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Towards Mitigating The Impacts Of Fuelwood Extraction In Yabo LGA Of Sokoto State: The Role Of Agroforestry

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ABSTRACT
This study assessed the role of agroforestry in mitigating the impacts of fuelwood extraction in Yabo local government area of Sokoto state. Quantitative technique was employed for the study hence the data was sourced largely from questionnaire administered on households. The sample size of the study area was 60 respondents covering the 5 sampled wards namely; Bengaje, Dagawa, Fakka, Kilgori and Yabo A. In the second stage, one (1) area was selected from each of the ward, Bengaje, Dagawa, Gudurega, Kilgori and Yabo. For the third stage, ten (12) respondents were selected from each of the area. This gave a total of 60 respondents. All respondents were selected using systematic random sampling. The findings of the study indicated that, there is a strong relationship between agroforestry and reduction of the impacts of fuelwood. However, despite its role, agroforestry adoption among the farmers in the study area was very low, as the adoption rate of agroforestry was 31.7% only while not yet adopted was 68.3%. Also majority of respondents 78.3% indicated fuelwood as their only source of energy, Charcoal 13.3% and only 8.4% are using LPG. It was found out socioeconomic status of individuals was largely the main factor responsible for the high utilization and exploitation of fuelwood as the only source of energy. The study recommends that there is need for government and other relevant NGOs to provide other alternative sources of energy as accessible, at a relatively cheaper and affordable rate. Equally there is need for mass mobilization/ enlightenment on the dangers of deforestation, importance of afforestation and adoption of agroforestry practices as one of the sustainable land management practices in the area.
Keywords: Agroforestry**,** Fuelwood, Mitigation and Household

1.1 INTRODUCTION

With increase in human population, the vegetation of the area started to diminish as a result of demand for fuelwood, land for farming and other forms of land use. These demands on vegetation as well as conversions for alternative human use results in environmental degradation and climate change challenges. People depending on fuelwood as sole energy source are most vulnerable to the effects of environmental degradation and climate change, since their lack of economic resources restricts them to depend only on fuelwood (Ntshangase *et al.* 2021). In sub-Saharan Africa, massive deforestation caused soil depletion and climate change. (Tamirat, W and Mekides, A 2020). Coupled with high demand for more intensive agriculture, land is always needed for one form of agricultural activity or the other thereby putting pressures on available vegetation, this is because earlier used methods of farming, like shifting

cultivation which allows for vegetation re-generation are no longer in use, hence there is a lower fuelwood than before (Garrity, 2022). There is a serious need for sustainable agroforestry practices that can address these issues. Agroforestry is a sustainable land management system that integrates trees, crops, and livestock on the same piece of land to maximize the benefits and productivity of the overall farming system. This integration has been recognized by Nair (2019) and Tamale et al. (2021) as one of the best traditional practices for livelihood sustainability, appropriate land management, and fostering sustainable development (Josep, et al., 2017). Understanding the intensive farming arrangement is crucial for maintaining a sustainable agricultural production system and addressing forest deprivation (Wang et al., 2022). Agroforestry, as documented by Koyejo et al. (2023), emerges as a multifaceted approach capable of enhancing agricultural system sustainability, preventing environmental degradation, enhancing agricultural productivity, increasing carbon sequestration, purifying water sources, and nurturing soil health and robust ecosystems while gaining stable incomes. Traditionally, agroforestry systems generate a wide collection of products from a compact land unit, including timber, fuel-wood, leaf litter, fruits, vegetables, among others, thereby meeting household needs and creating income opportunities for smallholder farmers (Obadimu et al, 2020). Agroforestry, with its capacity to improve agricultural land use systems and creates enduring benefits while minimizing adverse environmental consequences at local and global levels and at the same time emerges as a pivotal strategy (Sanou, et al., 2019). Its role in fulfilling daily needs, such as fodder, fuel-wood, and dietary supplements from fruit bearing trees, emphasizes its multifaceted offerings to rural livelihoods (Trabucco et al., 2020).

Tree-based systems are less risky and more profitable because they have multiple products and are less likely to be affected by pests (Garrity, 2022). In recent years, agricultural land has degraded due to natural dangers such as landslides, erosion, earthquakes, flooding, and deforestation among others. Agroforestry can function as reclamation and a method of land development in various locations since forests and crops can be managed simultaneously, ensuring the system's sustainability as well as its contribution to household livelihoods (fuel, fodder and fruits). Trees in agroforestry aid in carbon segregation and have the potential to help mitigate climate change. Agroforestry, as a biodiversity-friendly land use system, also contributes to the creation of wildlife corridors and connectivity (Tokede et al., 2020). As a result, it has the potential to protect the endangered species, grow commercial and systemic agroforestry in such lands, so adding to the income and livelihood of millions of farmers.

There are growing concerns worldwide that the growth of human population, the emissions of greenhouse gases from industrialization processes coupled with the unsustainable modes of resource exploitation will lead to the depletion and unavoidable extermination of the available renewable and non-renewable earth resources. Man from time immemorial has interacted negatively with his environment through his insatiable quest for food, shelter, energy and clothing. This has resulted to environmental problems such as deforestation, desertification and pollution of various types and magnitude on global, national and regional scales. In Yabo Local Government Area, of Sokoto State and indeed the entire state there was excessive pressure on natural resources, biodiversity and forest products are unsustainably used and dependence on these resources for livelihood and as source of income is the tradition. Most people in rural areas depend on fuel wood as the only source of energy for domestic uses (Bello, 2012).

As population increases, extraction increases until there are no vegetation/trees left to harvest, however the fuel wood extraction is usually done in an unsustainable manner where trees are cut down indiscriminately. The most affected species in the study area include; *Ceiba pentandra (Rini), Tamarindus indica (Tsamiya), Combretum nigricans (Tsiriri), Khaya senegalensis (Madacci), Aristida mutabilis (Dashi), Anogeissus leiocarpus (Marke), Diospyros mespiliformis (Kaiwa), Ximenia americana (Tsada), Prosopis africana (Kirya), Boscia angustifolia (Suruje),* (Dangulla, 2013), to mention just a few are all under threat as they are being unsustainably exploited for fuel wood and for different end uses (such as in herbal medicine, dyeing and building).Wood biomass from forest is the major source of domestic energy in most of developing countries. Equally fuel wood is usually collected from bush or outskirts while many people resort to purchase of the said commodity. The fuel need is also supplemented

by the use of charcoal in most of the household in the study area. This human activity affects the vegetation of the area negatively.

1.2 Statement of the Research Problem

Yabo local government area, like many other local governments areas in the states, is facing the impacts of climate change, including erratic rainfall patterns, increased temperatures, and extreme weather events. These were primarily caused by anthropogenic activities chiefly among them is fuelwood extraction. Majority of people in the study area rely heavily on fuelwood as the ultimate source of energy available for their domestic cooking needs. This was due to the socioeconomic levels of majority of inhabitant of the area. Agroforestry has the potential to enhance the resilience of tree based resources to respond to these climate-related challenges, by providing the needed fuelwood for domestic uses. Agroforestry play a crucial role in ensuring the supply of needed fuelwood in a sustainable manner through systematic pruning of tree branches and sustained planting of fuel-production trees within the locality. Despite its numerous benefits agroforestry often face numerous challenges, including limited access to land, access to good seedlings, poor extension services and market constraints. By studying the role of agroforestry in mitigating the impacts of fuelwood in the study area, it is possible to explore how agroforestry can be upscale to ensure sustained production of fuelwood. Understanding the role of agroforestry in mitigating the impacts of fuelwood extraction will help policy and decision-making processes to formulate policy decisions aimed at promoting agroforestry in the area.

1.3 Research questions

This study is guided by the following research questions:

- Are there other sources of energy in the study area?
- What are the types of agroforestry being practiced in the study area?
- What are the factors affecting adoption of agroforestry practices in the study area?

1.4 Aim and Objectives

The aim of this study is to identify the role of agroforestry in mitigating the impacts of fuelwood extraction in Yabo LGA of Sokoto state. The following specific objectives are to;

i. Identify other sources of energy in the study area.
ii. Evaluate the types of agroforestry being practiced in the study area.
iii. Identify the challenges of agroforestry adoption in the study area.

1.5 Significance of the Study

Trees are a very important component of the ecosystem because of their role as carbon sink, fuelwood, conservation of biodiversity, soil formation and protection, as well as facilitation of the earth's geo-chemical cycles. Deforestation of trees therefore, affects man both directly and indirectly as the energy needs of majority of people in the study area are obtained from trees and shrubs. Similarly some trees species provide fruits and fodder for man and animal feeds respectively, others provide shelter and medicines. But despite the above uses of trees they are currently over exploited mostly for fuelwood, this unsustainable exploitation of trees species adversely affected the supply chain of fuelwood in the study area, hence there is need for the adoption of agroforestry practices more especially in the area of silvo-culture (trees component of agroforestry) in order to ensure sustain supply of fuelwood in the study area. This study therefore is important to policy makers and academicians as well as non-governmental organizations as it is an attempt to unravel the state of deforestation in the study area and the role of agroforestry in mitigating the impacts. It will also propose correctional measures that will be used in solving the problem and initiating further studies.

1.6 Scope of the Study

Fuelwood extraction is one of the most pressing environmental issues in the study area which lead to a number of environmental disasters more especially in arid and semiarid regions where the study area is located. This study intends to identify the role of agroforestry in mitigating the impacts of fuelwood extraction in Yabo LGA of Sokoto state. A relatively small area is chosen for effective analysis of the fuelwood extraction as well as the role of agroforestry in mitigating the impact in the study area.

STUDY AREA AND RESEARCH METHODS

The Study Area

The study area (Yabo Local Government Area of Sokoto State) lies between latitudes $12^0$56'25"N and $12^0$55'47''N and longitudes $4^0$48'33''E and $5^0$08'16''E. It has a total land area of 789 km^2 and a population of 115,011 according to the 2006 census. The area is geologically located in the Taloka formation belonging to the broad cretaceous Rima group which is part of the extensive Sokoto basin (Kogbe, 1979). The Taloka formation has a maximum thickness of 180m and consists of fine to coarse sand, silty sands, shales and sandstones with many layers of clay/shale within the latter (Bello, 2012).

The climate of the area is that of sudano-sahelian ecological zone which is semi-arid types characterized by three distinct seasons - the cool, dry; the hot, dry and hot, wet. Temperature in the area ranges from 22^0C to 40^0Cs. Rainfall with emphasis to the annual totals, incidence and distribution is highly variable from year to year. The mean annual rainfall is 814.33mm (Sokoto State Government, 2004). Vegetation of the area is mostly the short feathery grasses with some trees and other woody species most of which are deciduous, dotting the area. The pattern of vegetation distribution is to a large extent, influenced by human activities though physical factors may assume local importance.

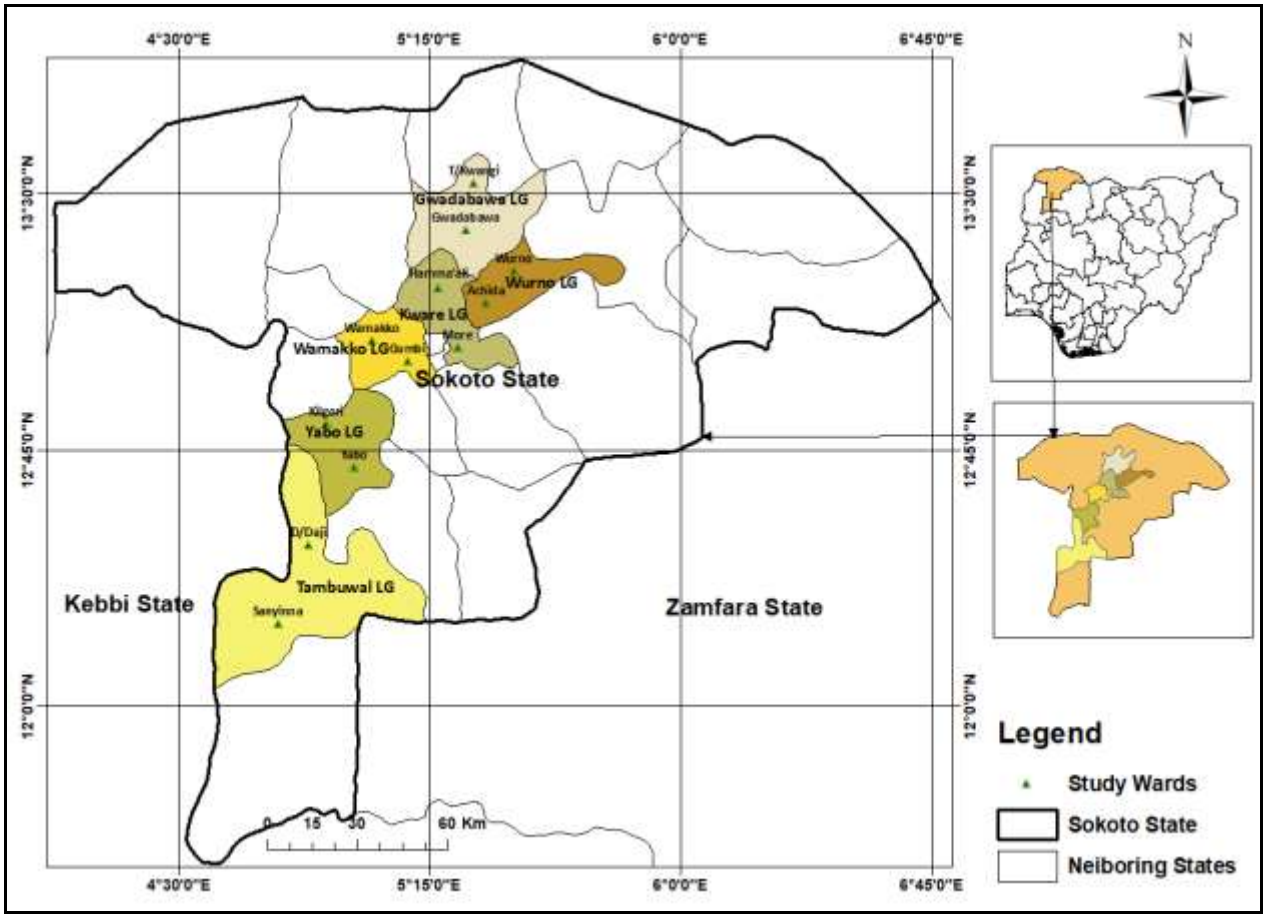

Figure 2: Map of Sokoto state showing study wards
Source: GIS Lab UDUS (2024)

Kilgori, Torankawa, Yabo A and Yabo B. It is bounded to the north by Bodinga local government area, to the east by Shagari local government area to the south by Tambuwal local government area and to the west by Silame local government area.

Methods of data collection and sampling techniques

Data for this study was collected with the aid of a structured questionnaire administered to farmers in Yabo Local Government Area. Multi-stage sampling technique was employed in selecting the respondents in the study area. In the first stage, five (5) wards were randomly selected: Bengaje, Dagawa, Fakka, Kilgori and Yabo A In the second stage, one (1) area was selected from each of the ward, Bengaje, Dagawa, Gudurega, Kilgori and Yabo. For the third stage, ten (12) respondents were selected from each of the area. This gave a total of 60 respondents.

Analytical techniques

Data obtained were analyzed using descriptive and inferential statistics techniques. Simple frequency distribution and percentages was used to describe the demographic and socioeconomic characteristics the respondents as well as to find out the source(s) of energy used and also examine the knowledge and attitude of respondents on agroforestry in the area. Coefficient correlation was used to show the relationship between agroforestry and fuelwood extraction at 0.01 level of significance.

RESULTS AND DISCUSSION

Demographic characteristics of respondents

A total of 60 residents from various wards in Yabo local government area filled and returned the questionnaire and they are used for analysis. Demographic details of the respondents are presented in table 1: below which clearly shown that majority (55%) of the respondents are females while the remaining (45%) are males. 40% are less than 30 years of age, 32% are between 31and 40 while 28% are between 41 years and above. 22% of the respondents had no formal education, 44% had primary education, 18% had secondary education while 16% had tertiary education. Majority (56%) are single while the minority (44%) are married. 86% of the respondents used fuelwood as the only source of energy while 14% are combining fuelwood with other sources of energy.

Table 1: Demographic characteristics of the respondents

Variables	Description	Frequency	Percentage (%)
Gender	Male	27	45
	Female	33	55
Age Range (Years)	< 30	32	53.4
	31 and 40	17	28.3
	41 and above	11	18.3
Educational Status	Non formal	19	31.6
	Primary	24	40
	Secondary	17	28.4
Marital Status	Single	39	65
	Married	21	35

***Source**: Computations from Fieldwork (2025)*

Table 2: below revealed the status of adoption of agroforestry practices by respondents in Yabo LGA of Sokoto state. The result of the findings showed that just 19 (31.7%) of the respondents are involved while the rest 41 (68.3%) are not involved. The implication is that majority of the respondents are not into agroforestry practices, this could have negative impacts on the sustainability of fuelwood production in the area. The result of this study supported the findings of Tokode et al., 2020 and Trabucco, et al., 2020 which revealed that despite the great potential of agroforestry practices in the production of fuelwood and other tree-based resources the adoption rate among people in Nigeria remain low

Table 2: Agroforestry status of respondents

Status of Agroforestry Practice	Frequency	Percentage (%)
Involved	19	31.7
Not yet involved	41	68.3
Total	**60**	**100**

***Source**: Computations from Fieldwork (2025)*

Table 3: Type of Agroforestry Practiced

Type of Agroforestry Practice	Frequency	Percentage (%)
Agrosilvicultural	29	48
Silvo-pastoral	22	37
Agro-Silvopastoral	9	15
Total	**60**	**100**

***Source**: Computations from Fieldwork (2025)*

Table 3 above indicated the types of agroforestry being practiced by the farmers in the area, 45% of respondents that makes up the majority practiced Agrosilvicultural (Crops and Trees) type of agroforestry, where farmers cultivate crops and trees on the same piece of land. Trees grown alongside crops were mostly economic trees such as Mango, Cashew, Moringa, Locust, and Baobab among others. 37% of respondents revealed that they practiced Silvo-pastoral (Trees and Animals) on the same piece of land, this is found mostly in rural nomadic settlements around Bengaje and Kilgori. Lastly, 15% are into Agro-Silvopastoral (Crops, Trees and Animals) type of agroforestry. This was found mostly farm houses located in Yabo "A" ward where some rich farmers established farm houses where poultry and dairy farming is practiced, economic trees are grown in addition to conventional agriculture. They are minority because the type requires more funding and technical knowhow than the other types.

Table 4: Sources of energy available

Variables	Frequency	Percentage (%)
Fuelwood	47	78.3
Charcoal	08	13.3
Cooking Gas (LPG)	05	8.4
Total	**60**	**100**

***Source**: Computations from Fieldwork (2025)*

Table 4: above show the sources of energy being used by the respondents, it was revealed that majority of respondents (78.3%) used fuelwood as the only source of energy, those that used charcoal account for (13.3%) while those that used cooking gas (LPG) were (8.4%). Those that used fuelwood as their only source of energy cited affordability of the products as their main reason for its high usage among the majority of household. This was because majority of them obtained the fuelwood from by themselves, through their children or from vendors at a relatively cheaper rate compared to other sources. Unlike fuelwood, charcoal is usually used by small sized households, due to their small number the quantity of

food to be cooked is small and thus required little time and energy than those with large family size. Regarding the use of LPG in the study area, only 9% of respondents used it as energy source. This was as result of the level of socio-economic prosperity of the people in the area, as majority of them are poor who couldn't afford to be buying LPG for their domestic cooking.

Table 5: Perceptions of respondents towards Agroforestry

Variable	Strongly Agree	Agree	Disagree
Agroforestry help people self-reliant In terms of fuelwood production	31 (52%)	20 (33%)	9 (15%)
Agroforestry benefits are more than just agriculture	30 (50%)	23 (38%)	7 (12%)
Agroforestry is capable of improving economic conditions of farmers	30 (50%)	26 (43%)	4 (7%)

***Source**: Computations from Fieldwork (2025)*

The result presented in table 5 above show the perception of respondents towards agroforestry adoption in the area. 85% of respondents believed strongly that agroforestry help people to be self-reliant in terms of fuelwood production, this means people can easily prune trees in order to obtain fuelwood and at the same time allow trees to make new leaves. Similarly agroforestry has multiple benefits than merely an agricultural activity, this was the assertion of the majority of respondents which make a total of 88%. In terms of economic benefits, most respondents believed that growing trees alongside crops and animals is profitable. Because a farmer can always sell fruits obtained from economic trees such as; Mango, Cashew, Guava, Date among others, this was the opinion of 93% of respondents.

Table 6: a summary of Correlation coefficient (r) tables of the significant relationship between agroforestry practice and fuelwood production

variable	Coefficient correlation	P-Value	Decision
Agroforestry practice and Fuelwood production	-0.387	0.005*	Significant

***Source**: Analysis of field study (2025). *Correlation is significant at 0.01*

The table 6 above revealed that there is significant relationship between agroforestry practice and fuelwood production in the study area, where a correlation coefficient (r) value is -0.387 and significant value is 0.005 (P> 0.01). This clearly shows that there is positive correlation between agroforestry practice and fuelwood production in the study area.

CONCLUSION

Despite the numerous advantages of agroforestry, more especially in the area of fuelwood production, majority of respondents do not practice it. This means that adoption and practice of agroforestry in Yabo LGA is very low. This could be attributed to in adequate extension services, lack of knowledge of agroforestry and farmers unwillingness to practice it due to time taken to reap the benefits of tree components of the agroforestry practice. Hence there is need for strong advocacy and sensitization of farmers and the general public on the importance of agroforestry not only in fuelwood production but also in agricultural diversification and climate change mitigation among others. This makes it imperatives for the involvement of major stakeholders in advancing the agroforestry practices in the study area and the provision of sustainable energy. Finally, the study found out that there is significant relationship between agroforestry practice and fuelwood production, this implies that there is need to engage farmers to adopt agroforestry practice as it guarantee sustainable fuel supply through systematic pruning of trees.

RECOMMENDATIONS

1. There need to intensify extension services across the study area and the state in general, this is because majority of respondents have little or no knowledge of agroforestry hence its adoption and possible practice is very low
2. Other alternative sources of energy such as Kerosene and Cooking Gas (LPG) should be made available and affordable to the indigent people more especially in rural areas. This is in addition to the use of energy saving stoves that burn less fuel.
3. Provision and distribution of free improved seedlings by government agencies and relevant NGOs in order to boost agroforestry activities and encourage people to embrace the culture of tree planting.
4. Advocacy on the eminent dangers of climate change and global warming
5. Enforcement of laws that prohibits illegal removal trees

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