo-Ilado are very low, K at Iju, Ogbese, Eleyo-Owo, Saasa and Igoba are low, K at Olokuta is moderate, K at FUTA and Adofure are high, and K at FECA and Aladura are very high. The K value ranges from 0 cmol/kg to 0.92 cmol/kg for BTG2. The map indicates that K at FUTA, Seebi, Aladura, Airport, Imafo-Ilado and Ijoka are very low, K at Alagbado and Oda are low, K at Igoba, Ogbese and FECA are high and K at Iju, Olokuta, Saasa and Adofure are very high

4.0 Discussions

Spatial distributions of major soil nutrients revealed variations from pedon one to pedon sixteen and from one horizon to the other. The spatial distribution have shown that the soil pH is very strongly acidic to neutral (4.68 – 6.73) and fairly ideal for most crops to thrive well. Plant growth and most soil processes, including nutrient availability and microbial activity, are favored by such range (Chude *et al*., 2011) Therefore, liming of the soils may not be necessary. The de-

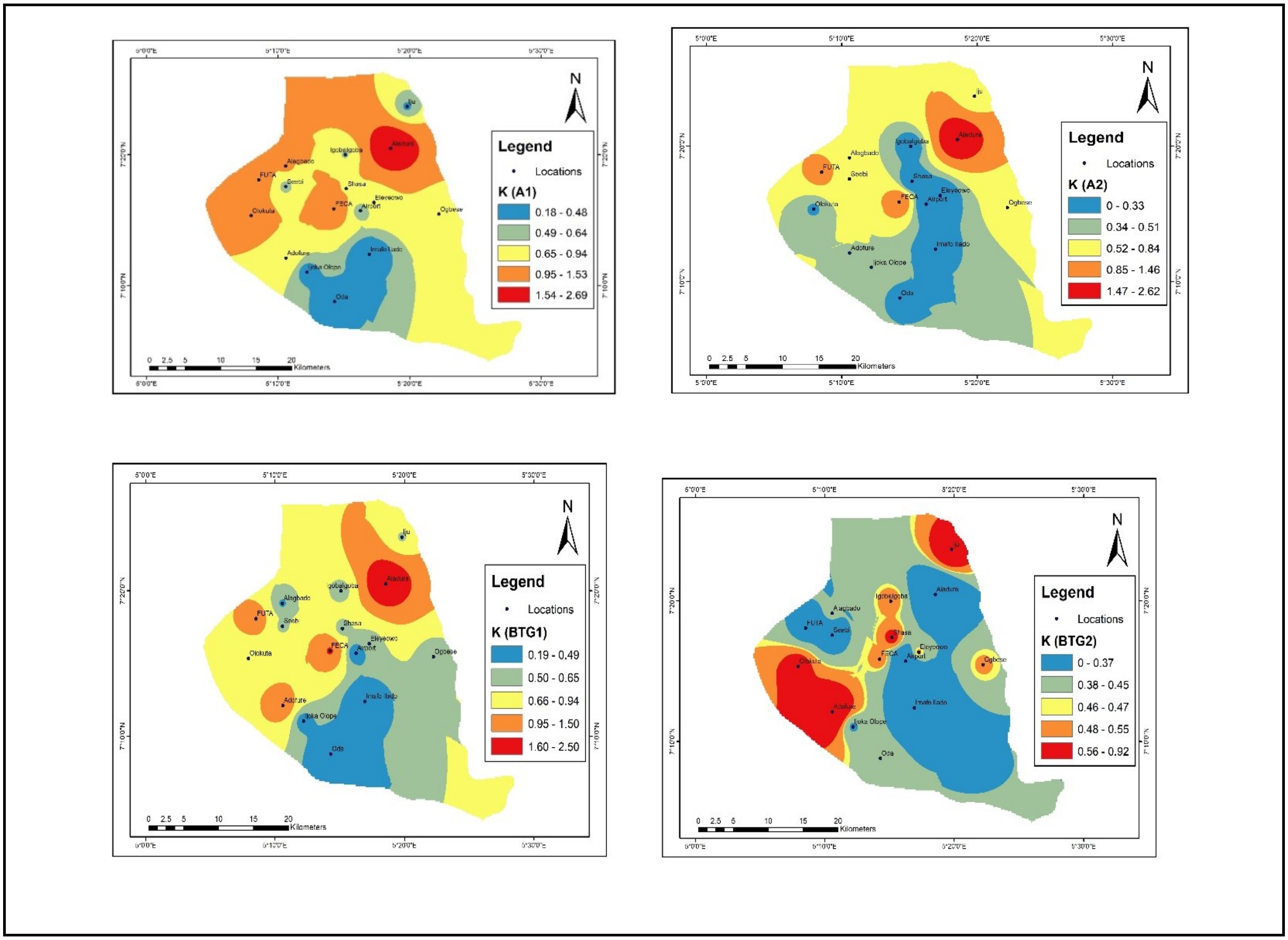

Plate 10: Soil Available Phosphorous spatial distribution for Akure North and South L.G.A

creased value of organic carbon with depth in all the pedons is probably, due to the concentration of plant and animal residues on the soil surface (Amusan *et al.,* 2006), generally low value of organic carbon in the soils could be attributed to impact of high temperature and high relative humidity which favors rapid mineralization of organic composition (Ewulo, 2012), at the A horizons. Also the different land use and landscape could be responsible for the low organic carbon content because of poor soil management such as burning of crop residues, intense cultivation and seasonal bush burning (Greenland *et al.,* 1992) which is a common practice Akure South L.G.A has contributed to decline in soil organic matter. Also clean clearing of soils for annual cropping has affected the soil organic matter this however limits the amount of organic carbon content in the soil. The concentration of organic carbon cannot conveniently sustain a good crop production programme on a long term basis. Hence, a substantial improvement has to be made through effective crop residue incorporation management strategies. Also there is need for the farmers of the study area to adopt cultural practices that will encourage the return and incorporation of plant/crop residues into the soil to increase the level of soil organic matter. The total nitrogen of 0.11% to 1.80 % was less than the critical value of 1.5 g/kg (FMA and RD, 2002). The available phosphorus value of 0.04 mg/kg to 22.09 mg/kg for most horizons while the exchangeable potassium 0.18 cmol/kg to 2.69 cmol/kg was higher than the critical value of 0.2 cmol/kg (Adeoye, 1986 and FMA and RD, 2002). The available phosphorus value of 0.04 mg/kg to 22.09 mg/kg in horizon A was also lower than the critical level of 16 mg/kg (Adeoye, 2012) therefore, the soil was not sufficient in major nutrient with the exception of potassium which is just a little bit above the critical value. The sites as indicated that the soil is slightly acidic the acidity will hinder Phosphorous forms to be absorbed more readily so there is need to make it readily available to the plant.

4.1 Nutrients Mapping and Distribution of Soil in Akure North and South L.G.A

This study exploits the possibility of using Remote Sensing and Geographic information systems towards achieving sustainable agricultural and environmental development with particular interest in loss of agricultural land, urban expansion, and vegetation loss. This study has shown the agricultural and non-agricultural land use and land nutrients distributions of Akure at different stages. It went further to establish the relationship between agricultural land cover and non-agricultural land in Akure are results of increasing anthropogenic pressure and rapid population growth (Awoniran *et al*., 2014) and these remain the major causes of changes in land use. The increase in population endeared more people to agriculture and this can lead to increase in food production.

5.0 Conclusions and Recommendation

Nutrients Spatial distributions of Akure land area show a lot of variability in the soil chemical distribution from one profile pit to others. Growing of tree crops such as banana/ plantain cocoa plantation is necessary to serves as shades, which will reduce excessive evapotranspiration for agricultural land areas. Cultural practices that would prevent erosion are essential on horizon A to prevent exposure of the plinthite layer. It is important to monitor pH of the soils to avoid fixing of phosphorus which at the time of this study was adequate. The urban development is encroaching fast into our agricultural land there is urgent need for Land and soil preservation in Akure. Meanwhile agricultural land needs government policy for avoidable encroachment for sustainable development. Government need to put policy in place and follow up in implementation to protect our soil/ land so that people will not go hungry in the nearest future. Planting of shade trees in urban and farm area is important to prevent direct penetration of sunlight and thus, reduce excessive evapotranspiration which will equally leads to micro climatic enhancement in the loss of land .

The pH of the soils in the study area is acidic in nature therefore liming of the soils to increase the pH of the site and ameliorate iron toxicity. Soil conservation, involving growing of cover crops and more drainage channels to drain out excess water during heavy downpour are very important. For the low fertility status; the use of inorganic fertilizer, organic fertilizer and planting leguminous plants, use of compost is hereby recommended to make the soil more suitable. The farmers of the study area should be sensitized on the need to reduce bush burning and heavy deforestation in order to avoid desert encroachment.

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