



The Effects of Land use Change on the Some Soil Properties in Gbonyin Local Government Area of Ekiti State, Nigeria

ADEBAYO, W. O.* and OLOFIN, E. O.

Department of Geography and Planning Science,
Ekiti State University, Ado – Ekiti, Nigeria.

Abstract

The aim of this research is to examine the response of some soil properties to the changes in land cover/land use in Gbonyin Local Government Area of Ekiti State, Nigeria. Land use changes as a result of human activities have been identified as one of the greatest pressures to soil and forest resources. The change from natural vegetation land use to built-up and agricultural land uses is becoming rampant in Gbonyin Local Government Area of Ekiti State, Nigeria. The objective of this study was to examine the effects of land use change on the some soil properties. Two major land use types which include forest lands and residential lands uses were explored. Soil samples were collected at the depth of 0 on 30cm through the use of soil auger from ten different locations in each of the two land use types in the study area making twenty soil samples. The use of t-test statistical tool was implored on the laboratory results in order to test for the differences between the soil in forest and residential land use types. Results revealed that the soil physico-chemical properties differed significantly between the sites. Chemical properties of the soil were found to be generally low in residential land use while they were high in vegetation land use. Bulk density was high in residential land use while it was low in forest land use.



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Land Use Change;
Land Cover Change;
Land Degradation;
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Introduction

Land use changes linked with the anthropogenic and natural factors affect many ecosystems including soil and forest¹ Land degradation resulting from various anthropogenic factors has been a major challenge since the 20th century and will remain high on the

international agenda in the 21st century.² According³ land degradation is increasing in severity and extent in many parts of the world, with more than 20% of all cultivated areas, 30% of forests and 10% of grasslands undergoing degradation. In recent years increasing amounts of Gbonyin lands have been

CONTACT Adebayo, W. O. ✉ Oluwadebayowolli@yahoo.com 📍 Department of Geography and Planning Science, Ekiti State University, Ado – Ekiti, Nigeria.



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developed and utilized for agriculture and human settlements. This has significantly impacted the land and altering forest ecosystem in Gbonyin Local Government Area of Ekiti State, Nigeria.

Land degradation affects both biotic and abiotic factors of the ecosystem, including factors like soil and water resources (surface and underground), vegetation, animals and micro-organisms.^{4,5,6} and ² on the effects of land use change on soil properties showed that, land use change from vegetation land use to built-up land use often leads to reduction of organic matter inputs and nutrients in the soil. Conversion of vegetation land use to another form of land uses such as agricultural and built-up land uses can lead to soil erosion which will eventually, reduced the nutrients in the soil.⁷

Most of the vegetated areas in the study area have been converted into agricultural and built-up land uses. This has resulted in the degradation of the land in the study area. However, the exact relationship between land use types and soil properties in Gbonyin Local Government Area of Ekiti State has not been well established. This study therefore, set out to examine the effect of land use changes on land degradation as reflected by soil properties such as bulk density, soil organic matter, calcium, magnesium and potassium in Gbonyin Local Government Area of Ekiti State, Nigeria.

The Study Area

Gbonyin Local Government Area of Ekiti State is located between latitudes 70321 and 70401 north

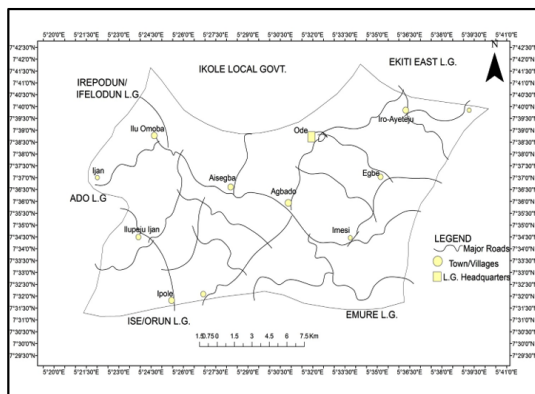


Fig. 1.1: Gbonyin local government area

Source: gis, 2018

of the equator and longitudes 50221 and 50431 east of the Greenwich meridian (see Fig 1.1).

Gbonyin Local Government Area is made up of eleven communities, comprising Aisegba, Agbado, Imesi, Egbe, Ijan, Irupeju – Ijan, Iluomoba, Ipole Iloro, Iro, Iro- Ayeteju and Ode- Ekiti. Ode- Ekiti is the Local Government headquarter (see Fig 1.1). Other farm- steads in the Local Government Area include Aba Ogundele, Aba Oba, Aba Akawo, Aba Temidire, Abajesin, Aba Kume, Aba Ajeoku, Aba Anifowose, Aba Panu, Ajebamidele, Ita- Aluko and Odiolowo (see Fig 1.1). Immigrants from Kogi, Ondo, Osun and Kwara States, who are mostly engaged in farming activities, populate the Local Government Area.

The study area is characterized by rainforest type of vegetation. Animals in the area include antelope, grass cutters, squirrels, porcupine, monkeys and snakes of all types. The study area is situated in the tropical rain forest region of Nigeria. The area has two distinct seasons- the dry and wet. It has adequate moisture that supports high yielding forest because it received between 1,000mm to 1,800mm of rainfall annually and annual temperature of between 25°C to 30°C.

The topography of the study area is undulating lowlands. The settlement pattern of the study is linear

Table 1.1: Common Trees Found in the Study Area

| S/N. | Botanical Names | Local Names |
|------|----------------------------|-------------|
| 1 | Macarange barteri | Araba |
| 2 | Triprochiton seleroxylon | Arere |
| 3 | Terminlia superb | Afara |
| 4 | Newboulolia laevis | Akoko |
| 5 | Albizzia feruginea | Ayere |
| 6 | Gynemtra megalophyllia | Eru |
| 7 | Symphomia gabonensis | Igi Odan |
| 8 | Melicia excels | Iroko |
| 9 | Blighia sapida | Igi Isin |
| 10 | Triplocliction scleroxylon | Obeche |
| 11 | Coraia millenii | Omo |
| 12 | Musanga smithii | Oro |
| 13 | Irvingia gabonensis | Oropa |

Source: Fieldwork, 2013.

Table 1: Summary of the Mean, the Standard Deviation, the Co-Efficient of Variable and T-Test Analysis of Calcium Concentration

| Land use types | N | Mean | Min. | Max. | S.D | C.V (%) | d.f. | Tcal | Ttab | Decision |
|----------------|----|-------|------|------|-------|---------|------|-------|------|----------|
| Forest | 10 | 55.82 | | | 11.31 | 20.26 | 18 | 10.33 | 2.1 | S |
| Residential | 10 | 18.34 | | | 1.95 | 10.63 | | | | |

P<0.05 level of significance. S= significance. NS= Non Significant. C.V.=Coefficient of Variation. S.D.= Standard Deviation. d.f.=degree of freedom. Tcal=T-test Calculated. Ttab=Ttest Tabulated.

pattern of settlement because most of the houses in the study area were built along the major roads. Agricultural, residential, transportation and industrial land uses are the major land uses in the study area. The vegetation of the area is of forest type, timber is produced in large quantity in the forest, hence the location of various saw-mills in the following major settlements of the Local Government Area:

- i. Agbado- Ekiti;
- ii. Aisegba- Ekiti;
- iii. Egbe- Ekiti;
- iv. Ijan- Ekiti;
- v. Imesi- Ekiti;
- vi. Iluomoba- Ekiti;
- vii. Ode- Ekiti.

The study area is characterized by rainforest type of vegetation and to justify the rainforest nature of the study area, table 1.1 shows the list of trees commonly found in the study area.

Material and Method

Two adjacent land uses (forest and residential) were purposively selected in the research area. Soil samples were collected at ten different locations in each of these land uses at 0 to 30cm depth with the use of soil auger. The twenty soil samples collected

were packed in cellophane bags, labeled and well fastened to preserve the moisture before laboratory test.

The result of the laboratory was further analyzed using t-test statistical method to test for significant differences among soil samples in relation to the two different land use types in Gbonyin Local Government Area of Ekiti State, Nigeria.

Experimental Procedure for Determination of Organic Matter

The Empty evaporating dish was weighed. Then, the soil sample was placed into the dish and reweighed. The dish containing the soil sample was heated strongly at a temperature of about 100 °c to remove moisture content. The soil was heated again and stirred with a rod until the organic matter was completely burnt during which the organic matter was converted into gases and escaped into the atmosphere. After heating the dish and the contents were cooled in the desiccators, the contents of organic matter in each of the soil samples were determined with this formula.

$$\text{Mass of organic matter} = \text{Mass of dried soil} - \text{Mass of burnt soil,} \dots\dots 3.1$$

Table 2: Summary of the Mean, the Standard Deviation, the Co-Efficient of Variability and T-Test Analysis of Potassium Concentration

| Land use types | N | Mean | S.D | C.V% | d.f. | Tcal | Ttab | Decision |
|----------------|----|-------|-------|-------|------|------|------|----------|
| Forest | 10 | 58.04 | 14.61 | 25.17 | 18 | 7.77 | 2.1 | S |
| Residential | 10 | 21.79 | 2.02 | 9.27 | | | | |

P<0.05 level of significance. S= significance. NS= Non Significant. C.V.=Coefficient of Variation. S.D.= Standard Deviation. d.f.=degree of freedom. Tcal=T-test Calculated. Ttab=Ttest Tabulated.

Table 3: Summary of the Mean, the Standard Deviation, the Co-Efficient of Variable and T-Test Analysis of Magnesium Concentration

| Land use types | N | Mean | S.D | C.V% | d.f. | Tcal | Ttab | Decision |
|----------------|----|-------|------|-------|------|-------|------|----------|
| Forest | 10 | 58.53 | 8.83 | 15.09 | 18 | 14.32 | 2.1 | S |
| Residential | 10 | 16.63 | 2.75 | 16.53 | | | | |

P<0.05 level of significance. S= significance. NS= Non Significant. C.V.=Coefficient of Variation. S.D.= Standard Deviation. d.f.=degree of freedom. Tcal=T-test Calculated. Ttab=Ttest Tabulated.

The percentage of organic matter in each of the soil sample was also determined using this formula (see appendix IV)

$$\frac{\text{Mass of organic matter} \times 100}{\text{Mass of dried soil}} \dots 3.2$$

Experimental Procedure for Determination of Bulk Density

The soil samples were burnt at 105°C, cooled in desiccators, weighed on sensitive weighing machine and weight recorded in grams. The bulk density was then calculated based on mass/volume ratio of the bulk density sampling ring and values were recorded (see Appendix V).

Results and Discussion

Two different adjacent land use (residential and forest) types were identified in Gbonyin Local Government Area of Ekiti State, Nigeria. The relationship between land use types and its effects on the some soil properties is the major concern of this study.

In tables 1, 2, 3 and 4 below, a brief description of calcium, potassium, magnesium and soil organic matter concentration in residential and forest land

uses are given. This includes the general summary of the mean, the standard deviation, the co-efficient of variability and t-test analysis of soil properties.

From Tables 1, 2, 3, and 4 the means and standard deviations of soil chemical properties concentration are seen to be differed with the variables in forest land use generally showing higher values than the variables in residential land use. For instance, the mean concentration of calcium in forest land use is 55.82 while it is 18.32 in residential land use. These similar trends were applicable to potassium, magnesium and soil organic matter.

The summary of the t-test in tables 1,2,3, and 4 reveal the differences in the concentration of soil chemical properties in the forest and residential land uses. For instance, the t-test analysis for calcium concentration showed that the Tcal (10.33) was higher than Ttab (2.10) at 0.05 level of significance which implies that there is significance difference in the calcium concentration between forest and residential land uses in Gbonyin Local Government Area of Ekiti State. These similar trends were an application to potassium, magnesium and soil organic matter.

Table 4: Summary of the Mean, the Standard Deviation, the Co-Efficient of Variable and T-Test Analysis of Organic Matter Concentration

| Land use types | N | Mean | S.D | C.V% | d.f. | Tcal | Ttab | Decision |
|----------------|----|------|------|-------|------|-------|------|----------|
| Forest | 10 | 7.79 | 1.79 | 22.98 | 18 | 11.93 | 2.1 | S |
| Residential | 10 | 0.67 | 0.58 | 0.87 | | | | |

P<0.05 level of significance. S= significance. NS= Non Significant. C.V.=Coefficient of Variation. S.D.= Standard Deviation. d.f.=degree of freedom. Tcal=T-test Calculated. Ttab=Ttest Tabulated.

Table 5: Summary of the Mean, the Standard Deviation, the Co-Efficient of Variable and T-Test Analysis of Bulk Density

| Land use types | N | Mean | S.D | C.V% | d.f. | Tcal | Ttab | Decision |
|----------------|----|------|------|-------|------|-------|------|----------|
| Forest | 10 | 0.94 | 0.59 | 8.13 | 18 | 11.49 | 2.1 | S |
| Residential | 10 | 7.26 | 1.64 | 22.59 | | | | |

P<0.05 level of significance. S= significance. NS= Non Significant. C.V.=Coefficient of Variation. S.D.= Standard Deviation. d.f.=degree of freedom. Tcal=T-test Calculated. Ttab=Ttest Tabulated.

The summary of the t-test in Table 5 reveals the different in the soil bulk density in the forest and residential land uses of the study area. The mean value in residential land use (7.26) was higher than the mean value of forest land use (0.94). The t-test analysis showed that the Tcal (11.49) was greater than Ttab (2.10) at 0.05 level of significance which implies that there is a significant difference in the soil bulk density between forest and residential land uses of Gbonyin Local Government Area of Ekiti State. This implies that the concentration of soil bulk in the residential land use of the study area is higher than that of the forest land use of the study area.

The changes in land use types experienced in Gbonyin Local Government Area of Ekiti State may be as a result of an increase in human population, forcing encroachment of forest land for human settlement. In concord with the current findings, previous studies such as^{8and9} show that change in land use types is highly dependent on the indiscriminate exploitation of environmental resources to meet the immediate needs of the people living in such environment without considering the long-term effect on the soil.

Good numbers of researchers, including^{10and11} agreed that most of the changes observed in land use in many parts of Africa, are majorly associated with urbanization and extension and of agricultural activities to new areas. The current findings showed that most plots within Gbonyin Local Government Area of Ekiti State sampling sites that had undergone changes in land use were initially vegetated land use before they were converted to agricultural and built-up land uses.

Like the current study¹² while studying the relationship between land use change and land degradation in

East Africa, reported that land use change has transformed land cover to farmlands, grazing lands and human settlement at the expense of natural vegetation. These changes are associated with environmental degradation such as deforestation, biodiversity loss and loss of soil nutrients. In the current study, high bulk density and low soil organic matter observed at the residential land use could have been as a result of conversion of forest land to residential land which together with poor farming system might have had an impact on the soil structure thus, increasing the bulk density and reducing the chemical properties of the soil and subsequently contributed to land degradation.

CONCLUSION

Based on the findings from this study, it was presumed that land use changes in Gbonyin Local Government Area of Ekiti State have an effect on soil physico-chemical properties, as exhibited by the differences in soil samples collected at different locations in the study area. This phenomenon can also explain the reasons for low chemical properties of the soil in residential land use as opposed to high chemical properties of the soil and low bulk density in forest land use in the study area. The findings of this study will point to the need to have concentrated policies on integrated soil and forest resources management in Gbonyin Local Government Area of Ekiti State, Nigeria.

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Conflict of Interest

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