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Effects of Tree Species Harvesting Practices on Taraba State Natural Ecosystems, Nigeria: A Case Study of Karim Lamido Local Government Area

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Abstract: This study assessed the effects of tree species harvesting practices on Taraba state natural ecosystems, a case study of Karim Lamido local government area (LGA). The study identified tree species, explores harvesting reasons, methods, implications, and measures for control. Purposive sampling technique was employed to select four (4) districts. Using Solvin's formula, a sample size of 399 respondents was selected, and the administration of the structured questionnaire was done at random. Data were analyzed using descriptive and inferential statistics such as frequency, bar chart, likert scale and chi-square. A total of 33 tree species from 21 families were identified, with Prosopis africana recording the highest percentage (99.50%) and Strychnos spinosa recording the lowest (0.50%). 45.61% strongly agreed they harvest tree species for food. These species have experienced major alterations due to the growing demands for food, medicine, fuel, and fiber, which have been made worse by overharvesting. The Pearson Chi-Square has a value of 527.920a, while the number of valid cases was 1995, and the p-value was less than the critical p-value of 0.05 ($P < 0.05$), making it statistically significant at all levels. This implies that various harvesting reasons lead to demand for various tree species which in turn leads to a variety of unsustainable harvesting practices. The population of the study area have expressed interest in forest protection but remained unwilling to stop tree species harvesting. This necessitates the need to development and execute sustainable harvesting and forest management initiatives, such as awareness campaigns, afforestation, agroforestry and silvicultural practices.

Keyword: Harvesting, Ecosystems, Tree species, Practices and Implication

INTRODUCTION

Karim Lamido natural ecosystems constitute one the major sources of tree species in Taraba State. The state is one among the few states in Nigeria that possesses a unique characteristic of natural forests (Meer *et al.*, 2019), which are the bedrock of natural ecosystems. Natural forests are typified by the co-existence of different tree species that play critical roles in providing goods and services (Meer *et al.*, 2019). According to Goldenberg *et al.* (2018) tree species crucial part of the Earth Systems (soil, water, and atmosphere), offering essential goods and services to both the ecosystem and human societies. In fact, trees are vital to man's existence because of the many economic, social and ecological functions it performs (Ampitan *et al.*, 2017). Trees supports the functions of soil, which include decomposition, nutrient cycling, soil respiration, invasion resistance, and ecosystem stability (Huston, 2014). Soil around the tree species is enriched by droppings of livestock that are sheltered from the hot sun by the tree species (Ampitan *et al.*, 2017). Tree species offer watershed protection, a regular supply of fresh water and prevents flooding and siltation of river beds downstream (Ampitan *et al.*, 2017). Trees play a major role in regulating the earth's climate through sequestering atmospheric (Köhl *et al.*, 2015; Mokria *et al.*, 2018).

Statistics showed that 12.2% of Nigeria's land area of 11,089,000 ha is covered with forests. However, these forests are seriously threatened by deforestation (Food and Agriculture Organization FAO, 2005; Ariyo, 2020). African savanna forests occupied about 15.1 million km² (Sobola *et al.*, 2021; Hammanjoda *et al.*, 2022) of the continent's land mass; this vegetation is undergoing extreme changes (Zerbo *et al.*, 2016) due to increasing levels of unsustainable harvesting practices and other environmental forms of deforestation. According to Rabgyal and Pelden (2020) increasing demand for tree species has put tremendous pressure on the wild population with many species already pushed in the high risk of extinction and endangered categories due to over-exploitation and unsustainable harvesting. Vancutsem *et al.* (2021) and Hammanjoda *et al.* (2022) reported an estimated loss of 218.7 million ha of tropical forests between 1990 and 2020, with 10% of the remaining 1071 million ha in a degraded state, thus affecting the overall function and structure of these forests and natural ecosystems in general. A global assessment indicates that about 9,000 tree species are threatened with extinction (Jensen and Meilby, 2012). These threats, especially the increased removal of whole-tree harvesting (i.e., extracting un-delimbed trees), have

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raised concern over the sustainability of forests (Wall, 2012) and natural ecosystems.

Most tree species are gradually being lost through overharvesting for food, medicine, charcoal, timber, and other activities like construction of roads and expansion of ranches and farms (Delvaux *et al.*, 2009). The harvesting methods focus on the economic reasons (Meer *et al.*, 2024), thereby adopting methods of extraction such as lopping of branches and premature harvesting. Natural ecosystems and many tree species have suffered significant harm as a result of the existing unsustainable harvesting practices and a lack of information about sustainable harvesting, hence the need for this study. Therefore, this study identified the tree species that are harvested in Karim Lamido Local Government Area (LGA) of Taraba State. It also looked into the reasons behind the harvesting, the various methods used, the implication of the practices, and measures to control tree harvesting in the study area.

METHODOLOGY

Study Area

Karim Lamido Local Government Area of Taraba State is located in North-western part of Taraba State. It lies between latitudes 8° 33′ – 10° 21′ N and longitudes 10° 21′ – 11° 24′ E (Figure 1). The LGA covers a land mass of 6,620 km^2 with a population of 195,844 (Karshima *et al.*, 2016). It is bounded to the west and north by Plateau and Bauchi States, respectively, to the northeast by Gombe State, to the east by Adamawa State, and to the south by the River Benue and traversed by several tributaries of the same river. It also shares its southwest boundary with Ibi LGA (Karshima *et al.*, 2016). Karim Lamido LGA is made up of eleven (11) districts (council wards), which include Amar, Andamin, Bachama, Bikwin, Darofai, Didango, Jen Ardido, Jen Kaigama, Karim A, Karim B, and Kwanchi (Eduweb, 2022). It has two distinct seasons, namely, the rainy season, which extends from May to October, and the dry season, which extends from November to April, with an average annual precipitation of 1058 mm and an annual average temperature of 28° C (Karshima *et al.*, 2016).

The vegetation of Karim Lamido LGA is characterized by scattered trees, shrubs, and tall grasses, which include *Daniellia oliveri, Vitex doniana, Afzalia africana, Prosopis africana, Vitelleria paradoxa, Khaya senegalensis,* and *Vitellaria paradoxa*. The fauna of the study area includes monkeys (*Cercopithecus aethioops*), red-flanked duikers (*Cephalophus rufilatus*), bats (*Chiroptera spp.*), grasscutters (*Thryonomys swinderianus*), giant rats (*Cricetomys gambianus*), rabbits (*Oryctolagus cuniculus*), giant forest squirrels (*Epixerus epii*), fowl (*Numida meleagris*), etc. (Taraba State Ministry of Environment TSME, 2024). Karim Lamido LGA has various ethnic groups, including Jenjo, Wurkum, Karinjo, Bambuka, Munga, Kodei, Dadiya, Bandawa and Fulani (Manpower, 2024). The major agricultural activities in the region include crop farming, livestock production and fishing (Karshima *et al.*, 2016; Serapta, 2020). Karim Lamido LGA is drained by River Pai and so many other smaller rivers and streams that flow into River Benue.

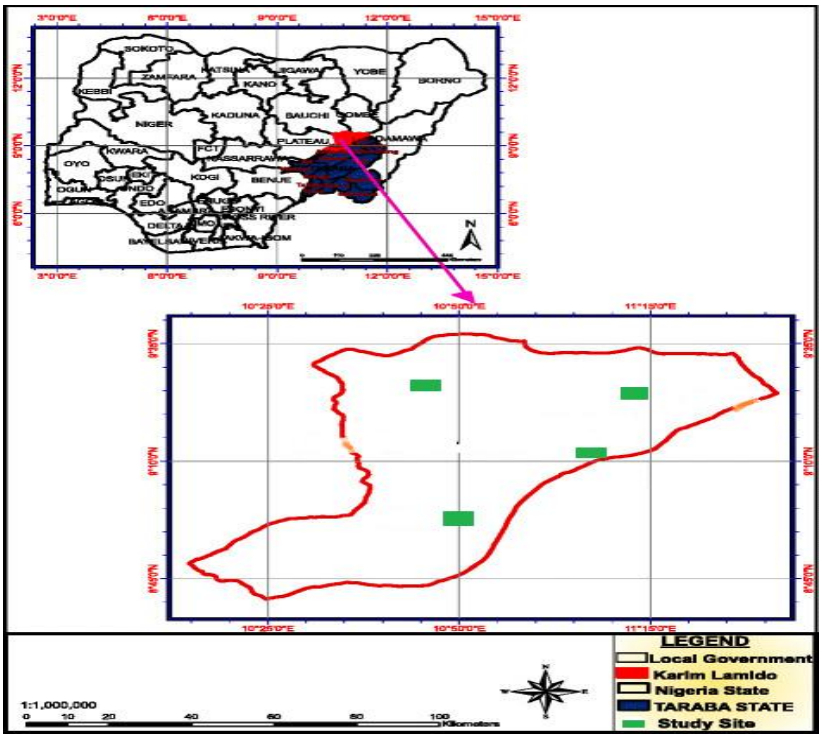

Figure 1: Map of Nigeria Showing Taraba State and the Study Area
Source: Karshima *et al.* (2016).

Data Collection

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Purposive sampling technique was employed to select four (4) districts (council wards) using a sampling intensity of 35% out of the eleven (11) districts of the study area. The selected districts include Karim B, Kwanchi, Darofai and Andamin. The choice of the sampled districts was based on the high rate of harvesting activities as outlined by Ahmed *et al.* (2016). Solvin's formula, adopted by Yamane (1967) and Meer *et al.* (2024), was used to select a sample size of 399 respondents from the target population of Karim Lamido LGA. The sample size was computed as follows:

$$n = \frac{N}{1 + N(e)^2}$$

Where; n = Sample size, N = Total population (195,844), e= Sampling error (0.05)

$$n = \frac{195{,}844}{1 + 195{,}844(0.05)^2} = \frac{195{,}844}{490.61} = 399$$

Administration of a structured questionnaire was done at random to obtain information on tree species identification, reasons and methods of tree species harvesting as well as implications and control of tree species harvesting in the study area. Oral interviews and group discussions were conducted with respondents in the locations where these harvesting activities were taking place.

Data Analysis

Data were analyzed using descriptive statistics (percentage, frequency, bar chart) and Likert scale rating (four scale). The Likert scale mean for all indicators were categorize as follows; the mean 1.00-1.49 = Strongly Disagree (SD), 1.50-2.49 = Disagree (D), 2.50-3.49 = Agree (A) and 3.50-4.00 = Strongly Agree (SA). Inferential statistic (chi-square) was used to test the hypothesis.

RESULTS AND DISCUSSION

Demographic Characteristics of the Respondents

The results of the demographic characteristics of the respondents are shown in Table 1, which indicates that 58.15% of the respondents were male and 41.85% were female. The largest proportion (50.38%) of respondents were between the ages of 10 and 30, followed by those between the ages of 31 and 50 (27.57%) and 51 years and above (20.05%). This means that majority of the respondents were mostly young male with average educational background, the attributes that imply an active population capable of reading and comprehending any new developments in sustainable tree species harvesting and forest management practices.

Majority of the respondents were married (55.89%) while 44.11% of them were single. Farmers made up the majority of the respondents (46.12%), followed by herbalists (25.31%), artisans (20.55%), and civil servants (8.02%). Table 1 further explained that that 41.10% of respondents had a household size of 15 or more, 23.56% had less than six individuals, 18.05% had between 11 and 15, and 17.29% agreed that they had between 6 and 10. The respondents' marital status and household size are suggestive of a potentially rapidly expanding population, which puts additional stress on tree species. This observation agrees with McCarty (2001) that rapid human population growth rate is the major cause of tree species loss. These population growths pose a serious challenge to tree species resources due to indiscriminate exploitation by farmers, artisans, and herbalists. This finding aligns with similar studies conducted by the National Wildlife Federation, NWF (2021), that forest ecosystem destruction is a result of human clearing of lands, mowing fields, and cutting down trees for the ever-growing spread of the human population.

Table 1: Demographic Characteristics of the Respondents in the Study Area

Option	Frequency	Percentage
Gender		
Male	232	58.15
Female	167	41.85
Age group		
10-30 years	201	50.38
31 -50 years	110	27.57
51 years and above	80	20.05
Educational level		
Primary	99	24.81
Secondary	173	43.36
Tertiary	42	10.53
Illiteracy (no formal education)	85	21.30
Marital Status		
Married	223	55.89
Single	176	44.11
Occupation		
Farming	184	46.12
Civil servants	32	8.02
Artisans	82	20.55
Herbalist	101	25.31
Household Size		
Below 6	94	23.56
6-10	69	17.29
11-15	72	18.05
Above 15	164	41.10

Tree Species Harvested in the Karim Lamido LGA

According to the respondents, there were 33 tree species from 21 families in the study area, with *Prosopis africana* accounting for the largest percentage (99.50%), followed by *Parkia biglobosa* (98.75%) while *Strychnos spinosa* recorded the least frequency (0.50%) (Table 2). The highest proportions were found in the Arecaceae, Combretaceae, Leguminosae, and Mimosoideae families, each with three species, followed by the Caesalpinoideae, Malvaceae, Meliaceae, and Verbenaceae families, each with two species (Table 2).

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The choice of *Prosopis africana* and *Parkia biglobosa* by the respondents could be connected to the considerable ecological, social, and economic importance as well as the ability of these species to meet many needs of the indigenous population. According to Houètchégnon *et al.* (2015) and Udo *et al.* (2016), *Prosopis africana* enriches the soil by fixing nitrogen; the tree species attracts bees and is a popular tree among bees, its leaves are rich in protein, and sugar pods are used as foodstuffs for feeding ruminants. The pulp of the pods contains 9.6% protein, 3% fat, and 53% carbohydrate and provides energy value 1168J. *Prosopis africana* and *Parkia biglobosa* seeds are fermented and used as condiments (Houètchégnon *et al.*, 2015; Udo *et al.*, 2016). The bark of *Parkia biglobosa* is used as mouthwash, vapour inhalant for toothache, or for ear complaints. It is macerated in baths for leprosy and used for bronchitis, pneumonia, skin infections, sores, ulcers, and washes for fever, malaria, diarrhea, and sterility. Roots are used in a lotion for sore eyes (Udo *et al.*, 2016). Meer and Tella (2018) also identified *Parkia biglobosa* as one among the top sixteen most preferred and the most commercialized fruit-producing species in the northern Guinea savanna ecological zone of Taraba State, Nigeria.

Table 2: Available Tree Species in the Study Area

S/No	Species	Local Name (Hausa)	Family	Frequency	Percentage (%)
1.	*Acacia species*	Bagarwa	*Leguminosae*	17	4.26
2.	*Adonsonia digitata*	Bàmbúú	Malvaceae	218	54.64
3.	*Annona senegalensis*	Gubduu	Annonaceae	384	96.24
4.	*Azadirachta indica*	Dogon yarro	Meliaceae	198	49.62
5.	*Bombax costatum*	Kuryaa	Bombacaceae	263	65.92
6.	*Borassus aethiopum*	Giginya	Arecaceae	182	45.61
7.	*Ceiba pentandra*	Rimi	Malvaceae	79	19.80
8.	*Combretum spp*	Gooda jiki	Combretaceae	46	11.53
9.	*Daniella oliveri*	Maaje	Caesalpinoideae	345	86.47
10.	*Elaesis guneensis*	Alayyadii	Arecaceae	83	20.80
11.	*Entada africana*	Tawatsa	Mimosoideae	28	7.02
12.	*Ficus spp*	Girca	Moraceae	109	27.32
13.	*Gmelina arborea*	Malaina	Verbenaceae	289	72.43
14.	*Grewia mollis*	Dargajii	Tiliaceae	62	15.54
15.	*Hymenocardia acida*	Jan yaro	Hymenocardiaceae	198	49.62
16.	*Hyphaene thebaica*	Goruba	Arecaceae	67	16.79
17.	*Khaya senegalensis*	Male	Meliaceae	361	90.48
18.	*Lophira lenceolata*	Namijin kadanya	Ochnaceae	59	14.79
19.	*Nuclea latifolia*	Ìgiyaa	Rubiaceae	15	3.76
20.	*Parinari spp*	Gawasa	Chrysobalanaceae	6	1.50
21.	*Parkia biglobosa*	Dabano	Mimosoideae	394	98.75
22.	*Pericopsis laxiflora*	*Makarfo*	*Leguminosae*	9	2.26
23.	*Pilliostigma thorningii*	Cancalii	Caesalpinoideae	92	23.06
24.	*Prosopis africana*	Kirya	Mimosoideae	397	99.50
25.	*Pteleopsis suberosa*	NA	Combretaceae	8	2.01
26.	*Pterocarpus erinaceus*	*Madrid*	*Leguminosae*	187	46.87
27.	*Sterculia setijera*	Kukkuki	Sterculiaceae	41	10.28
28.	*Strychnos spinosa*	Girgita	Loganiaceae	3	0.50
29.	*Syzygium guineese*	Malmoo	Myrtaceae	318	79.70
30.	*Terminalia spp*	Baushen	Combretaceae	36	9.02
31.	*Vitellaria paradoxa*	Kadanyar	Sapotaceae	390	97.74
32.	*Vitex donniana*	Dinyaa	Verbenaceae	392	98.25
33.	*Zizipus mauritiana*	Margaya	Rhamnaceae	377	94.49
	Total			**399**	**100**

Key: NA = Not available

Reasons for Harvesting Trees in the Study Area

The results of reasons for harvesting trees in Table 3 showed that 45.61% strongly agreed they harvest trees for food, 38.85% only agree, while 10.78% and 4.76% disagree and strongly disagree on the reasons for harvesting trees in the study area. 40.35% of the respondents agree that they harvest trees for medicine, 26.32% strongly agree, while 25.81% and 7.52% disagree and strongly disagree, respectively. 42.61% of the respondents agree that they harvest trees for the shelter, 20.80% strongly agree, while 16.04% and 20.55% disagree and strongly disagree, respectively. 16.29% agreed that religious and cultural reasons are an important reason, and 4.26% strongly agree, while the

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majority (25.31% and 54.14% representing disagree and strongly disagree, respectively) do not see religious and cultural reasons as important reasons for tree species harvesting in the study area. 35.84% agree that they harvest trees for cooking, trading, craft making, and construction of household items and farm tools; 21.80% strongly agree, while 24.06% and 18.30% disagree and strongly disagree respectively.

In general, 474 and 694 respondents representing 23.76% and 34.79%, respectively, agreed that they harvest tree species in the study area for a variety of reasons, particularly food, medicine, and shelter (Table 3). This agreed with Gaoue *et al.* (2017), who opined that tree species are harvested for timber and non-timber forest products (NTFP) that serve as important sources of medicine, food, and income for millions of people. It follows that tree species harvesting was widely practiced in the Karim Lamido LGA. This means that this population depend on a wide variety of tree species for their livelihood. This result is consistent with a study by Feka and Manzano (2008), which found that food, medicine, and shelter are among the different reasons why tree species are harvested. According to Ndangalasi *et al.* (2007), the harvesting and consumption of plant products is known to account for a large proportion of the livelihood. Bruschi *et al.* (2014) reported that the majority of the human population live in rural areas, and most of them rely directly upon a variety of NTFPs harvested from natural forest ecosystems for their daily subsistence as well as for their economic, social, spiritual, and cultural needs. They also reported that people living in urban areas also rely on NTFPs from natural forest ecosystems for house building, furniture, and energy.

Table 3: Reasons for Harvesting Trees and Levels of Agreement Cross Tabulation

Reason	SA (%)	A (%)	D (%)	SD (%)	Total
Food	182 (45.61)	155 (38.85)	43 (10.78)	19 (4.76)	399 (100)
Medicine	105 (26.32)	161 (40.35)	103 (25.81)	30 (7.52)	399 (100)
Shelter	83 (20.80)	170 (42.61)	64 (16.04)	82 (20.55)	399 (100)
Religious and cultural reasons	17 (4.26)	65 (16.29)	101 (25.31)	216 (54.14)	399 (100)
Cooking, trading, craft making and construction of household items and farm tools	87 (21.80)	143 (35.84)	96 (24.06)	73 (18.30)	399 (100)
Total	**474 (23.76)**	**694 (34.79)**	**407 (20.40)**	**420 (21.5)**	**1995 (100)**

It can be noted from Table 4 that the Pearson Chi-Square has a value of 527.920a, the Likelihood Ratio has a value of 527.651, Fisher's Exact Test has a value of 0.000, and the Linear-by-Linear Association has a value of 207.923b, while the number of valid cases is 1995, which is statistically significant at all levels since the p-value is less than the critical p-value of 0.05 ($P < 0.05$). This suggests that various reasons lead to demand for various tree species' parts, which in turn leads to a variety of harvesting practices, most of which are not sustainable. In line with the findings, Talukdar *et al.* (2020) found out that tree species parts are used by human beings over time for various reasons, like food, fodder, fiber, traditional medicine, agricultural amenities, and domestic materials, and many of these reasons are associated with cultures.

Table 4: Chi-Square Tests

	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	527.920[a]	12	.000	.000		
Likelihood Ratio	527.651	12	.000	.000		
Fisher's Exact Test	.000			.000		
Linear-by-Linear Association	207.923[b]	1	.000	.000	.000	.000
N of Valid Cases	1995					

1. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 81.40.
2. The standardized statistic is .000.

Methods of Harvesting the trees in Karim Lamido LGA

The results of the methods for harvesting trees are shown in Table 5, revealing that 34.59% strongly agreed that they harvest the entire tree plant, 39.85% only agreed, while 13.03% and 12.53% disagreed and strongly disagreed, respectively, on the methods. 16.79% strongly agreed, while 24.81% and 18.55% disagreed and strongly disagreed, respectively, that they don't harvest tree species prematurely, whereas 39.85% believe they prematurely take the tree portions. 35.59% of respondents strongly agreed that they harvest all the parts of tree species at once, compared to 22.06% and 11.78% of respondents who disagreed and strongly disagreed, respectively. 48.12% strongly agree that they harvest only selected trees and mature parts, 39.60% only agree, while 5.01% and 6.27% disagree and strongly disagree, respectively.

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This finding suggests that the majority of respondents use non-sustainable practices for harvesting trees. This may be connected to lack of subsidy and supportive policy and institutions to regulate tree species harvesting policies that favour sustainable practices. According to Forest-Plus (2013), Rabgyal and Pelden (2020), and Elwan, (2024), sustainable method of harvesting tree species is the only feasible harvesting strategy that employ methods and tools that limit plant harm. These harvesting strategies alter the local collectors' behavior patterns, enabling them to adopt sustainable harvesting techniques. The actual impact of harvesting depends on the method and type of resource that is removed. Wall (2012) maintained that whole-tree harvesting, especially in clear-cutting decline site productivity. Intensive and uncontrolled harvesting can reduce the abundance of solitary plants (Ndangalasi *et al.*, 2007).

A reasonable number of respondents (35.34% for disagree and 22.81% for strongly disagree) do not remove or harvest all tree species for farming purposes. This can be connected to the products and services offered by various tree species. In agreement with this finding, the United States Department of Agriculture (USDA) (2007) noted that trees are valued for basic goods (such as food and wood fiber) and ecological services (air and water purification, flood and climate regulation, biodiversity, and scenic landscapes) that are often perceived to be free and limitless.

Table 5: Methods of Harvesting Tree Species in Karim Lamido LGA

Statement	SA (%)	A (%)	D (%)	SD (%)
Harvesting whole tree plant	138 (34.59)	159 (39.85)	52 (13.03)	50 (12.53)
Harvesting the tree parts prematurely	67 (16.79)	159 (39.85)	99 (24.81)	74 (18.55)
Harvesting all the parts of the trees at a time	122 (30.58)	142 (35.59)	88 (22.06)	47 (11.78)
Harvesting only selected trees and mature parts	192 (48.12)	158 (39.60)	20 (5.01)	25 (6.27)
Harvesting all the trees for farming activities	55 (13.78)	109 (27.32)	141 (35.34)	91 (22.81)

Parts of Tree Species Harvested in the Study Area

According to the Table 5, most respondents (23.31%) strongly agreed and (34.34%) agreed that they harvest leaves. Only 22.06% and 20.30% disagreed and strongly disagreed, respectively (Figure 2). Similarly, 27.82% agreed that they harvest stem and bark, 13.53% strongly agree, while 26.32% and 32.33% disagreed and strongly disagreed, respectively. However, 45.36% agreed that they harvest fruits, flowers, and seeds; 39.10% strongly agreed, while 9.77% and 4.51% disagreed and strongly disagreed, respectively. 10.78% strongly agreed they harvest roots, 23.81% only agreed, while 24.56% and 40.85% disagreed and strongly disagreed, respectively. All the respondents (36.59%) disagreed, and (63.41%) strongly disagreed with none of the above (Figure 2).

This indicates that every respondent uses a variety of methods to harvest diverse tree species' parts. The inhabitants of Karim Lamido LGA of Taraba State make use of numerous tree species and their parts. This is because the species are useful for treating a variety of diseases; they are also a good source of food, and nomadic herders cut the leaves as a vital supply of feed for their animals. The respondents stated that the timber obtained from tree species is highly regarded. This result was similar to the one of USDA (2007), who identified tree species as natural assets for basic goods and services. Tree species offer essential services to both the ecosystem and human societies (Goldenberg *et al.*, 2018).

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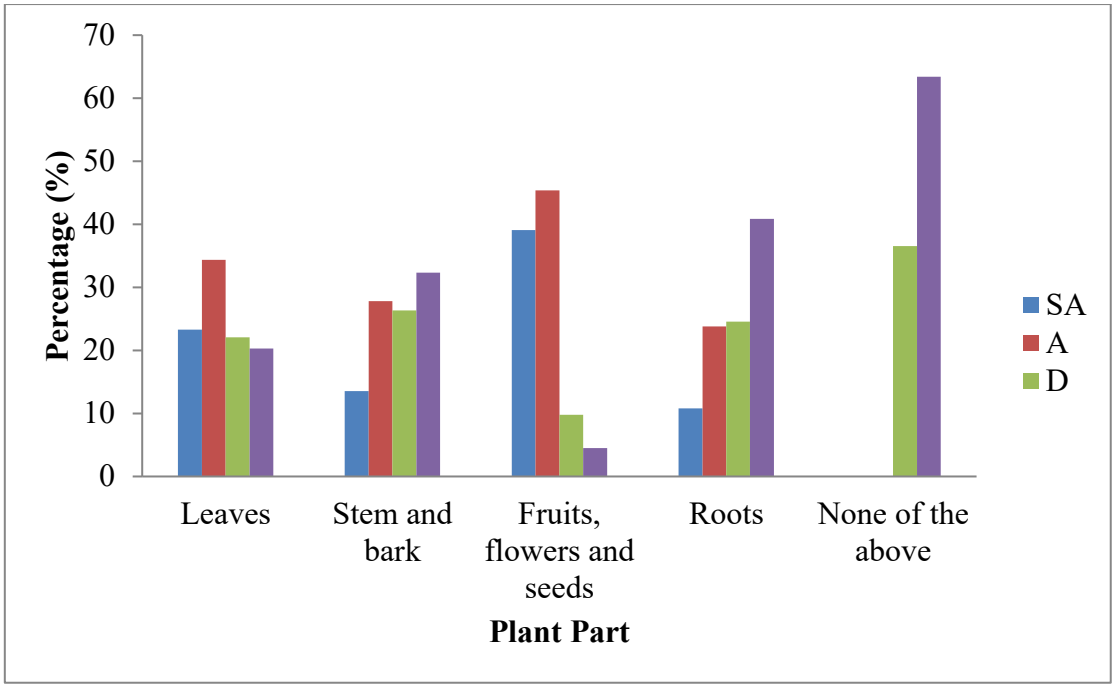

Figure 2: Parts of Trees Harvested in Karim Lamido LGA of Taraba State
Key: SA = Strongly Agree, A = Agree, D =Disagree, SD = Strongly Disagree.

Implications of Harvesting Practices in the Study Area

Majority of respondents (40.10% agreed and 21.30% strongly agreed) claimed that bad harvesting practices, especially overharvesting, total harvesting, and premature harvesting, had harmed or altered the morphology of the tree species in the research area. There were very few respondents who did not observe any harm brought on by subpar harvesting practices (30.08% disagreeing and 8.52% strongly disagreeing) (Table 6). On the decrease in the availability of tree species, 38.10% of the respondents strongly agreed, and 35.09% agreed that many tree species are decreasing to the point of extinction, which could be connected to the high exploitation rate (overharvesting). 19.80% and 7.02% disagree and strongly disagree, respectively. 48.12% agreed that the implications of harvesting practices can cause effects on humans and animals (both wild and domestic); 22.31% strongly agreed, while 20.05% and 9.52% disagreed and strongly disagreed, respectively. 34.34% agree that the implication of harvesting practices has an effect on water, air, and soil; 27.82% strongly agree, while 25.31% and 12.53% disagree and strongly disagree, respectively. 47.12% of the total respondents agreed that the physical manifestations of deforestation include soil erosion, air pollution, lack of soil fertility, water scarcity, and easy spread of pests and diseases; 15.04% strongly disagreed, while 24.56% and 13.28% disagreed and strongly disagreed that the physical manifestations of deforestation include soil erosion, air pollution, lack of soil fertility, water scarcity, and easy spread of pests and diseases.

The majority of the respondents shared their view that unsustainable harvest practices in the study area are seriously causing damage to the tree species. This report is in agreement with previous studies conducted by Gaoue and Ticktin (2008), and Delvaux *et al.* (2009), where they said removal of tree species parts has variable implications on the plants themselves, depending on the parts harvested. According to them, harvesting flowers and fruits has an adverse implication on regeneration and on the population viability. Similarly, Delvaux *et al.* (2009) opined that harvesting bark or roots is more damaging in terms of tree survival. The respondents also noted significant changes in the forest ecosystem of the study area, including air, water, soil, and living organisms. noticeable changes evolved into environmental problems like soil erosion, air pollution, lack of soil fertility, water scarcity, widespread pests and diseases, and loss of forest cover and biodiversity, which in turn affects the healthy condition of the human population of Karim Lamido LGA. This study agrees with the work by Weisse (2020), who saw a notable spike of tree species loss in 2016, 2017, and 2019, mainly linked to unsustainable harvesting. McHale (2008) identified several variables that are directly affected by forest harvesting, including vegetation, soil properties, watershed, and surface water quantity and quality. This result also demonstrates how cutting down a whole or individual tree can have a negative impact on the forest ecosystem of the study area. Gaoue and Ticktin (2008), in their study, assessed the impacts of combined bark and foliage harvest on *Khaya senegalensis* reproductive performance in Benin republic.

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Table 6: Respondents' Perception on the Implications of Harvesting Practices in the Study Area

Statement	SA (%)	A (%)	D (%)	SD (%)
Damage or change in shape as a result of poor harvesting method	85 (21.30)	160 (40.10)	120 (30.08)	34 (8.52)
Decrease in the availability of trees	152 (38.10)	140 (35.09)	79 (19.80)	28 (7.02)
Effect on human and animals (both wild and domestic)	89 (22.31)	192 (48.12)	80 (20.05)	38 (9.52)
Effect on water, air and soil	111 (27.82)	137 (34.34)	101 (25.31)	50 (12.53)
The physical manifestations of deforestation include soil erosion, air pollution, lack of soil futility, water scarcity, easy spread of pests and diseases	60 (15.04)	188 (47.12)	98 (24.56)	53 (13.28)

Measures to Control the Implications of Tree Species Harvesting in the Study Area

The results in table 7 showed the measures to control the implications of tree species harvesting; it can be noted that 23.31% and 20.55% of the respondents strongly agreed and agreed, respectively, that they are willing to stop the overharvesting of trees, while 23.56% and 32.58% disagreed and strongly disagreed, respectively. 16.29% and 20.05% strongly agreed and agreed that they are willing to welcome the ideal of conserving trees, while 31.33% and 32.33% disagreed and strongly disagreed, respectively. 40.85% and 44.61% strongly agreed and agreed, respectively, that they are willing to participate in forest conservation, while 11.03% and 3.51% disagree and strongly disagree, respectively. 37.59% and 34.59% strongly agreed and agreed, respectively, that they are willing to replace the harvested trees by planting new ones, while 9.52% and 18.30% disagree and strongly disagree, respectively. 12.03% and 39.85% strongly agreed and agreed, respectively, to indicate their willingness to accept sustainable harvesting measures and practices. 37.59% and 10.53% disagree and strongly disagree, respectively.

Despite their strong interest in forest protection, the respondents were unwilling to give up on the harvesting of some tree species. To ensure the long-term use of tree species, this necessitates the development and execution of sustainable harvesting and forest management initiatives, such as awareness campaigns, afforestation, agroforestry, and silvicultural techniques. Forest Stewardship Council (2024) and Brodie *et al.* (2016), reported that sustainable forest harvesting practices balance the needs of society with the long-term health of the forest.

Table 7: Measures to Control the Implications of Tree Species Harvesting in the Study Area

Statement	SA (%)	A (%)	D (%)	SD (%)
Willingness to stop over harvesting of trees	93 (23.31)	82 (20.55)	94 (23.56)	130 (32.58)
Willingness to welcome the ideal of conserving trees	65 (16.29)	80 (20.05)	125 (31.33)	129 (32.33)
Willingness to participate in forest conservation	163 (40.85)	178 (44.61)	44 (11.03)	14 (3.51)
Willingness to replace the harvested trees by planting new ones	150 (37.59)	138 (34.59)	38 (9.52)	73 (18.30)
Willingness to accept sustainable harvesting measure and practices	48 (12.03)	159 (39.85)	150 (37.59)	42 (10.53)

CONCLUSION

Karim Lamido LGA of Taraba State has experienced substantial pressure from the growing human population, which has led to a decline in the number of important tree species like *Prosopis africana, Parkia biglobosa* and *Strychnos spinosa*. Tree species have undergone tremendous changes as a result of the increasing demands for food, medicine, fuel, and fiber, which have been exacerbated by overharvesting and premature harvesting, outweighing the sustainable harvesting. The activities of unsustainable tree harvesting have posed negative impacts on the forest ecosystem of Karim Lamido LGA. Forest cover reduction, biodiversity loss, ecological imbalance, soil compaction, soil erosion, flooding, desert encroachment, and hydrological cycle disruption are some of these impacts.

Sustainable tree harvesting is therefore not only necessary for conservation of plant biodiversity, but also for the livelihoods of many rural peoples. The respondents were not willing to stop harvesting tree species in the study area. This may be connected to the livelihood support, provided by these resources. Majority of the respondents were not ready to embrace tree species conservation strategies. However, they were ready to participate in conservation programmes such as awareness campaigns, forest policy formulation and implementation. Since the majority of the population in the study area is ready to accept all types of sustainable harvesting techniques and practices, it follows that effective education and awareness campaigns will persuade the people to recognize the need to maintain forest resources. Education, an aggressive reforestation strategy, active agroforestry and silvicultural practices,

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and sustainable tree species exploitation should all be prioritized as part of increased efforts.

RECOMMENDATIONS

Concerned stakeholders should provide alternative sources of livelihood that will meet the growing demands of forest dependent communities. Appropriate environmental monitoring programmes should be adopted to checkmate, evaluate, and assess the impacts of forest harvesting and deforestation on the environment. Awareness campaigns should be organized to educate the local population on the need for sustainable harvesting and forestry practices, including silvicultural and agroforestry programmes.

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