ECONOMIC CONTRIBUTION OF NON-TIMBER FOREST PRODUCTS AND PLANT DIVERSITY TO RURAL LIVEHOODS IN MAYO-BELWA

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Abstract. Among the provisioning services are the non-timber forest products which include fruits, leaves, and medicinal plants honey etc., that have continued to benefit the rural populace. However, the full potential of these products to support local economies and promote sustainable forest management has not been fully integrated into development planning. Multi-stage and systematic sampling techniques were used for this study. Results obtained revealed that majority (86%) of the respondents living close to Gongoshi grazing reserve were males having a mean age of 39 years, mean household size of 8 individuals and were mostly (63.2%) married. The mean monthly income was N16,959 where majority (89.3%) of them lives on less than USD 1 (N1,511). The results further showed that sales of NTFPs were the major (43.5%) contributor to the total household income. Analysis of Variance (ANOVA) result revealed a significant relationship $P < 0.01$ among the various sources of income. Regression analysis on the influence of socio-economic attributes of respondents in the study area on total household income also revealed that age , education, occupation were all significant at $P < 0.01$ while marital status was not significant $P > 0.005$. Simpson 's Diversity Index was 0.896 hence the need for proper training of the people on value addition, processing, storage in addition to sustainable harvesting and conservation of the forest resources particularly the Non- Timber Forest Products.
Keywords: *economic impact, non-timber forest products, plant diversity, rural livelihood*

Introduction

Forests provide a wide range of provisioning, cultural, regulating and supporting services, among these provisioning services are the Non-Timber Forest Products (NTFPs), which include fruits, nuts, leaves, herbs, resins, honey, medicinal plants among others. These products are harvested from harvested from natural or managed forests and play a critical role in rural livelihoods and sustainable forest management. NTFPs contribute significantly to the socio-economic wellbeing of forest-dependent communities, especially in tropical regions like Nigeria (Arowosoge and Popoola, 2020). They serve as important sources of income, nutrition, and medicine, especially for populations living in or near forests. NTFPs are considered to be vital for sustaining rural livelihoods, reducing poverty, biodiversity conservation and facilating rural economic growth (Maske et al., 2011). The NTFPs provide the products such as food, shelter, medicines, fibres, energy and cultural artefect for many of the world's poorest people and a considerable proportion of the less poor (Saha and Sundriyal, 2012). In a

related study that over 500 million people in India are dependent on NTFPs for their subsistence and cash income. On the average, forest resources make up about 39% of the livelihoods of rural populations in Nigeria (Onyekuru and Marchant, 2014). The income from the sale of the NTFPs from households living in and around forest constitutes 40 to 60% of their total income (Nayak et al., 2014). It is estimated that about one (1) billion of the world's poorest people rely in one way or another on forests for livelihoods (Agrawal et al., 2013). NTFPs has continued to play a significant role in improving the livelihoods as well as meeting the basic needs especially food, medicine, poverty reduction etc. of the rural communities.

Forest product activities (Collection, processing and marketing of NTFPs) offer employment and generate income for millions of rural and urban poor worldwide. These activities provide additional income to rural households including forest and urban dwellers who do not have jobs (Aiyeloja and Oyebade, 2011). In the rural areas some forest products are collected and processed into vegetable oil, chewing stick, soap, charcoal etc. and sold for income (Osemeobo, 2000). Duong (2022) reported in a similar study that forest-based activities in developing countries like Nigeria mostly in the area of NTFPs, provide an equivalent of Seventeen (17) million full-time job in formal sector and another thirty (30) million in the informal sector as well as 13 – 35% of all rural off-farm employment. Forest products collected daily accounted for 94% of total income of 36% of rural population in Southern Nigeria (Nwaze and Kure, 2000). Harvesting and marketing of bush meat and snails are common income generating activities in the Eastern and Western part of Nigeria while in the Savannah area, honey, fuelwood, locust bean seed, gum arabic, and charcoal production generate a lot of income to the rural inhabitants (Onuche, 2011).

The collection and trade of NTFPs represent a key source of income for rural households and improve their overall livelihoods. These products are often sold in local markets and contribute to household food security and employment, especially among women and youths (Odeyemi et al., 2023). The value chains associated with NTFPs support various actors, including harvesters, traders, and traditional healers. According to Ibrahim et al. (2022), the trade of NTFPs can sometimes exceed the income derived from subsistence farming. Hence, their role in local economies is quite significant. The various contribution of these NTFPs to economic well-being of the people is no doubt enormous and they can serve as useful tool in bringing development to rural economics. Diversity of plants are fundamental to total forest diversity. Through knowing of plant diversity, data needed are generated for its sustainable conservation and protection (James et al., 2018). Knowing plant diversity of the forest area is imperative to gauge if the forest has coped with the various environmental pressures and the capacity of the species to regenerate naturally (Patrick et al., 2022).

Recently, there is a growing interest globally in the sustainable use of NTFPs as alternatives to timber extraction to prevent deforestation and biodiversity loss. Sustainable NTFPs utilization allows communities to earn income while preserving forest ecosystems, contributing to the goals of conservation and poverty alleviation (FAO, 2022). Ikurekang et al. (2009) reported that the principle of forest sustainability must be upheld if our available vegetation must serve the current population in Mayo-belwa Local Government Area. This practice is increasingly gaining attention as communities strive to balance economic survival with environmental sustainability. However, challenges such as overharvesting, lack of market access, poor value addition, and inadequate government support hinder the full potential of the NTFP sector and has

continued to persist (Ibrahim and Musa, 2023). These issues have limited the scale and impact of NTFPs in regional development planning. Moreover, limited empirical data on the contribution of NTFPs to the local economy creates a knowledge gap for policy makers and development agencies. Therefore, a deeper understanding of the economic impact of NTFPs and plant diversity on rural livelihood improvement will help rural and even urban inhabitants appreciate and conserve forest sustainably.

Materials and Methods

Study area

Location

Adamawa State is located at the North Eastern part of Nigeria. It was created from the defunct Gongola State and since been one of the thirty-six (36) states which presently constitute the Federal Republic of Nigeria. The state is one of the largest Nigeria State in terms of Landmass. Adamawa State lies between latitude 70 and 110N of the equator and longitude 110 and 140E of the Greenwich Meridian. The total land area covered by the state is approximately 38,741 square kilometers. It is bounded to the North by Borno State, West by Gombe State, South by Taraba State and to the East by the Cameroon Republic (Anderson, 2012). It is divided into 21 Local Government Areas. It has a population of about 3,168,101 (National Bureau of Statistics [NBS], 2007). The major occupations of the people in Adamawa State are farming, fishing and livestock rearing as well as commercial activities.

Geology

The geology of Mayo-belwa Local Government Area (LGA) in Adamawa State is characterized by predominantly sedimentary rock formations. The area is primarily made up of sandstones, shales, and limestone, with some pockets of basalt from volcanic activity in the region. These geological formations contribute to the area's rich soil, which supports agricultural activities, particularly in farming and livestock rearing. The Mayo-Belwa River, which flows through the LGA, is influenced by the underlying geology, helping to sustain the area's agriculture. The region's geological structure also affects its water table, with some areas experiencing challenges with groundwater accessibility (Oduh et al., 2022).

Climate

Mayo-belwa Local Government Area (LGA) in Adamawa State, Nigeria, experiences a tropical savanna climate characterized by distinct wet and dry seasons. The rainy season typically spans from May to September, with July and August being the peak months, receiving an average of 141 mm and 970 mm of precipitation, respectively. In contrast, the dry season occurs from November to April, with January, February, and December being the driest months, averaging 0 mm of precipitation. Annual rainfall totals approximately 475 mm, with about 82 rainy days per year. Average temperatures range between 25°C and 33°C, with the warmest months being March, April, and May, where daily mean temperatures range from 31°C to 33°C. Humidity levels are highest during the rainy season.

Soil and vegetation

Soils in the area are predominantly brown or brownish-red laterites, rich in iron and aluminum, resulting in hardpans near the surface due to oxidation. Vegetation is primarily savanna, with grass cover being dominant, interspersed with patches of woodland and forested areas, particularly along river valleys. Some of the tree species in the study area are Parkia biglobosa (African locust bean), Vitellaria paradoxa (shea butter tree), Detarium microcarpum (detar tree), Tamarindus indica (tamarind), Adansonia digitata (baobab) Anogeissus leiocarpus among others. These trees are ecologically and economically important, providing non-timber forest products (NTFPs) such as fruits, nuts, seeds, gums, and leaves, which significantly contribute to household food security, traditional medicine, and rural livelihoods in Mayo-belwa and surrounding areas (Ibrahim et al., 2022; Bello et al., 2021).

Study location

The study was carried out in Mayo-belwa Local Government Area, located in the southern part of Adamawa State, Northeastern Nigeria. It lies approximately between latitudes 8°40'N and 9°00'N and longitudes 12°00'E and 12°30'E. The area covers about 2,368 km² and lies within the Guinea Savanna ecological zone, characterized by a tropical wet and dry climate with distinct rainy and dry seasons. Mayo-belwa shares boundaries with Taraba State to the west and is drained by tributaries of the Benue River, which supports fertile soils and vegetation suitable for agriculture, livestock rearing, and non-timber forest product (NTFP) harvesting. These ecological and socio-economic features make Mayo-belwa an important site for research on rural livelihoods and resource utilization.

Gongoshi grazing reserve

Gongoshi Grazing Reserve, one of the 32 officially designated grazing reserves in Adamawa State, spans approximately 9,600 hectares within Mayo-belwa Local Government Area and serves as a vital component in local livestock and rural economy systems. The Federal Government has recently committed to revamping the reserve to enhance its grazing potential and overall utility. The reserve's size and strategic importance underscore its capacity to accommodate large herds and support structured ranching and non-timber forest product activities, making it a key site for studying resource use, ecological sustainability, and livelihood diversification in the region.

Sampling procedure

Multi stage sampling technique was used. In the first stage, four (4) wards namely Mayo-belwa, Mayo-farang, Bajama and Binyeri were purposively selected out of the twelve (12) existing wards in Mayo-belwa LGA located around Gongoshi grazing reserve. This was due to there closeness to the reserve as well as high number of forest dependent communities in the wards selected. In the second stage, two villages each from the wards was purposively selected. These villages namely Garu, Binkola, Wuro-Bantere, Gigaro, Bumbun, Alkali Manga, Gembe and Tola were selected due to their high dependency on non-timber forest products from the reserve. They were considered to have more access to the reserve where people extract NTFPs for sales and consumptions. A total of eight (8) villages was selected for this research. The total

sample size (questionnaires) was calculated by using Yamenes formula as adopted by Asfew and Zergwa (2022).

$$n = \frac{N}{(1+N\ (e)^2)} \qquad \text{Eq. (1)}$$

Where; n = sample size (questionnaires); N = total number of Population; e = level of precision (0.05). The total sample size (n) was 385, however due to the variation in number of population size, the equal proportional sample size was determined in distributing the sample size (questionnaires) proportionately in the eight villages by using Cochran formula as adopted by Asfew and Zergwa (2022).

$$N_h = n \text{ x } \frac{N_h}{N} \qquad \text{Eq. (2)}$$

Where; Nh = number of populations in each village; n = total number of questionnaires to be administered; N = total number of populations in all villages. *Table 1* indicate the distribution of sample size in the study area.

Table 1. *Distribution of sample size in the study area.*

S/N	Wards	Villages	Sample Frame	Sample Size
1	Mayo-Belwa	Garu	913	35
		Binkola	1172	45
2	Mayo-Farang	Wuro Bantare	2101	80
		Gigaro	1730	66
3	Bajama	Bubum	1301	50
		Alkali Manga	709	27
4	Binyeri	Gembe	630	24
		Tola	1532	58
Total			10,088	385

Data collection

Data was collected with the help of structured questionnaire designed in a way to capture data on socio-economic attributes of respondents, commonly harvested non-timber forest products, contribution of some non-timber forest products to total household income and profitability of marketing NTFPs. The questionnaires were administered to the respondents by the researcher and a research assistant familiar with the selected villages. Before administering the questionnaires, a preliminary survey were carried out, this was done in order to gather information on areas endowed with non-timber forest products, NTFPs available in those areas and in their markets, forest activities they engaged in among others. Based on this preliminary information, the researcher developed the questionnaire for further investigations.

Data analysis

Both descriptive and analytical (inferential) statistics were used for data analysis. Descriptive statistics including frequency, percentages, and tables were used in summarizing the contribution of NTFPs to total household income. Statistical Package for Social Sciences (SPSS) version 25.0 was used for data analysis.

Descriptive analysis of total household income

Total household income was computed as the sum of income of all people in a particular household. It includes forest incomes (proceeds from sales of fuelwood, honey, fruits, fodder, medicinal herbs, etc.) income from off-farm action activities such as, employment (trading, tailoring, carpentery, etc.) formal employment (Salary and wages), Capital gains (money earned from interest on capital lent out and rent on building), remittances (money sent by children and relatives), and agricultural incomes (Proceeds from sales of livestock and crops) as reported. The mathematical computation is presented as follows:

$$THI = OFI + AI + FI \qquad \text{Eq. (3)}$$

Where; THI = Total Household Income; OFI = Off-Farm Income; AI = Agricultural Income; FI = Forest Income. The per capita daily household income was computed by taking per capital household monthly income divided by 31 days in a month. Analysis of variance (ANOVA) was also used in determining if there exists any significant difference among the three sources of households' income.

Multiple regression analysis

The multiple regression model was used in determining the influence of socio-economic attributes on the total household income. The model is as follows (Adedotun, 2024):

$$Y = a + b1 + X1 + b2 + X2 + b3\ X3 \ldots.\ bn\ Xn + \Sigma \qquad \text{Eq. (4)}$$

Where; Y = household income generated (dependent variable); a = intercept; b1, b2, b3 …..bn …. regression co-efficient; X1, X2, X3 ….Xn ….socio-economic characteristics (independent variables); Σ = error.

Gross margin

Gross Margin (GM) is the difference between the Total Revenue (TR) and the Total Variable Cost (TVC) of commodity. The formula is as follows:

$$GM = TR - TVC \qquad \text{Eq. (5)}$$

Where; GM = gross margin; TR = total revenue; TVC = total variable cost.

Diversity of plant species

Simpson's diversity index was employed for determining the diversity of plant species, as adopted by Saka et al. (2025). The formula is presented as follows:

$$D = 1 - \left(\frac{\Sigma_n(n-1)}{N(N-1)}\right) \qquad \text{Eq. (6)}$$

Where; D = Simpson's diversity index; n = total number of organisms of a particular species; N = total number of organisms of all species. Systematic Sampling was adopted

for the ecological aspect of this study. In Gongoshi grazing reserve, four (4) transects of 1km (1,000m) length was laid at an interval of 400m. In each transects, four square plots of 100 x 100m were laid alternately along each transect at 200m interval. In each sampled plot, identification and complete enumeration was carried out on plant species with diameter ≥10cm at breast height (Dbh). Plant species that could not be identified were collected and later taken to the herbarium in the department of Forestry and Wildlife Management, Modibbo Adama University for proper identification.

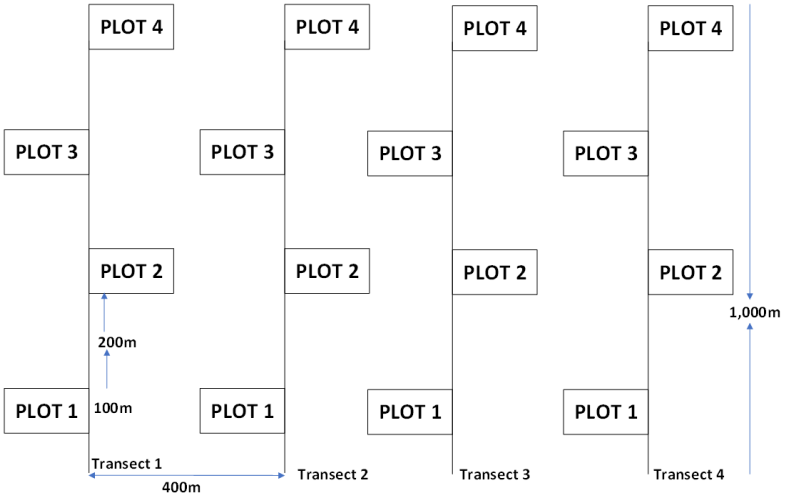

Figure 1. *Diagram showing sampling technique.*

Results and Discussion

Socio-economic attributes of respondents around Gongoshi grazing reserve

The socio-economic attributes of respondents living around Gongoshi grazing reserve presented in *Table 2* revealed that most respondents (223) were males having 57.9% while females had 42.1%. This shows that men were more involved in activities related to NTFPs extraction in the study area. This finding agrees THAT reported in a similar study that males (86%) are involved in activities related to extraction of NTFPs. However, this findings is in contrast with the result of Paneru (2024) who reported that majority (47.7%) of those involved in NTFPs related activity in the study area were females. Majority (32.7%) of sampled respondents were between the age of 29 – 39 years, followed by 26.5% between 40 – 50 years, 22.9% between 18 – 28 years and 17.9% were aged 51 years and above (*Table* 2). The mean age of the respondents in the study area was 39 years. This indicates that most of the respondents were within the active age groups, suggesting that most of the population engaged in NTFPs activities were young and energetic. This result conforms with that reported that majority (32%) of respondents are within the age group of 30 – 39 years having a mean age of 38 years. Paneru (2024) also reported in a related study that the presence of significant portion of young population within the age of 15 and 35 years in DadeIdhura district were engaged in NTFPs collection activities. Results from *Table 2* further reveals that most of the respondents 79.9% in the study area had primary, secondary and tertiary education while 20.2% did not attend conventional education system. This result agrees with the

findings of Paneru (2024) who reported in a related study that most of the respondents were educated. This implies that majority of respondents had basic to intermediate levels of education, hence this may influence the adoption of improved harvesting, marketing and conservation of NTFP species.

***Table 2**. Socio-economic attributes of respondents around Gongoshi grazing reserve.*

Variable	Category	Frequency	Percentage (%)
Gender	Male	223	57.9
	Female	162	42.1
Age Distribution(years)	18 – 28	88	22.9
	29 – 39	126	32.7
	40 – 50	102	26.5
	51 and Above	69	17.9
Education Qualification	No Formal Education	78	20.2
	Primary	109	28.3
	Secondary	133	34.5
	Tertiary	65	17.1
Marital Status	Married	243	63.2
	Singled	81	21.1
	Divorced	26	6.7
	Windowed	35	9.0
Main Occupation	Farmer	178	46.2
	Trader	71	18.4
	NTFPs Extraction	99	25.6
	Civil Servant	38	9.8
Household Size	1 – 3	50	13.0
	4 – 6	140	36.3
	7 – 9	119	30.9
	10 and Above	76	19.7
Household Income N/ Annually	< 100,000	88	22.9
	100,001 – 200,000	133	34.5
	200,001 – 300,000	102	26.5
	Above 300,000	62	16.1
Per Capital Daily Household Income (N)	< 500	109	28.3
	501 – 1,000	154	39.9
	1,001 – 1,500	81	21.1
	Above 1,500	41	10.7

Since majority of the respondents had formal education, the study area stands a better chance of accepting for conservation of trees in Gongoshi Grazing Reserve, so that they can continue to benefit from it. Awareness should be created among members of the communities on the dangers of over-exploitation of the resources (Adedotun, 2024). The marital status shows that most (63.2%) of the respondents were married having a household size of 4 – 6 persons (Table 2). This is an indication that NTFPs harvesting, marketing and utilization is more common among the married individuals as they put more pressure on collection of NTFPs from the reserve either as source of food or income to meet the demand of their household. This finding disagrees with the results of Paneru (2024) who reported that majority (32.4%) of the respondents involves in collection of NTFPs were unmarried. Farming was the main occupation of the respondents having 46.2%, this was followed by NTFPs extraction 25.6%, trading had 18.4% while 9.8% were Civil servant (Table 2). This finding reveals that the rural livelihoods in the study area are heavily dependent on agriculture and forest resources, specifically NTFPs. This result conforms to the findings. Who also reported that most of the respondents in the study area have farming and NTFs extraction as their main occupation. However, over-harvesting of medicinal plant species and fruits bearing trees can lead to decline in population and diversity of the area.

Majority of respondents earned within the income class of N100,001 – N200,000 annually. This income class has the highest frequency of 133 (34.5%) followed by those

within income class of N200,001 – N300,000 with the frequency of 102 (26.5%), 22.9% earned less than N100,000 while 16.1% earned above N300,000 (*Table 2*). The mean monthly income of respondents was N16,959. It was observed from the field survey that the income distribution of respondents in the study area falls within low to medium income categories where the per capita daily household income indicates that 89.3% of individuals in the interviewed household were living on less than USD 1(N1511) per day with a mean of USD 0.6 (N889) per person per household. This finding conforms with reported that 77% of individual in the study area were living on less than USD 1 per day. This finding further reveals that due to the fact that most respondent's falls within or below poverty threshold, access to basic needs such as medicine, food, may be limited and this may lead to an increase dependence on NTFPs from the grazing reserve for survival. This data further exposes crushing deprivation in basic necessities across Northern communities in Nigeria which resulted to heavy reliance on cooking fuel like wood and other forest resources especially NTFPs. The 2022 Multidimensional Poverty Index Survey report shows a staggering 65% of Nigeria's poor- about 86 million people live in Northeast zone of the country..

Contribution of NTFPs to households' income

Percentage contribution to household income by sources

The percentage contribution of sales of NTFPs, Agriculture and Off-farm activities incomes to total household income is shown in *Table 3*. The findings from this study reveals that communities close to Gongoshi Grazing Reserve benefits a lot from it and the reserve has become some sort of economic life wire that without it they might hardly survive. The NTFPs income (proceeds from sales of firewood fodder, fruits, honey, medicinal herbs etc.). accounts for 43.5% of the total household incomes in the study area, followed by agriculture 36.3% while Off-farm activities (Employments, tailoring, carpentry, Salary, Rent, etc.) account for 20.2%.This findings shows that NTFPs contribute very significantly to household income and is the economic back bone of all the communities living around Gongoshi Grazing Reserve. This may be due to the fact that extraction of NTFPs is less stressful and cost less compare to agriculture, and also the reason why women are also involved fully in it as indicated in *Table 2*. The findings from the study, also implies that NTFPs account for slightly more than one-third of the total household income in the study area. This finding conforms reported that NTFPs account for 30% of the total household income. Results from Table 3 further reveals that the contribution of off-farm activities recorded in the study area was low (20.2%), this indicates that income generated from them are not much and may not have any significant impact on the rural livelihoods. A related study that most rural off-farm income is low.

Table 3*. Contribution of different income sources to household income.*

Income Sources	Frequency	Percentage (%)
Sales of NTFPs	168	43.5
Agriculture	140	36.3
Off-farm Activities	77	20.2
Total	385	100.0

Mean difference of households' income by sources

Analysis of Variance (ANOVA) results on various sources (Sales of NTFPs, Agriculture, Off-farm activities) of household income was presented in *Table 4*. The results show an F-value of 6.82, that is statistically significant at 1% level ($P < 0.01$). This indicates that there are meaningful differences in the mean income contribution across the three sources of household income. The contribution of NTFPs is significantly higher than agriculture and off-farm activities, underscoring their central role in rural household economics. This finding conforms with reported in a related study that average income derived from sales of NTFPs were significantly higher ($p< 0.05$), than off-farm incomes.

***Table 4**. ANOVA results of households' income by sources.*

Source of Variation	Sum of Squares	Df	Mean Square	F-valve
Sources of income	18.27	2	9.14	6.82*
Error	511.42	382	1.34	
Total	529.69	384		

*Note: *Significant at 1%*

Influence of socio-economic attributes on total household income

Results from *Table 5* shows the regression analysis of socio-economic attributes of the respondents around Gongoshi Grazing Reserve on household income. The model was statistically significant $P < 0.001$, explaining 36.1% of the variance ($R2 = 0.361$) in household income. Gender has positive coefficient of 0.214 and was significant ($P < 0.05$), suggesting that male- headed households tend to earn slightly higher income than female headed households. Age also contributes positively (0.036) and is significantly $P < 0.01$, meaning that older respondents tend to have more stable income, likely due to experience and more access to resources. Education was significant $P < 0.01$, higher educational attainment improves income outcomes. Occupation of the respondents was highly significant $P < 0.01$, showing that engagement in economically viable activities increases earnings. However, marital status of the respondents was not significant $P > 0.005$, indicating that being married does not independently influence income. Household size has a negative coefficient of -0.142 and was significant $P < 0.05$, suggesting that larger families had reduce income due to higher dependency burden. This finding agrees also reported in a related study that gender of the respondents have a positive coefficient and was significant at 1%.

***Table 5**. Multiple regression analysis of socio-economic attributes on total household income.*

Variables	Coefficient	Standard error	t-value	Remark
Constant	2.317	0.418	5.54***	S
X1 (Gender)	0.214	0.089	2.40*	S
X2 (Age)	0.036	0.011	3.27**	S
X3 (Education)	0.178	0.052	3.42**	S
X4 (Marital Status)	0.095	0.073	1.30NS	NS
X5 (Occupation)	0.264	0.083	3.18**	S
X6 (Household Size)	-0.142	0.061	-2.33*	S
R2	0.361			
Adjusted R2	0.347			
F-Value	25.41			

*Note: *Significant at 5%; **Significant at 1%; ***Significant at 0.1%; NS not significant at 0.5%.*

Influence of some NTFPs activities on household income

The regression analysis of some NTFPs activities on household income presented in *Table 6* reveals that the household income is significantly influenced by some NTFPs related activities, explaining about 61% of the variation (R2 = 0.610) in rural household income. Engagement in NTFPs harvesting, type of NTFPs harvested and uses all showed positive coefficient of 0.298, 0.192 and 0.143. They were all significant at 0.1% and 5% respectively. On the other hand, challenges such as market fluctuations/ transport constraints and declining forest biodiversity have a negative coefficient of -0.176, -0.243 that all significantly affected household income. This underscores how environmental degradation and infrastructural limitations can erode the economic benefits from NTFPs. Labour type either family or hired was not significant P > 0.005, suggesting that whether households relied on family or hired labour, it does not substantially affect income levels. However, harvesting duration was significant P < 0.05, implying that households with longer harvesting experience earn more from NTFPs. It was clear from this research study that NTFPs significantly enhance rural household income in the study area, though their long-term contribution is at risk due to ecological and market related challenges. Nwosu and Udo (2023) reported in a related study that limited access to processing technologies and poor market infrastructure were key barriers to the commercialization of NTFPs. Therefore, improve processing technology can add value to raw products in addition to market and transport infrastructure towards maximizing the livelihood benefits of NTFPs.

Table 6*. Multiple regression analysis of NTFP activities influencing household income.*

Variables	Coefficient	Standard error	t-value	Remark
Constant	1.134	0.291	3.89***	S
X1 (Harvesting of NTFPs)	0.298	0.087	3.43***	S
X2 (Type of NTFPs)	0.192	0.076	2.53*	S
X3 (Uses of NTFPs)	0.143	0.071	2.01*	S
X4 (Engagement [Full/ Partial])	0.221	0.082	2.70**	S
X5 (Labour Type)	0.109	0.067	1.63NS	NS
X6 (Harvesting Duration)	0.134	0.064	2.09*	S
X7 (Challenges [Market/ Transport])	-0.176	0.071	-2.48*	S
X8 (Change in Forest Biodiversity)	-0.243	0.078	-3.12**	S
R2	0.610			
Adjusted R2	0.594			
F-Value	26.84			

*Note: *Significant at 5%; **Significant at 1%; ***Significant at 0.1%; NS not significant at 0.5%.*

Estimated profit and profit margin of some NTFPs obtained from Gongoshi grazing reserve

esults from *Table 7* shows that profits were realized from all the NTPFs obtained and sold in the study area. This findings has shown the important role played by NTFPs in the overall livelihood sustenance of the rural people. Herbs/ Medicinal plants have the highest profit margin of 28% followed by fuelwood 25%. This call for proper sustainable way of harvesting this plant resources so that they can be available for future generations. This finding agrees with the results reported in a related study that fuelwood has a profit margin of 33% in Vunoklang. The gross margin calculated was N550,870. By re-investing revenue generated from NTFPs obtained from the area, villagers around the reserve can improve their livelihood while still contributing to sustainable forest management and conservation.

***Table 7**. Estimated profit and profit margin of some NTFPs obtained from Gongoshi grazing reserve.*

Type of NTFPs	Quantity Obtained Monthly	Total Variable Cost	Total Revenue	Profit	Margin (%)
Fruits	203 Baskets	243,600	304,500	60,900	20
Herbs/ Medicinal Plants	709 Kilograms	35,450	49,630	14,180	28
Fuelwood	4,680 Bundles	702,000	936,000	234,000	25
Vegetables	226 Bundles	90,400	113,000	22,600	20
Squirrel	162 Pieces	81,000	97,200	16,200	17
Grasscutter	42 Pieces	14,700	16,800	2,100	12.5
Honey	198 Litres	792,000	990,000	198,000	20
Grass	103 Bundles	13,560	16,450	3,390	20
	Total	1,972,710	2,523,580		

Diversity of plant species

A total of 228 trees were enumerated in all the four sampled transects. The identified trees belong to eleven (11) families and fifteen (15) different species (See Appendix I). Simpson's Diversity Index (D) of Gongoshi grazing reserve was 0.896. This calls for sustainable harvesting and conservation of the forest resources particularly the NTFPs.

Conservation status of plant species in gongoshi grazing reserve

The conservation status of plant species are presented in *Table 8*. The Conservation status are reported by Data Deficient (DD), Least Concern (LC), Not Evaluated (NE) and Vulnerable (VU). Each of the species was assessed against the International Union for Conservation of Nature Red List Criteria. Results from this table shows that LC had the highest frequency with 73.3% followed by VU (13.3%) while NE and DD had 6.7% each. The high number of species under the Least Concern (LC) could be due to the level of management and protection. This result agrees with the findings of Saka et al. (2025) who reported that majority (60%) of the NTFPs species in the study area fall under the LC category.

***Table 8**. Conservation status of plant species in Gongoshi grazing reserve.*

S/N	Scientific Name	Conservation Status
1	Azadirachta indica	LC
2	Ficus syncomorus	NE
3	Anona senegalensis	LC
4	Detarium macrocarpum	LC
5	Khaya senegalensis	VU
6	Ceiba pentandra	LC
7	Moringa oleifera	LC
8	Jatropha curcas	LC
9	Adansonia digitata	LC
10	Vitellaria paradoxa	VU
11	Tamarindus indica	LC
12	Sterculia setigera	DD
13	Hymenocardia acida	LC
14	Citrus limon	LC
15	Ziziphus spina-christi	LC

Note: LC = Least Concern; NE = Not Evaluated; VU = Vulnerable; DD = Data Deficient.

Conclusion

The study concludes that Non-Timber Forest Products (NTFPs) significantly contribute to rural household income, food security, and socio-economic stability. With sales of NTFPs serving as the major contribution to total household income for most respondents, alongside their use in food, medicine, and energy, the products remain indispensable to rural survival and welfare. The findings from this research further revealed that socio-economic factors such as education, occupation, household size, and engagement in NTFP activities influence household earnings, while profitability estimates confirm that NTFPs are economically viable despite persistent challenges such as poor markets, transportation constraints, bush burning, and overexploitation. The study also highlights evidence of declining forest biodiversity, indicating unsustainable harvesting practices that threaten long-term resource availability. Therefore, NTFPs not only serve as a buffer against poverty but also underscore the need for sustainable management of forest resources to ensure both livelihood improvement and biodiversity conservation. Based on the study findings, the following recommendations are suggested: Government and NGOs should support sustainable harvesting and conservation of NTFPs to prevent biodiversity loss; Rural farmers and marketers should be trained on value addition, processing, and storage to reduce post-harvest losses; Improved infrastructure, especially rural roads and transport systems, should be developed to enhance market access for NTFPs; Policies and cooperatives should be strengthened to regulate pricing, reduce market fluctuations, and increase profitability.

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Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

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