

Impact of Deforestation on the Environment Around Kiru Town, Kano State, North-Western Nigeria

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ABSTRACT

Forestry resources are undergoing highly dynamic and conflicting societal demands and environmental pressures. Several of the fundamental and impending deforestation issues are not essentially due to inadequate forestry resources, climate change or a lack of technological expertise to manage these resources, but rather because of poor management and governance of available forestry resources and ecological systems. This study has reported our novel effort to assess the impact of deforestation on environmental degradation around Kiru Town. The study found that fuelwood extraction was the foremost factor causing deforestation, followed by agricultural land use and that human activity had a considerable impact on deforestation. The use of alternative domestic fuel sources is lacking, which has led to amplified pressure on forestry resources in the study area. However, awareness of the effects of deforestation on the environment is high among people in the study area. However, unfortunately, they lack alternative domestic energy sources, making it challenging to conserve vegetation in the study area. Therefore, the study concludes that, even though human activities heavily impact forestry resources in the study area, more forestry resources are threatened by urbanization and agriculture.

Keywords: Deforestation. Environmental Degradation. Urbanization. Firewood, Kiru Town

1. INTRODUCTION

Deforestation can be described as transforming a permanent form of forest land into other types of land uses such as urban development, agriculture or grazing (Van Kooten and Bulte, 2000; Zambrano-Monserrate et al., 2018). At the same time, the enlargement of agriculture and livestock farming and the increasing lumbering as a source of wood or tree felling for fuel have been essential for the economic development of countries. These have also caused the vanishing of about 50% of the global forest resources, which has caused the loss of biodiversity (plants, animals) in many parts of the world (Noble et al., 2000). Deforestation also causes an environmental change on the planet, for example, by increasing CO₂ releases. After fossil fuel burning, deforestation is the second primary anthropogenic source of CO₂ in the atmosphere (Van der Werf et al., 2009;

Zambrano-Monserrate et al., 2018). This is because the vegetations and soils of tropical woodlands store vast amounts of carbon. When plants are scorched to clear farmland, carbon turns into CO₂, one of the greenhouse gases (GHG) that fast-track environmental change, snowballing environmental degradation (FAO, 2015; Zambrano-Monserrate et al., 2018). More so, the obliteration of forestry decreases the ability of the planet to engross CO₂ from the atmosphere (Van der Werf et al., 2009). Also, tropical forests retain about 15% of the CO₂ currently produced on our planet (Zambrano-Monserrate et al., 2018).

Several studies have examined the relationship between environmental degradation and economic development. In the first stage of economic development, there is a positive relationship between environmental

degradation and growth until reaching a turning point, where the relationship takes the form of an inverted U-relationship. Consequently, higher economic development leads to ecological development (Grossman and Krueger, 1995; Tiwari et al., 2013; Onafowora and Owoye, 2014; Jebli, 2016; Zambrano-Monserrate et al., 2016; Zambrano-Monserrate et al., 2018). Another body of literature proxy's degradation by deforestation rates because of the direct effects of growth on natural capital to accommodate productive efforts (e.g., agriculture) (Indarto and Mutaqin, 2016). Thus, Waluyo and Terawaki (2016) analyze the relationship between Indonesia's economic development and deforestation rates. Their results support the long-run inverted-U relationship, which implies that, while the deforestation rate increases at the initial stage of economic growth, it declines after a threshold point. As a result, nations with large amounts of forest have approximately equal deforestation rates, regardless of national wealth. The results highlight a strong relationship between forest cover and economic development, which determines rates of forest change among nations (Zambrano-Monserrate et al., 2018).

The continental deforestation rate is highest in Africa (2.8%) and net natural forest decrease rate of 3.1% from 2010 to 2015 compared to the global average of 0.13% and 0.24%, respectively (Fasona et al., 2018). Agriculture is the foremost driver of land-use change and deforestation in developing countries. Large-scale commercial agriculture accounts for about 40% of deforestation in the tropics and subtropics (Fasona et al., 2018). Other drivers include local subsistence farming (33%),

mining (7%) (Hosonuma et al., 2012; (Fasona et al., 2018)). Fuelwood collection and charcoal have also been described as significant forest degradation drivers for the African continent at about 48% (Fasona et al., 2018). This suggests that local small-scale activities (fuelwood collection, charcoal production, and livestock grazing in forests) are the most relevant in large parts of Africa (Hosonuma et al., 2012; Fasona et al., 2018).

Nigerian forests occupy about ten million hectares (~10% of the 92,376,700 hectares total land area). The Nigerian forest resources that thrive in the highland and lowland jungles, woodlands, and plantations provide ~2.5% to the GDP and offer employment for over two million persons through the supply of fuelwood and poles additional 80,000 people working in the log processing industries. Unfortunately, Oyebo et al. (2010) succumb that less than 10% of Nigeria's natural forest cover remains undamaged. In particular, the forest estates from which wood and other products are derived have been subjected to severe infringements, vegetation degradation and de-reservation for agriculture, industrial development, and urbanization (Fasona et al., 2018). The Kiru Local Government Area of Kano State is no exception. This research aims to assess the impact of deforestation on environmental degradation around Kiru Town of Kano State, North-western Nigeria.

2. THE STUDY AREA

2.1. Location and climate

Kiru town is located on latitude 11°20'N and 11°45'N and longitude 7°58'E and 8°E16'E (Figure 1). Kiru local government shares

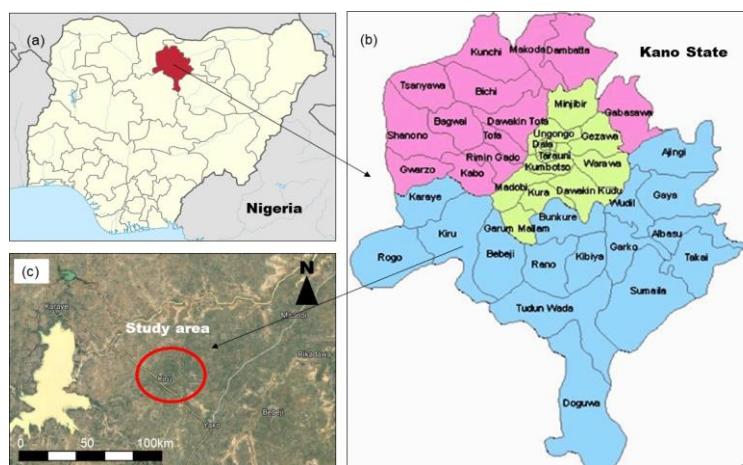


Figure 1: The Study Area

infrastructure (10%), Urbanization (10%), and

political boundaries with Kabo to the north,

Madobi in the northeast, Babeji to the south, and Tudun Wada. In the southwest, it shares a boundary with Kaduna state.

The climate of the study area is the tropical wet and dry type coded as 'Aw' in Koppens classification. The climate of the study area is dominated by two winds system (South Westerlies and North Westerlies). These results in both wet and dry seasons in the area (Murtala et al., 2015). The south-westerlies are coming from the Atlantic Ocean. This moist-laden air account for all the rainfall in the study area.

During Harmattan, the site is characterized by cold temperature and dust-laden winds from the Sahara Desert (Murtala et al., 2015). As a result, the mean annual rainfall of the Kano region decreases from about 1000mm in the southern part to about 800mm in the north and the northeast (Murtala et al., 2015). The study area in particular and the Kiru Local Government area receive about 800mm to 1000 annual rainfall (Murtala et al., 2015). The central annual temperature of the kano region is about 26°C, with a mean monthly value ranging between 21°C in the coldest month (December, January, and 31°C in the hottest month, i.e., April/May (Murtala et al., 2015).

2.2. Vegetation

The natural vegetation of the kano region is of the Sudan Savannah Type. The study area, which included the immediate environs of Kiru Town, is characterized by savannah Orchard bush, scrub and scattered vegetation. The man has altered most of these features through bush burning to clear land for cultivation and settlement purposes (Bichi and Ibrahim 2018).

The tree species in the study area include *Tamarindus indica*, *Diaphyros mospliformis*, *Parkia-bigibosa*, etc. They have adaptive features against the drought and tiny leaves. Broad canopies usually characterize the trees, and they are hardly taller than 20 meters (Bichi and Ibrahim 2018). However, further water loss through evapotranspiration is checked by shading their leaves during the dry season. Some trees species store much water in their trunks, e.g. Baobab (Kuka). The grasses are more abundant in the rainy season, during which they are greenish. They dry up in the dry season and turn brownish during the dry season. (Bichi and Ibrahim, 2018).

2.3. Geology and Soil

The crystalline rock of the basement complex characterizes the Kiru local government area. The stones are pre-Cambrian in origin and have been in existence for millions of years. The rocks have been subjected to chemical and other forms of weathering all this time. As a result, numerous granitic outcrops occur in isolated or grouped founds. In several locations, the dominant ones are Dutsen Koka, Dutson ranges, and Dutsen Bauda. The soil in the study area is lateritic, derived from the weathering of rock; it is rich in minerals, making it suitable for crop cultivation. Also, the study area has hydromorphic soil in patches around riverine areas and Fadama (floodplain), which give rise to intensive farming by Kiru people.

2.4. Land Use/Economic Activities

Farming is the predominant occupation of the people in the study area. The main crops grown are grains, including guinea corn, potatoes, and groundnuts. These are typically produced during the rainy season, which starts around May and ends in October. By December, all farm crops have been harvested except cassava and cotton. Minor occupation during the dry season includes irrigation farming and rearing of animals.

3. MATERIAL AND METHODS

This study employed direct field observation and questionnaire admiration. The focus was on the causes of deforestation, the rate of deforestation and its consequences on the environment (soil erosion). A total of six questions were asked, all of which were tailored toward identifying the causes of deforestation, forms of environmental degradation and the socio-economic impact of environmental degradation in the study area. Fifty respondents were randomly selected. The questions addressed to the respondents are as follows: 1). What are the causes of deforestation: (a) Natural causes or death (); (b) Cut down for agricultural land uses (); (c) Cut down for uses as fuelwood (); (d) Cut down for building purpose (); (e) Other specify (.....); 2). What form of energy do you use for cooking: (a) Gas (); Fuelwood (); (c) Electricity (); (d) Charcoal (); (e) Grain stalk; (f) Other specify (.....); 3). What do you think are the effect of deforestation: (a) Soil erosion (); (b) Desertification (); (c) Flooding (); (d) Drought (); (e) Other specify (.....); 4). Have you ever planted a tree: (a) yes; (b) No; 5). When do you sell most of your fuelwood: (a) In the town ();

(b) From neighbouring settlement (); (c) People come to buy from the city (); (d) Taken to the city (); (e) Other specify (.....); 6). Do the sourcing of fuelwood cause deforestation: (a) Very great extent (); (b) Great extent (); (c) To some extent (); (d) Indication (); (e) Not at all (); (f) Other specify (.....). The questionnaire excludes general information because all the respondents are adults and form owners. Similarly, the land use practice in the study area is primarily the same. Therefore, this study measures farmers' awareness regarding the activities and how these activities lead to environmental degradation.

3.1. Filed Observation

Direct field observation was undertaken to identify deforestation's types, pattern, and consequences in the study area. Numerous pictures were obtained and summarized in Figures 2 and 3 below.

The data gathered from 50 questionnaires used in this study was organized and standardized using basic descriptive statistics (frequency, percentage). Further, the several samples test ANOVA (Kruskal-Wallis) was used to measure the variability of the respondent's views about the questions asked. This method allows for comparing several independent random samples and can be used as a non-parametric substitute to the one way ANOVA (Critchlow and Fligner, 1991; Conover, 1999; Hollander and Wolfe, 1999). The Kruskal-Wallis test statistic for k samples, each of size n_i is defined viz:

$$T = \frac{1}{s^2} \left[\sum_{i=1}^k \frac{R_i}{n_i} - N \frac{(N+1)^2}{4} \right] \quad \text{Eq. 1.}$$

where N is the total number (all *in*) and R_i is the sum of the ranks (from all samples drawn)



Figure 2: (a): Photo shows evidence that the area is forested; (b): Photo shows the evidence of cutting down trees in the area; and (c) Photo shows forest area that has been converted to farmland.

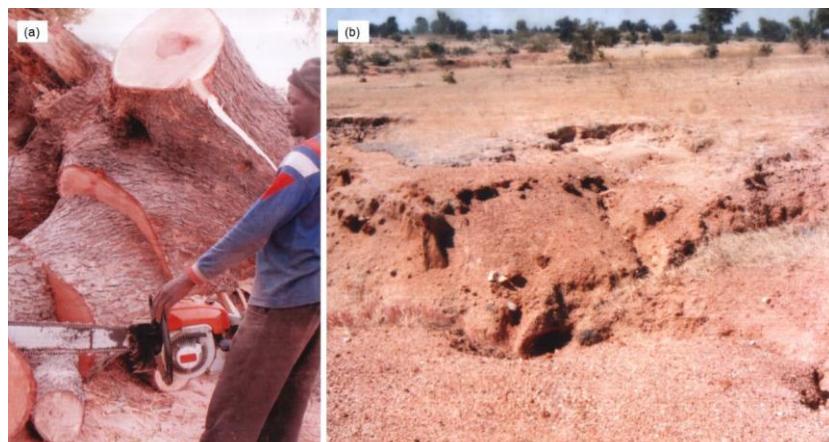


Figure 3: (a): Photo shows the cutting down of trees in the study area; **(b):** Photo shows the resultant consequences of deforestation (desertification and soil erosion).

3.2. Statistical Analysis

for the i th sample and:

$$S^2 \frac{1}{N-1} = \left[\sum_{all} R_{ij}^2 - N \frac{(N+1)^2}{4} \right] \text{ Eq. 2.}$$

The test's null hypothesis is that all k distribution functions are equal. The alternative hypothesis is that at least one of the populations tends to yield larger values than at least one of the other variables (Critchlow and Fligner, 1991; Conover, 1999). The statistical analysis was conducted using the PAST3 statistical software @ less than 0.001 significant level.

4. RESULT AND DISCUSSION

Table 1 summarises people's views regarding deforestation's causes and consequences in the study. Fuelwood extraction was the foremost factor causing deforestation in the study area. Sixty percent (60%) of the respondents agreed to this view (Table 1a). This was followed by agricultural land use (30%). The two variables put together constitute ~90% of the causes of deforestation in the study area (Figure 4a).

Table 1: People's responses concerning the causes and effects of deforestation

Variables	Frequency	Percent age
(a). Causes of deforestation		
Cut for fuelwood	30	60
Cut for agricultural land use	15	30
Cut for residential purposes	4	8
Natural death	1	2
Total	50	100
(b). Sources of energy		
Coal	0	0
Electricity	1	2
Gas	0	0
Fuelwood	38	76
Animal Dung	1	2
Grain stalks	10	20
Total	50	100
(c). Destination cutdown trees		
Use in the village	30	59
Taken to a central urban area	20	40
People come to buy from outside	0	1
Total	50	100
(d). Effects of deforestation		
Soil erosion	12	24
Flooding	10	20
Desertification	28	56
Total	50	100
(e). Afforestation exercise		
Yes	7	14

No	43	86
Total	50	100
(f). Extent of deforestation		
Very great extent	30	60
Great Extent	15	30
To some extent	3	6
Indication	2	4
Not at all	0	0

It suggests that if alternative sources of cooking fuel can be made available, 60% of the forest in the study area will remain undestroyed. Eight percent of the respondents in the study area opined that felling trees for building purposes were responsible for deforestation in the study area. This further presents another driver for forest destruction and can be attributed to population growth and settlements expansion. Lastly, 2% of the respondents showed that natural death by trees contributes to deforestation in the study area. Trees die naturally, which does not constitute any severe environmental issue since the decomposed vegetal materials add to soil nutrients. Most people in the study area (76%) rely on firewood as a domestic energy source (cooking). Twenty percent (20%) rely on grain stalks, 2% rely on electricity, and 2% rely on animal dung (Table 1b).

There is no utilization of gas for cooking in the study area (0%), suggesting that the study area is primarily rural, or the respondents are mainly engaged in most economic activities (Figure 4b). This further indicates that if electricity and gas supply can be enhanced, about 96% of the vegetation cover can be preserved in the study area. However, the destination of vegetal sources indicated that 59% of the felled trees are utilized in Kiru Town, and 40% is transported to the nearby urban areas (Table 1c). This also suggests the impact of urbanization on deforestation and the need to provide alternative energy sources both in rural and urban settlements. Furthermore, awareness of the effects of deforestation on the environment varies with respondents. Twenty-four percent (24%) believed that deforestation could cause soil erosion. Twenty percent (20%) understood that deforestation could cause flooding, and 56% opined that desertification could be caused by deforestation (Figure 4d). This presents a good case scenario regarding people's awareness of the impact of

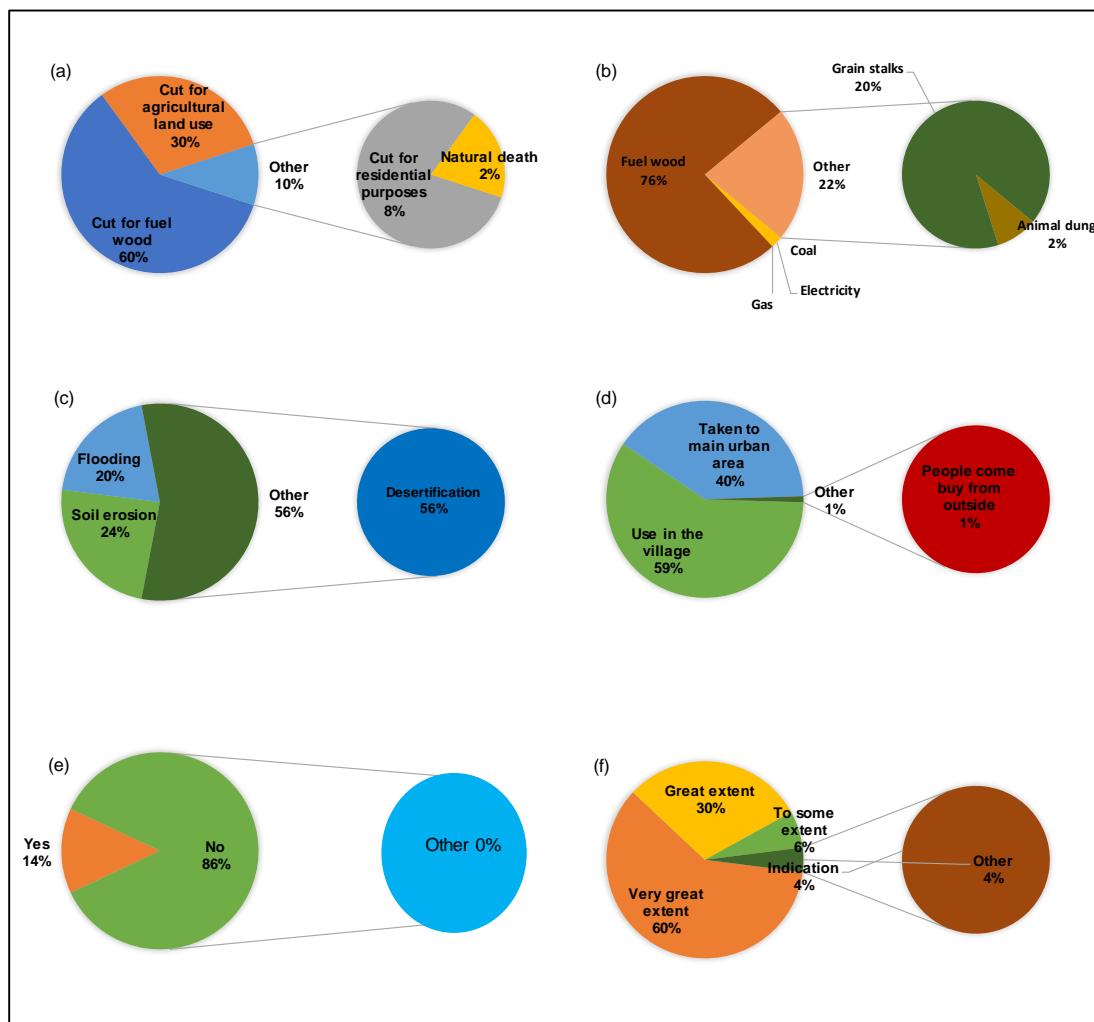


Figure 4: People's responses in the study area; (a): Causes deforestation; (b): Sources of energy; (c): Destination cutdown trees; (d): Effects of deforestation; (e): Afforestation exercise; and (f): Extent of deforestation.

deforestation. However, making available alternative sources of domestic energy remained a significant challenge.

Regarding afforestation, only 14% of the respondents have attempted planting trees in their farms, and 86% have never tried afforestation in the study area, suggesting that afforestation programs are only carried out by government agencies (Figure 4e). This presents a tremendous environmental challenge because more trees are destroyed than replanted in the study area. Also, the people's awareness of the extents to which deforestation has led to environmental degradation was measured (Table 1f). Sixty percent (60%) have observed that deforestation has reached a great extent in the study area. Thirty percent (30%) observed some great destructions, 6% have observed it to some extents, and 4% are unaware (Figure 4f). Therefore, less campaign on the environmental impacts of deforestation is required.

4.1. Statistical application

Besides, several samples ANOVA (Kruskal-Wallis test) was used to test the hypothesis that there is no significant difference between peoples opinion regarding the impact of deforestation on environmental degradation in the study area. Results (Table 2) revealed that there is no significant difference between sample medians. This is further validated using a standard probability plot of residuals (Figure 5a-f). The expected probability plot of residuals can be used to verify the hypothesis that residuals are normally distributed. The standard probability plot of the residuals should approximately follow a straight line, as indicated in Figure 5. When a residual field displays a non-normal pattern, other residual properties can check for other problems with

Table 2: Results of several samples ANOVA (Kruskal-Wallis Non-Parametric test)

Kruskal-Wallis Non-Parametric test	H(chi2)	Hc (tie corrected)	p(same)
1. Causes of deforestation	0.5208	0.5271	0.4678
2. Sources of Energy	0.2308	0.2409	0.6236
3. Destination cutdown trees	1.19	1.19	0.2752
4. Effects of deforestation	1.19	1.19	0.2752
5. Afforestation exercise	0.6	0.6	0.4386
6. Extent of deforestation	0.5345	0.5411	0.462

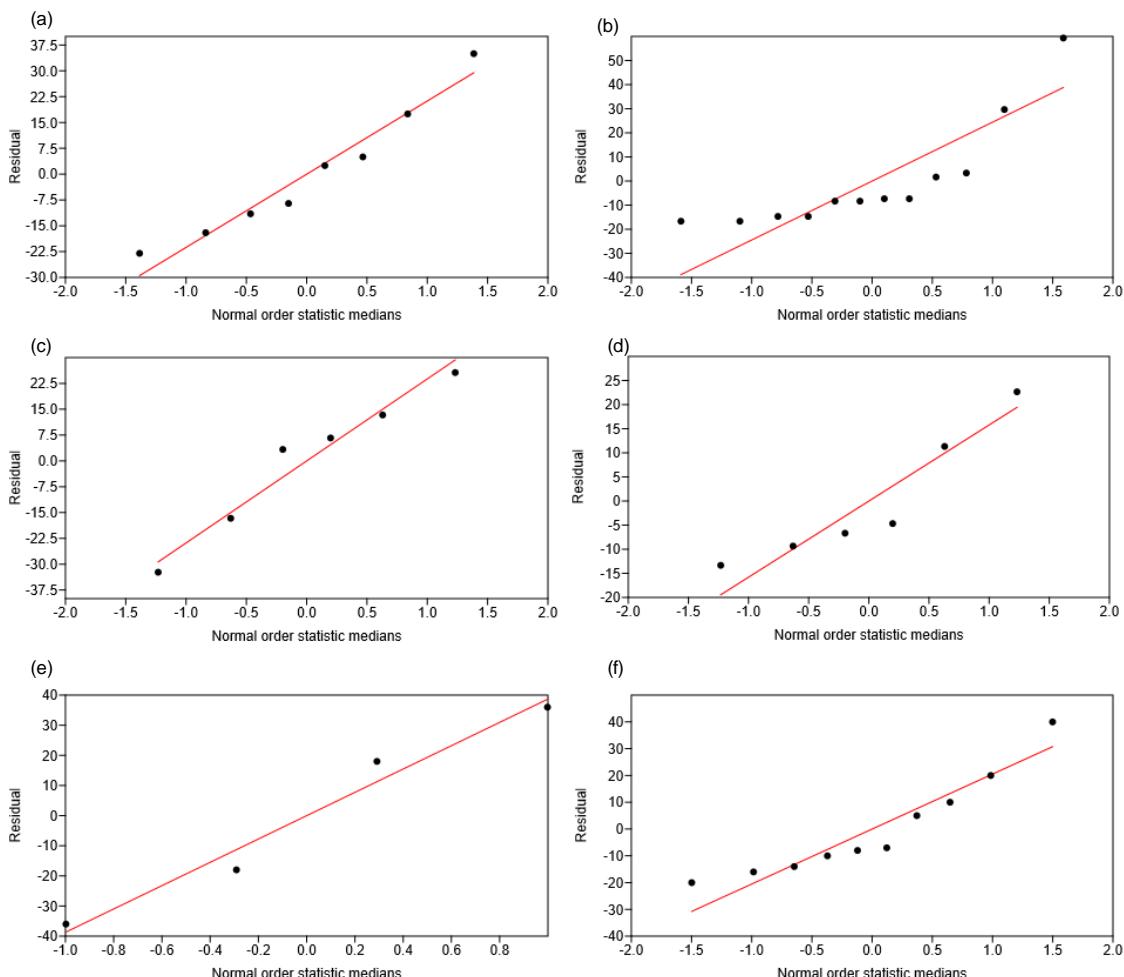


Figure 5: Residuals plot for homogeneity of respondent's views; (a): Causes deforestation; (b): Sources of energy; (c): Destination of cutdown trees; (d): Effects of deforestation; (e): Afforestation exercise; and (f): Extent of deforestation.

the model, such as missing terms or a time order effect.

Prediction intervals can be inaccurate if the residuals do not follow a normal distribution. Suppose the residuals do not follow a normal distribution and the statistics have a smaller amount of observations (<15). In that case, confidence intervals for predictions, confidence intervals for coefficients, and p-values for coefficients can be inaccurate. The observed normality in this analysis confirms the accuracy of the data used in this study.

4.2. Implications for environmental management in Nigeria

This study found that deforestation is alarming, even though the peoples in the study area are very much aware of its consequences on the environment. Environmental problems, including desertification, urbanization, deforestation, overpopulation, and pollution, have become essential paradigms in Nigeria in the last three decades. Conversely, Government, Non-governmental Organization, corporate bodies and individual's interests in reducing, stemming and mitigating the

consequences of environmental degradation resulting from deforestation is very recent (Omofonmwan and Edoh, 2008). It was not until December 1988 that the Federal Government passed the Federal Environmental Protection Agency (FEPA) Decree 58 (of that year), setting up FEPA to work out rules governing the handling of Nigerian's environment. Before the 1988 Decree (which established FEPA), some laws and government acts were related to environmental protection (Omofonmwan and Edoh, 2008). They include; the mineral act of 1969, 1973 and 1984, oil in navigable water Decree of 1968, the associated Gas injection act of 1969 and Chad Basin development act of 1973, to mention but a few (Omofonmwan and Edoh, 2008). These laws and acts were promulgated to address specific and identified environmental problems. However, they were narrow in scope and spatially restricted. Decree No 58 of 1988, as amended by Decree 59 of 1992, which gave birth to the FEPA (Now Ministry of Environment), empowers the agency to control all issues relating to Nigeria Environment, its resources, exploitation, and management (Omofonmwan and Edoh, 2008).

Despite the legal backing and funding, which FEPA receives from the federal government, the level of success recorded by FEPA is a far cry from her set objectives and goals. This is because the rate of environmental degradation is growing worse than before establishing FEPA (Omofonmwan and Edoh, 2008). For example, urbanization, deforestation, desertification, and pollution are now more remarkable than ever before. Suppose appropriate techniques and technology of environmental protection and management are not put in place. In that case, Nigeria may become a rugged country to live in by the next 15 years (Omofonmwan and Edoh, 2008). FEPA, as an institution or agency, is foreign to the people. It is not indigenous. The concept or idea did not evolve from the people's tradition or way of life. FEPA is very far from the people and the environment. Her officials are like the tax collectors of the olden days. As a development strategy, FEPA is "Top-down" and not "Bottom-up", which is more popular (Omofonmwan and Edoh, 2008).

For FEPA to succeed, specific basic ideas about environmental management have to be conceptualized. Before the dawn of

modernization, our people were tied intricately to their environment. They have the technology of utilizing the resources within the environment and protecting the same from despoliation. In this regard, the concept of FEPA should be community-based (Omofonmwan and Edoh, 2008). For example, in disseminating modern and scientific methods of agriculture, the agency creates what is called "Agric cell". An agricultural officer attached to each cell goes to educate the people about modern methods of crop cultivation. In a similar vein, environmental protection officers should be sent to one or a group of communities to further enlighten them on modern methods and environmental protection techniques (Omofonmwan and Edoh, 2008).

5 CONCLUSION

The literature is almost unanimous on the impact of deforestation on environmental degradation, especially as it relates to lumbering, firewood/charcoal extraction, clearance for farming and urban encroachment. This study has reported our novel effort to assess the impact of deforestation on environmental degradation around Kiru Town in Kano State. Although the history of using vegetation resources is as old as man on the planet, the current trend in deforestation and the resultant consequences are apparent. This study found that:

1. Fuelwood extraction was the foremost factor causing deforestation, followed by agricultural land use.
2. Although there is increased urbanization, the latter had a considerable impact on deforestation in the study area; 40% of firewood obtained from Kiru is used in the nearby urban area.
3. The use of gas and other alternative sources of clean energy is lacking, which led to increased pressure on vegetation resources in the study area.
4. Awareness of the effects of deforestation on the environment is high among people in the study area. However, they lack alternative domestic energy sources, making it challenging to conserve vegetation in the study area.
5. Statistical tests of people's responses indicate no significant difference between sample medians.

Nevertheless, this investigation covers only Kiru and its environs; therefore, a comprehensive study on deforestation is suggested over broader spatial and temporal scales. This is quite relevant and timely, owing to the demographic conditions of Kano State. More forestry resources are threatened by increasing urbanization and agriculture in the entire northern parts of Nigeria. Under current environmental conditions, further degradation of vegetation must be discouraged to maintain ecological balance in the region, which is currently threatened by climate change.

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