

A Soil Survey and Land-Use Analysis of Janguza North along Kano Gwarzo Road, Kano-Nigeria

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Abstract- A soil survey and land use analysis was carried out around the northern part of Janguza along Kano – Gwarzo road. A pH meter was used to analyze the soil samples from the study area, a hydrometer method was used to determine the particle size distributions of the soil samples, and also the calculation of particle size was done to determine the percentage of clay, sand and silt in the samples collected. It was discovered that all the soil samples from the study area were acidic, it was also discovered from the result of particle size calculations of clay, silt and sand that soil sample D1 recorded the highest percentage of clay with (11.44%), soil sample A1 recorded the highest percentage of silt with (30%) and soil sample B2 recorded the highest percentage of sand with (92.56%), and it was also discovered that loamy sand soil is the most dominant type of soil at the study area. The research recommend that for proper land management practices at the study area, there is need for the creation of contour ridges and strict measures should be put in place in order to stop the excavation of sand at the study area.

Index Terms- A Soil Survey, Analysis, Janguza North, Kano-Gwarzo, Land-Use

I. INTRODUCTION

Land degradation lowers the productive potential of land resources, affecting soil, water, forest and grass land, and all these have given birth to issues of conservation.

If unchecked degradation can lead to irreversible loss of the natural resources on which production depends. The severity are of two kinds of degradation: soil erosion and rangeland degradation (desertification) has sometimes been subject of exaggerated claims. Both are indeed widespread and serious but satisfactory measurements of their effect are yet to be made. Soil fertility decline is more widespread than formerly realized, leading to reduced crop yields and lowered responses to fertilizers (Salako, 2010).

It is estimated that 5% of the agricultural land in less developed countries has been lost by degradation, and productivity has been appreciably reduced on a further 25% and some 10% of irrigated lands are severely salinized. In dry or semi-arid zone where water is most needed, the limits to water availability have been reached. Over the past 10 years, forest cover in tropical regions has been lost at 0.8% a year, there is no

sign yet that the rate of clearance has been checked (Salako, 2010).

The direct causes of degradation are a combination of natural hazards with unsuitable management practices. Underlying these is economic and social reason, fundamentally arising from poverty and land shortage. There is a casual link between population increase, land shortage, poverty and land degradation. Tentative economic analysis suggest that degradation is costing developing countries between 5% and 10% of their agricultural sector production. This affects the people through reduced food supplies, lower incomes, greater risk and increased landlessness (Salako, 2010).

The survey and recording of the distribution of various soil types for providing information that will assist in decision making on land use through soil survey is of utmost importance in land development and management (Salako, 2010).

The practical purpose of soil survey is to enable more numerous, more accurate and more useful predictions to be made. To achieve this, it is necessary to determine the pattern of the soil cover and to divide this pattern into relatively homogeneous units; to survey the distribution of these units, so that soil properties over any area can be predicted and to characterize the surveyed units in such a way that useful statements can be made about their land use potentials and responses to change in management. (Young & Dent, 1981).

Therefore the need for survey of soil and land-use will provide easy and comprehensive framework in understanding soil characteristics in an area.

II. METHODOLOGY

The methodology employed for the purpose of this survey was free traverse survey where the study area is studied based on physiographic sub division of the region.

SAMPLE ANALYSIS

SOIL pH

This is also termed as soil reaction, It is the degree of acidity or alkalinity of a soil. It is determined by the level or the concentration of the base forming cations in the exchange complex. It is also the comparative concentration of hydroxyl ions (H⁻). Soil pH is termed the master variable that affects all soil properties and in some cases crop ability to grow and where to grow. pH is measured either calorimetrically or

electrometrically (Munsell Soil Color Charts, 1975). For this survey however, the electrometric method was employed using a 1:2.5 soil to water ratio through the following procedures:

1. 10g of soil sample was weighted into a small glass beaker.
2. 25mls of distilled water was added to the sample and stirred using a glass stirring rod.
3. The content was allowed to stand for a while and then stirred again.
4. The pH value was taken using a calibrated pH meter by dipping it into the solution.

Table 1: Show the Result of pH analysis

s/n	Sample	pH value	pH meter rating
1	A1	5.7	Slightly Acidic
2	A2	5.7	Slightly Acidic
3	B1	5.9	Very Slightly acidic
4	B2	6.0	Very Slightly acidic
5	C1	5.8	Slightly Acidic
6	C2	5.8	Slightly Acidic
7	D1	5.8	Very Slightly Acidic
8	D2	5.6	Slightly Acidic
9	E1	5.8	Slightly Acidic
10	E2	5.1	Strong acidic

Source: Field work Adamu, 2012

From the result of pH analysis of samples above, the soil of the area studied were found to be acidic, but with variation, the

degree of acidity of most of the area are having slightly acidic soil and few have very slightly acidic soil with only one sample strongly acidic.

PARTICLE SIZE DISTRIBUTION (P.S.D)

This is a mechanical analysis that is used to determine the proportion of different particle sizes in the soil. In fact is the basic indicator of soil physical and chemical properties. Two methods of P.S.D determinations were used in the laboratories which are the pipette and the hydrometer methods (Eno et al, 2009). For this analysis however, the hydrometer method was employed which involves the following steps:

1. 50g of soil was weighted into a bottle.
2. 100ml of sodium hexa-meta-phosphate solution (kalgol) was added to the soil in the plastic bottle and was shaken for 50 seconds.
3. The content was transferred to a measuring cylinder and filled to mane with water and mixed with a plunger.
4. Hydrometer was inserted and reading was taken within 40 seconds as the first hydrometer reading denoted R1 and temperature reading taken denoted T1.
5. The cylinder was then allowed to stand for 2hours undisturbed after which the second hydrometer and temperature readings were taken and recorded as R2 and T2 respectively.

Table 2: Shows the Particle size distribution analysis result.

s/n	Sample	R ₁ (g/l)	T ₁ (⁰ C)	R ₂ (g/l)	T ₂ (⁰ C)
1.	A1	16.0	22.0	01.0	20.0
2.	A2	6.0	22.0	0.10	20.0
3.	B1	8.5	22.0	02.0	20.0
4.	B2	3.0	22.0	00.0	20.0
5.	C1	11.0	22.0	01.0	20.0
6.	C2	10.5	22.0	02.0	20.0
7.	D1	10.0	22.0	05.0	20.0
8.	D2	8.0	22.0	03.0	20.0
9.	E1	14.0	22.0	03.0	20.0
10.	E2	5.0	22.0	04.0	20.0

Source: field work Adamu, 2012

CALCULATIONS OF PARTICLE SIZE ANALYSIS

The percentage of clay, sand and silt were calculated as follows:

1. Percentage of the clay
2. % of clay, = corrected 2 hrs reading x 100
3. Weight of sample used

Thus % of clay = $\frac{R_2 + (T \times 0.36)}{50} \times 100$

50

Temperature of hydrometer calibrated at 20⁰c will have a corrected 2hours reading of the temperature of sample recorded minus 20⁰c. The temperature calculated was 22⁰c; the corrected 2hours reading is: 22⁰c - 20⁰c = 2⁰c

Therefore, $2 \times 0.36 = 0.72$

$$\text{Percentage of clay} = \frac{(R_2 + 0.72) \times 100}{50}$$

50

$$\text{Sample A}_1, \% \text{ of clay} = \frac{(01.0 + 0.72) \times 100}{50}$$

50

$$= \frac{172}{50}$$

$$= 3.44\%$$

$$\text{Sample A}_2, \% \text{ of clay} = \frac{(0.10 + 0.72) \times 100}{50}$$

50

$$= \frac{82}{50}$$

$$= 1.64\%$$

$$\text{Sample B}_1 \% \text{ of clay} = \frac{(2.0 + 0.72) \times 100}{50} = \frac{272}{50} = 5.44\%$$

$$\text{Sample B}_2 \% \text{ of clay} = \frac{(0.0 + 0.72) \times 100}{50} = \frac{72}{50} = 1.44\%$$

$$\text{Sample C}_1 \% \text{ of clay} = \frac{(1.0 + 0.72) \times 100}{50} = \frac{172}{50} = 3.44\%$$

$$\text{Sample C}_2 \% \text{ of clay} = \frac{(2.0 + 0.72) \times 100}{50} = \frac{272}{50} = 5.44\%$$

$$\text{Sample D}_1 \% \text{ of clay} = \frac{(5.0 + 0.72) \times 100}{50} = \frac{572}{50} = 11.44\%$$

$$\text{Sample D}_2 \% \text{ of clay} = \frac{(3.0 + 0.72) \times 100}{50} = \frac{372}{50} = 7.44\%$$

$$\text{Sample E}_1 \% \text{ of clay} = \frac{(3.0 + 0.72) \times 100}{50} = \frac{372}{50} = 7.44\%$$

$$\text{Sample E}_2 \% \text{ of clay} = \frac{(4.0 + 0.72) \times 100}{50} = \frac{472}{50} = 9.44\%$$

PERCENTAGE OF SILT:

$$\text{Thus, \% of silt} = \frac{(R_1 + (T \times 0.36)) \times 100}{50} - \% \text{ clay}$$

Therefore

$$\text{Sample A}_1 \% \text{ of silt} = \frac{(16 + 0.72) \times 100}{50} - 3.44\% = 30\%$$

$$\text{Sample A}_2 \% \text{ of silt} = \frac{(6 + 0.72) \times 100}{50} - 1.64\% = 11.8\%$$

$$\text{Sample B}_1 \% \text{ of silt} = \frac{(8.5 + 0.72) \times 100}{50} - 5.44\% = 13\%$$

$$\text{Sample B}_2 \% \text{ of silt} = \frac{(3 + 0.72) \times 100}{50} - 1.44\% = 6\%$$

$$\text{Sample C}_1 \% \text{ of silt} = \frac{(11 + 0.72) \times 100}{50} - 3.44\% = 20\%$$

$$\text{Sample C}_2 \% \text{ of silt} = \frac{(10.5 + 0.72) \times 100}{50} - 5.44\% = 17\%$$

$$\text{Sample D}_1 \% \text{ of silt} = \frac{(10 + 0.72) \times 100}{50} - 11.44\% = 10\%$$

$$\text{Sample D}_2 \% \text{ of silt} = \frac{(8 + 0.72) \times 100}{50} - 7.44\% = 10\%$$

$$\text{Sample E}_1 \% \text{ of silt} = \frac{(14 + 0.72) \times 100}{50} - 7.44\% = 22\%$$

$$\text{Sample E}_2 \% \text{ of silt} = \frac{(5 + 0.72) \times 100}{50} - 9.44\% = 2\%$$

Percentage of sand:

$$\text{Percentage of sand} = 100 - (\% \text{ silt} + \% \text{ clay}).$$

Thus;

$$\text{Sample A}_1 = 100 - (30 + 3.44) = 66.56\%$$

$$\text{Sample A}_2 = 100 - (11.8 + 1.64) = 86.56\%$$

$$\text{Sample B}_1 = 100 - (13 + 5.44) = 81.56\%$$

$$\text{Sample B}_2 = 100 - (6 + 1.44) = 92.56\%$$

$$\text{Sample C}_1 = 100 - (20 + 3.44) = 76.56\%$$

$$\text{Sample C}_2 = 100 - (17 + 5.44) = 77.56\%$$

$$\text{Sample D}_1 = 100 - (10 + 11.44) = 78.56\%$$

$$\text{Sample D}_2 = 100 - (10 + 7.44) = 82.56\%$$

$$\text{Sample E}_1 = 100 - (22 + 7.44) = 70.56\%$$

$$\text{Sample E}_2 = 100 - (2 + 9.44) = 88.56\%$$

Table 3: Shows the Percentage of sand, silt and clay

s/n	Sample	% of sand	% of silt	% of clay	Soil type
1.	A ₁	66.56	30	3.44	Loamy sand
2.	A ₂	86.56	11.5	1.64	Sand
3.	B ₁	81.56	13	5.44	Loamy sand
4.	B ₂	92.56	6	1.44	Sand
5.	C ₁	76.56	20	3.44	Loamy sand
6.	C ₂	77.56	17	5.44	Loamy sand
7.	D ₁	78.56	10	11.44	Loamy sand
8.	D ₂	82.56	10	7.44	Loamy sand
9.	E ₁	70.56	22	7.44	Loamy sand
10.	E ₂	88.56	2	9.44	Sand

Source: Field Work Adamu, 2012

Base on the result of the analysis of sample above loamy sand soil are the most dominant soil in the area studied and with few sandy soil.

S/NO	SOIL SAMPLE	EC VALUE (DSM ⁻¹)
1.	A ₁	11.38
2.	A ₂	8.18
3.	B ₁	9.0
4.	B ₂	15.97
5.	C ₁	6.75
6.	C ₂	5.15
7.	D ₁	4.56
8.	D ₂	3.25
9.	E ₁	2.72
10.	E ₂	5.91

Source: field work Adamu, 2012

GENERAL DESCRIPTION OF THE AREA

The study area is part of the Kano plain areas that falls under the Jakara plains, It is located between Latitudes 11°96'1"N and 11°96'3"N and Longitudes 8°24' E to 8°34'E (Benneth , 1978).

Field observation shows that the area is characterized by having different land use that includes agriculture, sand excavation, settlements and bare land with no vegetation cover.

The vegetation cover of the study area is the Sudan savannah type which is mostly shrubs of acacia species. Soils of the area are mostly sandy-loam with little clay content (Field Work, 2012).

The climate of the area is tropical characterized by having mean annual rainfall of 700mm, mean temperature of 26°C, dominant slope of ±1° and relative relief of about 30 (Benneth , 1978).

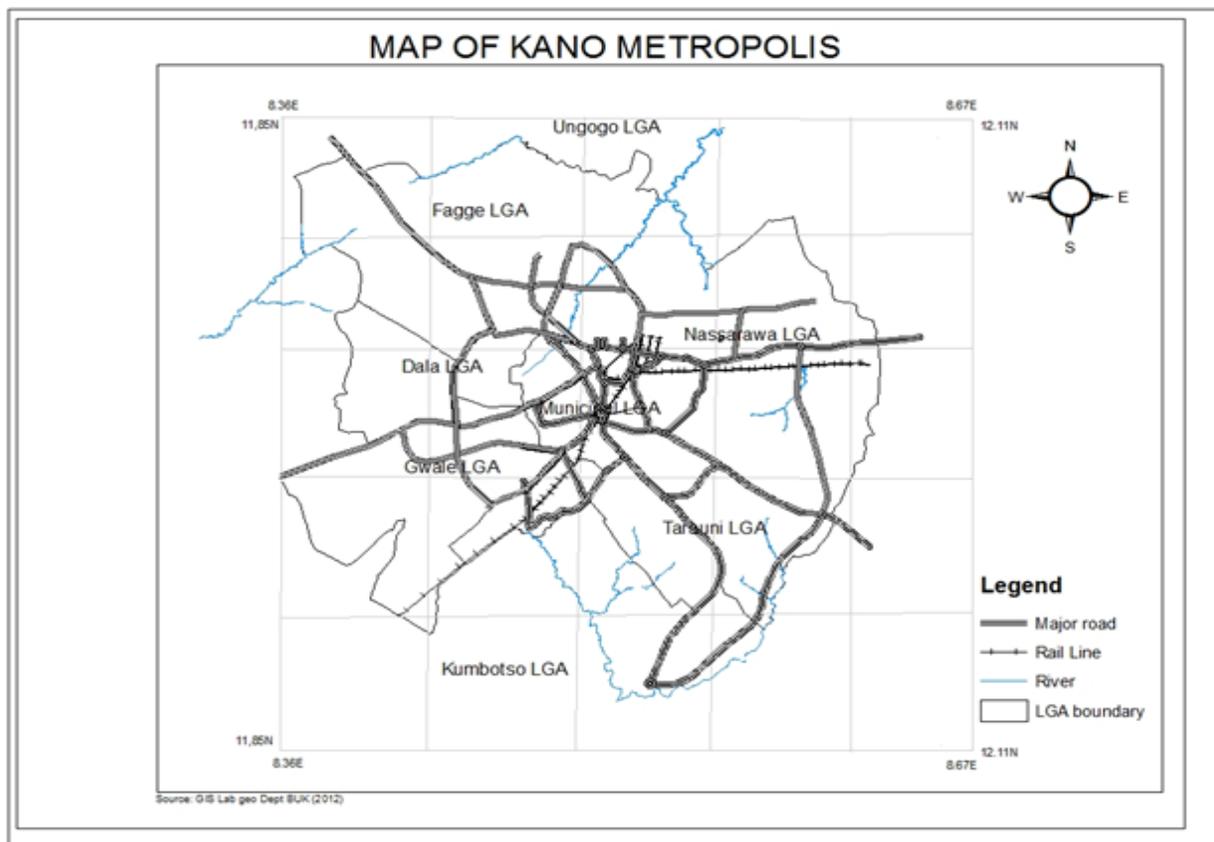


FIG 1: MAP OF KANO METROPOLIS

SURVEY UNITS OF THE STUDY AREA

Soils are surveyed according to their morphology with the expectation that soils which look and feel alike will behave similarly and those that appear different will behave differently in many circumstances. This is for the purpose of providing a

framework of quantitative definition of soils found in an area (Mitchell, 1991).

Based on the survey carried out, the area can simply be described as an area exhibiting similarities as well as differences especially with regards to the different type of land use obtainable there (Faniran and Areola 1978).

MANAGEMENT PROBLEMS

A change in soil quality and potential productivity is mostly caused by poor management. Soil as a natural resource that supports plant and animal life can be change due to responses to use and management practices as a result of natural processes. Nigeria is among countries with mainly low to medium productivity of soils which can be improved with good management. Nigeria has lost 285,000sqkm of land which is nearly one third of its total 924,000sqkm to soil degradation due to lack of good management of the land (Salako, 2010). Kano falls under the region characterized by low organic carbon that serves as a determinant of soil quality in terms of agricultural productivity (Salako, 2010).

SOME OF THE PROBLEMS IDENTIFY AT THE STUDY AREA

1. Excavation of sand near the river bank of the river situated at the study area.
2. Improper cultivation of the soil in the area as it was observed instead of making ridges along slopes, they were across the slopes and this contributes run off and erosion by water.

III. RECOMMENDATION

For proper land management practices at the study area, there is need for the creation of contour ridges, and strict measures should be put in place in order to control excavation of sand. This would serve as an effort towards the attainment of the goal of sustainability science for the benefit of the present and future generation.

IV. CONCLUSION

Conclusively, based on results of this survey, the area surveyed exhibits characteristics of a typical Sudan savannah. As a result of human interference, (cultivation and sand excavation), the entire system is changing where by the soils of the area are fast eroding and washed down to the river (Watari river). Vegetation cover of the area is scanty with few dry species; mostly acacia.

Soils of the area have low quality in terms of agricultural productivity as they were found to have lost most of their nutrients through erosion activities. The soils are mostly acidic, have soil colors that are indicative of erosion with salinity condition.

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