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# INVESTIGATING DEFFORESTATION EFFECTS IN SUDAN SAVANNA OF TROPICAL ENVIRONMENT: CASE STUDY OF TSAIDA VILLAGE, NORTH WEST NIGERIA

***Adamu MUSTAPHA, Ado ABDU; Fatima Adamu Garba DAKATA & Ayuba ADAMU**
**Department of Geography,**
**Faculty of Earth and Environmental Sciences,**
**Kano University of Science and Technology Wudil,**
**Kano State, Nigeria**
****Correspondence Email: amustapha494@gmail.com***

**ABSTRACT**
This study investigates the effect of deforestation with the view of protecting the integrity of environment and ecological status. Questionnaire administration and casual survey were used and administered to the respondents in each randomly selected hamlet within the study area. The results revealed that, large numbers of tree species are progressively disappearing due to massive exploitation for fuel wood without re-planting. Further, multiple linear regression models identified that socio-economic characteristics play a vital role in determining the rate of deforestation in the study area. The study revealed that, the removal of tree species for fuel wood purposes have a far reaching consequences on the structure and functioning of ecosystem.
**Keywords:** deforestation, Tsaida village, Kano region, fuel woods, multiple linear regressions

## INTRODUCTION

Deforestation can simply be defined as the clearing of earth's forest on massive scale, often resulting in damage to the quality of the land. Forests still cover about 30 percent of the world land area, but swaths are lost each and every year. The world's rainforest could completely vanish in a hundred years at the current rate of deforestation. Forests are cut down for many reasons, but most of them are related to money or to people's need to provide for their families. Harrad (2008) stated that deforestation and general environmental degradation come across many disciplines, including Forestry, Agriculture, Animal Husbandry, Preventive Medicine, Geography, Engineering, Town Planning, Sociology and Rural Development. Activities associated with each and every of the discipline continue to have an invariable adverse effect in one way or the other on environments. It was for this reason that about 115 countries including Nigeria met at Stockholm Sweden in 1972 and deliberated on the deteriorating environmental conditions and subsequently designated on the 5$^{th}$ day of June, each year as the "World Environmental Day". This is an annual reminder to humanity on the environment. The biggest driver of deforestation is agriculture, crops or grazing livestock. Often many small farmers will each clear a few acres to feed their families by cutting down trees and burning them in a process known as "Slash and Burn" Agriculture.

Logging operations, which provide the world wood and paper products, also cut countless trees each year. Loggers, some of them acting illegally, also build roads to access more and more remote forests which lead to further deforestation. For example, Wikipedia (2013) defined deforestation clearance or clearing as the removal of trees and converted to a non-forest use. Deforestation causes global warming, water recycling, severe extinction. Removing trees deprives the forest of portions of its canopy, which blocks the sun's rays during the day and holds in heat at night. Deforestation as a major problem for living creature to survive peaceful, a stable environment must exist (balance between environment and environmental resources). The aim of this study is to assess the level of deforestation on the environment in Tsaida Gaya Local Government Area of Kano State.

**Description of the study area**

Tsaida is a village in Gaya local Government area of Kano State, North Western Nigeria. It is located on latitude 11º 12' N and longitude 9º 12' E. It is bordered in the North by Ajingi Local Government, to the west by Wudil Local Government, to the south by Albasu Local Government, and to the east by Dutse Local Government area of Jigawa state. Gaya Town is the headquarter of Gaya Local Government, established in 1976, and it is located in the southern part of Kano State with distance of 65 Km from Kano City. The study area Tsaida is 1Km away from Gaya to the east along Kano-Maiduguri Road. The study area has population of about 201,016, with male population of 102,489, and female 98,537 (2006 census).

The study area falls under the basement complex area of the Kano region. It contains a position of dissected pereplain developed crystalline pre-Cambrian rocks of the basement complex. The major rock types in the area are granite, gneisses and quartzite (Abbas, 2009). The occupy relief region ranging between 450 m and 650 m. The relief of the study area could be described as high plain of Hausaland. Mature soil in Tsaida area is derived mostly from wind drift materials which cover the regolith of the ancient rocks. It is only in the area where the soil is derived from the regolith of the rocks of the basement complex. The soil types are mainly sandy, loamy and brown to reddish brown in color, however, alluvial soil are found around the river which makes the soil highly productive.

The natural vegetation of the study area falls under Sudan Savannah type (Olofin, 1987). It is composed of variety of trees scattered over an expanse of grassland. The trees are usually characterized by broad canopies and they are hardly taller than 2 meters. The Baobab is peculiar tree, taller and larger than others, which are common all over the landscape. There are various types of Acacias and most of the tree species are adapted to drought condition through long tap roots and dry leaves which make it possible to retain their greenness throughout the year, others shed their leaves during the dry seasons, their underground stems develop new shoot during the wet season. Grasses in the study area hardly grow taller than 1.5 meters at maturity except in favored spots. There are also some thorny shrubs and medium trees in the drier interfluves and the area rocky or dissected terrain. The types of trees mostly found in the study area include *Adansonia digitata*, baobab, *Acacia albida*, mahogany, *Azaradica indica* and tucalyptise.

The present climate of the study area is tropical wet and dry types (Olofin, 1987) coded "Aw" by Wladimir Koppen. The major characteristics of the climatic condition are rainfall, temperature and evaporation. The climate is influenced by two distinctive wind system prevailing all over West Africa. The distinctive wind systems are tropical marine or maritime air masses (MT) and tropical continental air masses (CT). The south easterlies wind which is called the maritime air mass originated from Atlantic Ocean to south and this wind carries moisture along. However, it is the arrival of this wind in this climatic region (between May and September) marked the period of raining season. The tropical continental air masses which originated from the Sahara desert to north. The dominance of this wind system in this region marked the period of dry season, which is partly dry and hot and the dry and cold. The dry hot season period is between March and May. Rainfall is a very critical element in the study area. This is because it is deficient during the dry season, the precipitation occurs during the summer month, which starts mostly from May and ends in October. The beginning and length of rainfall vary from year to year. The highest amount of rainfall is characterized by strong wind, thunder and lightning. The showers are intense and last for short period. The average rainfall in a normal year is about 864.1 mm.

Both drainage and hydrology of the study area are influenced by climate, rock structure, and human induced activities. There is very limited accumulation of ground water in the study area. The climate of the region controls the amount of water that is available both underground and surface and at the sub-surface at any given time within a year. The climate also controls the regime and other characteristics of the river, for example, water is available during the wet month both on surface and sub-surface. The unmodified streams in the region are characterized by flash flows, storms discharge and seasonality. Surface water is not available during the dry season, except in the few deep ponds and borrow-pits. The ground water level falls rapidly through sea page, extraction by man and high evaporation.

## METHODOLOGY

### Data Collection

In conducting the study, the researchers divided the study area into three hamlets whose inhabitant are engaging much in deforestation regardless of type of trees being cut using random sampling. A survey and casual interview techniques were used to collect data from the respondents (head of households) for this study. For the survey technique, copies of questionnaire were administered to the respondents in each randomly selected hamlet within the study area. The number of questionnaire administered to each hamlet was based on the size of each the hamlet in accordance with the population proportionate to sample procedure. The hamlets are as follows: Kwari, Karfi and Fanidau villages. Kwari was served with 30 copies of questionnaires. Karfi and Fanidau were served with 15 copies of the questionnaire as they have almost same number of respondents. A total of sixty copies of questionnaire were administered to both male and female of the study area through random sampling. Furthermore, casual interview was conducted with the officials of Gaya Local Government in charge of forest reserve to get information concerning environmental consequences of using forest resources as a source of fuel in the study area.

### Data Analysis

Descriptive statistics which involved simple statistics such as percentage, pie-chart, and tables were used in data analysis. Data were also analyzed using inferential statistics using multiple linear Regression analysis. Multiple regressions are an extension of simple linear regression. It is used to predict the dependent variable based on the value of two or more independent variables. The variable we want to predict is called the dependent (or sometimes, the outcome, target or criterion variable). The variables used to predict the value of the dependent variables are called the independent variables (or sometimes, the predictors, explanatory or regression variables). Multiple regressions also determine the overall fit (variance explained) of the model and the relative contribution of each of the predictors to the total variance explained. Before applying multiple linear regression models satisfy eight assumptions for multiple regressions to give you a valid result (Mustapha and Getso, 2013).

1. The dependent and independent variables should be measured on a continuous scale (i.e., it is either an interval or ratio variable).
2. Data must have two or more independent variables, which can be either continuous (i.e., an interval or ratio variable) or categorical (i.e., an ordinal or nominal variable).
3. Data must satisfy the assumption of independence of observations (i.e., independence of residuals), which can be easily checked using the Durbin-Watson statistics.
4. The data must have a linear relationship between (a) the dependent variable and each of your independent variables, and (b) the dependent variable and the independent variables collectively.
5. Data must show homoscedasticity, which is where the variances along the line of best fit remain similar as you move along the line.
6. Data must not show multicolinearity, which occurs when you have two or more independent variables that are highly correlated with each other.
7. There should be no significant outliers, high leverage points. Outliers, leverage and influential points are different terms used to represent observations in the data set.
8. Finally, you need to check that the residuals (errors) are approximately normally distributed; two common methods to check these assumptions include (a) a histogram (with a super imposed normal curve) and a normal P-P plot; or (b) a normal Q-Q plot of the studentized residuals.

## RESULTS AND DISCUSSION

The result obtained were presentenced using tables, percentage as follows: The age group used in this study is aimed at identifying those who can give information required on the situation of deforestation in the study area. Respondent's age groups are divided into four groups; i.e., 20-30, 31-40, 41-50, and 50 above. These groups are further classified into growing age population 20-30, working population/energetic or productive 31-40, and 41above old age. The result is presented in Table 1.

**Table 1 Respondent's Age Structure**

| Age (Years) | Respondent | Percentage (%) |
|---|---|---|
| 20-30 | 10 | 16.7 |
| 31-40 | 25 | 41.6 |
| 41-50 | 16 | 26.6 |
| 50 above | 9 | 15 |
| Total | 60 | 100 |

It is clearly shown that the majority of respondents used in this study fall within the working population or productive group, i.e., 31-40 years with the largest percentage of 41.6%. This are the people that mainly engaged in activities associated with deforestation, and this is because most of them are productive and largely depend on this activities, the growing population is not fully participating in fuel wood collection but a few number of them are practicing this activity occasionally, the old people are less energetic or dependent group, as such, cutting and felling trees for fuel is difficult for them.

Table 2 presents the occupation of the respondents. From the result, fuel wood traders account for 36.6% of the population, while the farmers account for 30%. These two groups are engaged in fuel wood exploitation in the study area, mostly for commercial and domestic uses.

**Table 2. Occupation of the Respondents**

| Occupation | Respondent | Percentage ( %) |
|---|---|---|
| Fuel wood Traders | 22 | 36.6 |
| Farmers | 18 | 30 |
| Students | 12 | 20 |
| Others | 8 | 13.3 |
| Total | 60 | 100 |

Deforestation in the area is linked to the demand for fuel wood. Table 3 presents the types of tree species that are used for fuel wood in the area.

**Table 3 Tree Species used in the study area as source of Fuel**

| Botanical Name | Local Name |
|---|---|
| Tamarindus indica | *Tsamiya* |
| Parkia biglobossa | *Dorowa* |
| Piliostigma reticulatum | *Kargo* |
| Adansonia digitata | *Kuka* |
| Faid herbia albida | *Gawo* |
| Knaya senegalensis | *Madaci* |
| Diospyrus mesipiliformis | *Kanya* |
| Acacia sieberriana | *Fara-kaya* |
| Butyrospernum parkii | *Kadanya* |
| Acacia nicotica | *Bagaruwa* |

Despite the presence of large number of tree species in the study area, there are some that are of good quality as sources of fuel which are progressively disappearing in the area are presented in Table 4.

**Table 4 Tree species mostly used as fuel in the study area**

| Botanical Name | Local Name | Reasons |
|---|---|---|
| Piliostigma reticulatum | *Kargo* | Easily dry |
| Faid herbia albida | *Gawo* | Dry quick |
| Acacia sieberriana | *Fara-kaya* | Easily dry |
| Tamarindus indica | *Tsamiya* | Ignites quick and produce heat |
| Anogeisus leiocarpus | *Marke* | Produce good charcoal and burns slowly |

Tree species that are not used as fuel woods and are therefore, not exploited much are presented in Table 5

**Table 5 Tree species not preferred as fuel wood**

| Botanical Name | Local Name | Reasons |
|---|---|---|
| Adansonia digitata | *Kuka* | Wood contais moisture and very hard to dry |
| Balaniles acgyptiaca | *Aduwa* | Did not dry quick |
| Sterculia settigera | *Kukkuki* | Very smoky and do not burn easily |

Respondents gave different views on the change in numbers of vegetation in the area. The views are summarized in Table 6.

**Table 6. Respondents' views on Vegetation Disappearance**

| Trees | Respondents | Percentage (%) |
|---|---|---|
| Increasing | 16 | 26.7 |
| Stable | 9 | 15 |
| Decreasing | 35 | 58.3 |
| Total | 60 | 100 |

Table 6 shows that 26.7% of the respondents agreed that vegetation is increasing, for example, baobab (Kuka). It is clearly known that, there is spiritual belief that Jinn used to reside on the tree so the people are not willing to cut that particular tree talk less of burning its wood. And also, the wood of this particular tree is very weak such that it cannot be used as a fuel wood. 15% agreed that vegetation is stable while 58.3% argued that vegetation is decreasing. This shows clearly without any doubt that vegetation is decreasing in greater number going by the respondents' views. The result shows that trees/vegetation in the area is decreasing and this is due to massive exploitation of forest resources for fuel without replanting. Indiscriminate tree cutting largely contributed to the trees disappearance in the area. This cutting down of trees in the area is linked to the demand for fuel, and this is because wood is the dominant energy source to rural communities. The activities associate with trees cutting for fuel has serious negative impacts on the environment and especially, on vegetation cover and soil. Thus, removal of tree species for fuel can have far reaching consequences for the structure and functioning of the ecosystem. Once forest is cleared, the soil may become more prone to seasonal drought, increased soil erosion and even the wind speed also increased too.

Multiple linear regressions model was applied on the socio economic characteristic of the respondents to determine the best predictors of deforestation in the study area. The ANOVA of the coefficient of determination was presented on Table 7 and it revealed that the *F*-statistics ($F$ = 2.436) was very large and the corresponding $p$ value was highly significant ($p$ = 0.0001) or lower than the alpha value (0.05).

**Table 7 The model summary**

| Model | Sum of square | df | Mean Square | F | *P* value |
|---|---|---|---|---|---|
| Regression | 9.472 | 4 | 2.368 | 2.436 | .0001 |
| Residual | 53.461 | 55 | .972 | | |
| Total | 62.933 | 59 | | | |

a. ***Dependent Variable***: reason for tree cutting

b. ***Predictors: (Constant),*** occupation of the respondent, gender of the respondent, marital status of the respondents, age of the respondents

Based on the collinearity diagnostic table obtained, none of the models dimensions has conditional index about the threshold limit 30.0, none of the tolerance values is smaller than 0.10 and none of the VIF statistics are less than 10.0. This indicated that, there is no multicollinearity problem among the predictors' variables of the models. Since there is no multicollinearity problem between the predictors included in the dry and wet seasons samples in the final models and the classical assumptions of normality, linearity and equality of variance are all met. It is reasonably to conclude that estimated multiple linear regressions models to explain rate of deforestation in Tsaida Village is stable, good and quite respectable. The Condition Index (CI) is

a measure of the relative amount of variance associated with an Eigen value. A large CI indicates a high degree of collinearity. Eigen value provides an indication of how many distinct dimension are among the independent variables. CI is the square roots of the ratios of the largest Eigen values to each successive Eigen values. A value of CI greater than 15 indicates a possible problem and an index greater than 30 suggests a serious problem with collinearity (Kutner et al., 2004). Condition index which also gives information about the collinearity shows that the regressor were uncorrelated, because the higher the condition index, the higher the multicollinearity.

**Table 8. Coefficient of determination**

| Variables | Coefficient (ß) | T | Significant |
|---|---|---|---|
| Constant | 0.961 | 1.148 | 0.256 |
| $X_1$ | 0.390 | 0.346 | 0.010 |
| $X_2$ | 0.145 | 2.517 | 0.006 |
| $X_3$ | 0.021 | -0.860 | 0.031 |
| $X_4$ | 0.137 | 0.249 | 0.001 |

c. ***Dependent Variable***: reason for tree cutting

d. ***Predictors: (Constant),*** $X_1$=occupation of the respondent, $X_2$= gender of the respondent, $X_3$= marital status of the respondents, $X_4$= age of the respondents

However, from the regression results, Gender of the respondents ($X_1$), Marital Status of the respondents ($X_2$) and Occupation of the respondents ($X_4$) tested significant at 1% probability with a coefficient value of 0.39, 0.145 and 0.137 respectively. This implies that when any of these three variables is increased by 1 unit, they will cause a corresponding increase in the output (i.e., level of tree cutting) by 0.39, 0.145 and 0.137 respectively. Moreover, the R-square adjusted of 0.59% imply that the variables included in the model explain 0.59% of the area, while the F-value of 2.436 affirm the findings as it was found to be significant at 0.05. Hence, the study concluded that gender, marital status, age and occupation of the respondents were the major determinants of tree cutting in the study area.

## CONCLUSION

The results of this study has shown that the study area have suffered from fuel wood exploitation through indiscriminate tree cutting for fuel. Result revealed indiscriminate tree cutting has largely contributed to the tree disappearing and there is demand for fuel wood because it is the dominant source of energy used in the area. Deforestation has serious consequences on the environment especially on soil cover, once vegetation is removed or cleared, soil may become prone to erosion and drought. This study recommends that Government should find a way of enlightening the rural dwellers on the consequences of deforestation and crop residues for example maize, and sorghum should be used as substitutes for fuel wood in the area.

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