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Contributions, engagement and dependency of agroforestry to livelihood among rural farmers in Osho Forest Reserve in Oyo State

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Abstract

An increasingly popular land-use strategy to improve food security, revenue creation, and environmental preservation is agroforestry, which combines trees with crops and cattle. The contribution of agroforestry methods to rural livelihoods in Osho Forest Reserve, Oyo State, Nigeria, was evaluated in this study, 120 homes were chosen from five communities near forests using a two-stage sample procedure, and standardized questionnaires were used to gather data. Descriptive statistics and logit regression models were employed for analysis. According to the results, most respondents (57.5%) were in the productive age range of 31 to 40 years, 61.7% were female, and 55% had only completed secondary school. Among the contributions were increased nutrition (82.5%) and food security (94.2%). expanded household income streams (50.8%) and enhanced land productivity (76.7%). According to regression analysis, age ($\beta = 0.137$, $p < 0.10$), household size ($\beta = 1.491$, $p < 0.01$), and secondary occupation ($p < 0.10$) all significantly impacted household engagement in agroforestry, whereas age ($\beta = 0.083$, $p < 0.10$) and household size ($\beta = 1.163$, $p < 0.01$) significantly determined reliance on agroforestry. Lack of government backing (58.3%), high labor expenses (50.8%), insufficient financial resources (51.7%), and poor technical knowledge (59.2%) were the main obstacles to adoption. According to the study's findings, agroforestry considerably improves rural livelihoods and lessens dependency on forest resources. To maintain adoption among communities that depend on forests, it suggests enhancing extension services, expanding access to loans and high-quality seedlings, and advocating for enabling laws.

Nomenclature and units

Yi	Kurtosis = is the dependent variable (household dependency on agroforestry practices
Pn	Final population
P_o	Initial population
e	Exponential
r	Growth at 3.5%

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1.0 Introduction

Agroforestry is the intentional planting of trees with other elements, such as crops and livestock, on the same piece of land, according to Mbow *et al.* (2014) agroforestry has a lengthy history, with the ultimate goal of increasing food production, early farmers incorporated trees into farming systems to support agriculture. By the end of the 19th century, however, the planting of plantations had become the primary goal of agroforestry and the idea behind modern agroforestry, which began in 1971, was that crop-tree-livestock relationships might maximize agricultural and forestry production at the same time (Liliane *et al*., 2020; Adelani, 2023). Accordingly, agroforestry uses a variety of systems that are based on the combination of many elements (Orisakwe *et al*., 2014). These systems consist of aquasilviculture, serisilviculture, apisilviculture, and other more specialized systems including agrosilviculture, pastoralsilviculture, and agropastoralsilviculture (Alavalapati *et al*., 2015).

One of the most important ways to prevent the loss of forest cover in agricultural settings is still through agroforestry methods (Bankole *et al*., 2012). Geremy (2016) asserts that instead of permitting farmers to continue using the conventional method of caring for trees on their properties without fulfilling the potential advantages of agroforestry systems, agricultural policies and practices have changed to support the introduction and intensification of contemporary agroforestry practices.

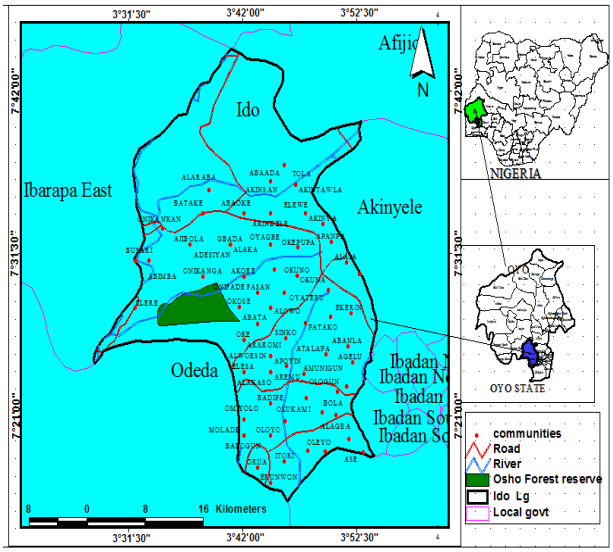
According to Sanou *et al.* (2019), agroforestry systems integrate sustainable agriculture production with trees and offer the benefit of helping to mitigate the negative consequences of deforestation by promoting natural forest cover through tree cultivation. Around the world, numerous economists and social scientists have defined the term "livelihood." According to Ayantayoe *et al.*, 2017; Bekalu *et al*., 2019; Birhanu *et al*., 2016), "A livelihood is sustainable if it can cope and recover from stress and shocks, maintain or enhance its capabilities and assets; and provide sustainable livelihood opportunities for the next generation." A livelihood is defined as one that includes the capabilities, assets (stores, resources, claims, and access), and activities necessary for a means of living. Additionally, agroforestry improves food security by supplying a variety of food crops all year round, stabilizing household nutrition (Muthuri *et al*., 2021; Abbe *et al*., 2020). By controlling microclimates and storing carbon, agroforestry plays a major role in mitigating climate change. Trees lower surface temperatures, retain moisture better, and increase crop resilience to changing weather conditions (Jose, 2017; Mbow *et al*., 2019).

2.0 Research Methodology

2.1 Study Area

The study was conducted in Osho Forest Reserve in Ido Local Government Area of Oyo State, south-western Nigeria (Figure 1). The reserve is situated in the derived savanna ecological zone between 6°50′ N and 4°30′ E at about 152 m above sea level. Osho Forest Reserve was initially constituted as Ibadan Native Administration Forest Reserve on 6 January 1932 under the seal of W Buchanan South, the Lieutenant-Governor for Southern Provinces. It was reclassified as Ibadan District Native Authority Forest Reserve through a 1951 Amendment Order (Vide W. R. Republic Notice No. 12 of 1952 in WR Gazette No. 13 of 21 February 1952) under the seals of AJ Phillips (Ag. Resident, Ibadan Province) and TM Shankland (Ag. Civil Secretary, Western Region). The reserve had an original land area of about 51.8 km^2 but was reduced to about 35 km^2 through the 1951 Amendment Order. The forest reserve contains an abundance of valuable tree and other flora and fauna species. The climate of Osho Forest Reserve is mainly tropical, characterized by two seasons, namely dry and wet seasons. Two distinct wet seasons occur in the reserve, May to July and September to November, apart from the break in August. The major dry season occurs between December and March and is usually accompanied by northeast trade winds. The average annual rainfall is about 1 257 mm, while the relative humidity ranges from 84.5% in June–September to 78.8% in December–January. The mean annual maximum and minimum temperatures are about 31.3 °C and 21.0 °C, respectively.

Figure 1: Map of the study area



Source: Babatunde et *al., 2025*

2.2 Sampling Procedure and Size

The study was carried out in Osho forest reserve. Osho forest reserved was purposely selected because of prevalence of agroforestry practices among the farmers living around the reserve. This study employed a two stage sampling method to select sample households. In the first stage involved an identification of seven (7) communities surrounding the forest reserve which include, Adedapo, Gbagba, Agbetu, Onifufu, Mabole (Bolorunpelu), Abokede and Onikanga and through a

reconnaissance survey of villages bounded by the Reserve, five (5) (Abokede, Onifufu, Adedapo and Agbetu, Onikanga.) of the seven settlements were selected due to the predominance of agroforestry practices in the area. In the second stage, the population of the communities for the year 1991 was obtained from the National Population Commission of Oyo State and from this; a projection of the 2024 population of each village bounded by the reserve was done using the projection formula adopted by Olawuyi, *et al.,* (2019).

$P_n=P_oe^{rt}$

Where P_n=Final population, P_o=Initial population, e=exponential, r= Growth at 3.5%

t= Time of projection i.e. (x-1991) = 2024-1991=33

A formula adopted by Suleiman *et al*., (2017) was used to compute the appropriate sample size for the study, taking into consideration the population size of the household heads of the selected communities. The formula minimizes sampling error and using formula is express as

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

Where: n = is the sample size to be estimated, N = is the definite population of the communities

e = is the significance level (0.05).

Table 1: Sampling frame and sampling size

Villages	1991 population	2024 projection population	Sample size
Adedapo	254	806	29
Agbetu	113	359	13
Onifufu	200	635	23
Abokede	231	733	26
Onikanga	252	800	29
Total	1,050	3,333	120

Source: Author computation

2.3 Method of Data Collection

The Primary data was used for the study. Primary data was collected from the field through the administration of well-structured questionnaire.

2.4 Method of Data Analysis

Descriptive and inferential (logit regression model) statistics was used to analyze the data.

Model specification

The Logit model is written as follows:

$Y= a+b_1X_1+b_2X_2+ b_3X_3+ b_4X_4+b_5X_5\ldots\ldots Xn$

Yi = is the dependent variable (household dependency on agroforestry practices =1, 0=otherwise)

X_1= Sex (1= female, 2= male)

X_2= age (in years)

X_3= Educational level (years of schooling)

X_4 =Family size (number of family members)

X_5= Monthly income from primary occupation (in naira)

X_6= Secondary occupation

X_7 = Years of experience (in years)

X_8 = Farm size (hectare)

X_9 =Access to credit (access =1, non-access = 0)

X_{10} = Membership of cooperative society (member =1, non-member =0)

The Logit model is written as follows:

$Y= a+b_1X_1+b_2X_2+ b_3X_3+ b_4X_4+b_5X_5\ldots\ldots Xn$

Yi = is the dependent variable (rural household engagement on agroforestry practices =1, 0=otherwise)

X_1= Sex (1= male 0=otherwise)

X_2= Age (in years)

X_3= Educational level (years of formal schooling)

X_4 =Household size (number of family members)

X_5= Monthly income from primary occupation (₦)

X_6= Secondary occupation

X_7 = Years of experience in primary occupation (years)

X_8 = Farm size (hectare)

X_9 =Marital status (married =1,0 otherwise

X_{10} = Distance from house to reserve (km)

3.0 Results and Discussions

3.1 Socio-economic Characteristics of respondents in the study

The analysis of the respondents' ages, as shown in Table 2, reveals that the age group of 31 to 40 years old has the highest percentage of 57.5%. This suggests that the respondents were in their productive and active age group and could engaged in Agroforestry in the study area, this is consistent with Liliane *et al*., (2020) observation that the younger a household member is, the more actively they engage in the agroforestry and use of forest resources, while the older the household member, the less likely they are to engage in these activities due to loss of strength, this outcome is consistent with Babatunde *et al*., (2020) and Adeoye and Adebayo,(2021). The majority of responders (61.7%) were women. This suggests that a greater proportion of females in the study area engaged in the agroforestry and consumption of forest resources than their male counterparts. This finding was supported by Babatunde *et al*., 2019; Ahmad *et al.*, 2023). 38% of household heads were single, according to the marital status results of the rural households studied, the majority (55%) had completed secondary school, the fact that the majority of respondents had access to formal education suggests that their literacy level may have contributed to their awareness of agroforestry and forest

preservation initiatives, as well as the effects of excessive exploitation of forest resources, especially trees, on global warming, this result was corroborated by Babatunde and Babatunde, (2020) . For their own household needs and financial benefit, they actively exploit the forest resources. In his research, Abdulahi *et al*., (2019) also highlighted that the high percentage of uneducated people in rural areas is largely to blame for the overuse of forest resources, since they consistently deny any efforts to moderately utilize them at a rate that is acceptable. It is clear that the majority (62.5%) live in households with 4 - 6 persons. The study's findings are consistent with those of Ibrahim *et al.*, (2018), who found that 48.33% of respondents lived in households with a size between 6 and 10. They discovered that most NTFP extractors have comparatively large households. This result is also consistent with Olaniyi *et al.* (2013), who found that 69.2% of rural women had homes with six to ten people. They actively use the forest resources to meet their own needs and to make money. According to Adelani, (2023) research, the high proportion of illiterate individuals in rural regions is primarily responsible for the excessive use of forest resources, as they continually reject attempts to moderately use them at a reasonable rate. The findings indicated that 52.5% of the respondents had less than five years of experience in these areas. According to Akter *et al.*, (2022), years of experience in the agroforestry and use of forest resources have a significant impact on the exploitation of these resources, marketing expertise, and the establishment of social groups among forest users, which is a sign of their proficiency in the activity.

The majority of the respondents (53.2%) belonged to one or more associations in the study region, according to the data. Membership in a number of organizations or associations, particularly cooperatives and professional associations, should typically make credit and important information more accessible for better health. This supports the results of Adelani,.(2023), who found that belonging to diverse groups enhanced wellbeing. The findings demonstrated that in the research area, the majority of rural households (81.7%) had access to credit.

Table 2: Socio-economic characteristics of respondents

Socio-economic characteristics	Frequency	Percentage
Age group		
Below 30 years	22	18.3
31-40 years	69	57.5
41-50 years	27	22.5
51-60 years	2	1.7
Gender		
Male	46	38.3
Female	74	61.7
Marital status		
Single	37	30.8
Married	27	22.5
Divorced	30	25.0
Widow	26	21.7
Household size		
1-3	45	37.5
4-6	75	62.5
Educational level		
Primary	17	14.2
Secondary	66	55.0
Tertiary	37	30.8
Years of working experience		
Below 5 years	63	52.5
5-10 years	41	34.2
11-15 years	16	13.3
Access to credit		
Yes		
No	22	18.3
Member of Association		
Yes	64	53.3
No	56	46.7
Total	120	100.0

Source: Field Survey, 2025.

3.2 Contribution of Agroforestry Practices to Rural Livelihood

Table 3 shows how respondents in the study area view the contribution of agroforestry activities to rural livelihood. Contributions included improved access to fuel wood and timber for home needs (69.2%) and a year-round supply of food for household members (84.2%). By diversifying household revenue streams, the requirement for outside income sources was decreased (50.8%). According to Babatunde *et al*. (2020), this result had a positive effect on household education by enabling families to devote more funds for children's education (63.3%), improved household members' overall health and nutrition through a greater variety of food sources (82.5%), and increased employment opportunities for household members, particularly in activities like planting, harvesting, and processing trees (58.3%). improved community relationships through the sharing of resources and knowledge (60.0%), improved household resilience to environmental challenges like soil erosion and flooding (51.7%), more medicinal plants and herbs, improved health and lower health care costs (54.2%), improved market access for the sale of products grown through these practices (65.8%), and increased land productivity through the effective combining of crops and trees (76.6%). Better housing, transportation, and access to contemporary utilities were among the other factors that improved household living standards (60.0%), sustainable land use practices that benefit the community's economy and environment over the long term (58.3%), and increased household food security by lowering reliance on purchased food (94.2%).

Table 3: Contribution of Agroforestry Practices to Rural Livelihood in The Study Area

VARIABLES	YES		NO	
	Freq	%	Freq	%
Agroforestry practices have increased the household income in our community.	36	30.0	84	70.0
Agroforestry provides a reliable source of food for household members throughout the year.	101	84.2	19	15.8
The integration of trees in farming systems has improved soil fertility on household farms.	26	21.7	94	78.3
Agroforestry practices have contributed to better access to timber and fuel wood for household needs.	83	69.2	37	30.8
The sale of agroforestry products (e.g., fruits, timber, herbs) has significantly improved our family's financial stability.	43	35.8	77	64.2
Agroforestry has reduced the need for external sources of income by diversifying household revenue streams.	61	50.8	59	49.2
Agroforestry practices have helped reduce the risk of crop failure during droughts or other extreme weather events.	39	32.5	81	67.5
Agroforestry contributes to improving the overall health and nutrition of household members through increased diversity of food sources.	99	82.5	21	17.5
The practice of agroforestry has enabled households to save money that would have otherwise been spent on external resources (e.g., food, timber)	58	48.3	62	51.7
Agroforestry has increased employment opportunities for household members, particularly in activities like tree planting, and harvesting	70	58.3	50	41.7
Agroforestry practices have had a positive impact on household education by allowing families to allocate more resources for children's education.	76	63.3	44	36.7
The incorporation of agroforestry has enhanced household resilience to environmental challenges such as soil erosion and flooding.	62	51.7	58	48.3
Agroforestry has provided households with additional medicinal plants and herbs, improving health and reducing health care costs.	65	54.2	55	45.8
Agroforestry has reduced the pressure on the forest reserve by providing alternative sources of forest products (e.g., firewood, timber).	46	38.3	74	61.7
The presence of agroforestry in the community has improved community relationships through shared knowledge and resources.	72	60.0	48	40.0
Agroforestry has led to better market access for the sale of products grown	79	65.8	41	34.2
Agroforestry practices have increased land productivity by combining crops and trees effectively.	92	76.7	28	23.3
The income from agroforestry practices has contributed to improving household living standards, such as better housing, transportation, and access to modern utilities.	72	60.0	48	40.0
Agroforestry has encouraged sustainable land use practices that have long-term benefits for the community's environment and economy.	70	58.3	50	41.7
Agroforestry has enhanced food security by reducing reliance on purchased food	113	94.2	7	5.8

Source: Authors Computation, 2025

3.3 Factors determining the engagement of rural household in agroforestry practices

The logit regression analysis was used to determine the factors that influenced the respondent's engagement in agroforestry practices. The results of the analysis are presented in Table 4. Results of the regression model revealed that age, household size and availability of secondary occupation had significant effect on agroforestry engagement practices in the study area. The coefficient of age was significant at 10% and positive. This implies that the higher the age of the respondents the more their engagement in agroforestry practices in the study area. This result was corroborated by Babatunde *et al.*, (2019). The coefficient of household size of the respondents was significant

at 1% and positive his showed that there is direct relationship between the household size of the respondents and their engagement in agroforestry practices. The implication of this result was that increase in the household size of the respondents will lead to increase in their engagement in their agroforestry practices in the study area.

The co-efficient of engagement in secondary occupation by the respondent was significant at 10% and had a positive association with agroforestry practices in the study area. This implied that the more the rural household engaged in secondary occupation the more likely to engaged in the agroforestry practices in the study area.

Table 4: Factors that influenced the rural household engagement in agroforestry practices

Variables	Co-efficient	S .Error	t-value
Constant	-6.612	0.763	-2.12
Sex	0.217	1.599	0.14
Age	0.137*	0.070	1.95
Educational level	-0.742	0.496	-1.50
Household size	1.491***	0.424	3.52
Monthly income	-0.000	0.000	-0.12
Secondary occupation	0.000*	0.000	1.83
Years of experience	0.043	0.322	0.13
Farm size	0.004	0.014	0.33
Marital status	-1.087	0.763	-1.42
Distance from house to reserve	-0.015	0.050	-0.31

Source: Authors Computation, 2024. NOTE: *** sig at 1%, **sig at 5%, * sig at 10%

3.4 Factors determining the of rural household dependency on agroforestry practices

The factors influencing the respondent's reliance on agroforestry techniques were identified using the logit regression analysis. Table 5 displays the findings of the analysis. Results of the regression model demonstrated that age and household size had substantial effect on agroforestry dependency in the studied area At 10%, the age coefficient was positive and significant. This suggests that respondents' reliance on agroforestry activities in the research area increases with their age. The respondents' household size had a positive and significant coefficient of 1%. This demonstrated a clear correlation between the respondents' reliance on agroforestry practices and the size of their households. These findings implied that respondents' reliance on agroforestry practices in the research area would increase as their household sizes increased.

Table 5: Factors that influenced the rural household dependency on agroforestry practices

Variables	Co-efficient	S. Error	t-value
Constant	-4.831	4.237	-1.14
Sex	-1.264	1.185	-1.07
Age	0.083*	0.048	1.74
Educational level	0.045	0-066	0.68
Household size	1.163***	0.347	3.35
Monthly income from primary occupation	-0.000	0.000	-0.12
Secondary occupation	-0.257	0.190	-1.35
Years of experience	-0.034	0.328	-0.10
Farm size	0.008	0.012	0.73
Access to credit	-0.479	0.863	-0.56
Membership of cooperative society	0.838	0.771	1.09

Source: Authors Computation, 2025. NOTE: *** sig at 1%, **sig at 5%, * sig at 10%

3.5 Challenges Faced in Practicing Agroforestry Among Respondents

The main obstacles that respondents encountered when engaging in agroforestry in the research area are displayed in Table 5. Lack of government support or incentives for agroforestry adoption (58.3%), high labor costs associated with setting up and maintaining agroforestry systems (50.8%), limited knowledge or skills regarding agroforestry practices (59.2%), and insufficient financial resources to invest in agroforestry activities (51.7%) are the main obstacles. This

result agreed with Ibrahim *et al*.,(2019). Agroforestry and traditional agricultural operations' rivalry for land and resources (56.7%) and the effects of pests and diseases on agroforestry crops (55.8%) are the other two. It demonstrates that, in spite of the enormous benefits that agroforestry methods give to the community's inhabitants, respondents in the research region encounter several challenges when attempting to implement these practices. Similar obstacles to the adoption of agroforestry systems, including lack of government assistance, labor requirements, and budgetary constraints, were identified by Abdulahhi *et al.* (2018).

Table 6: Challenges Faced in Practicing Agroforestry Among Respondents in The Study Area

	Major		Minor		Not at all	
	Freq	%	Freq	%	Freq	%
Lack of access to quality seedlings or planting materials for agroforestry.	50	41.7	63	52.5	7	5.8
Limited knowledge or skills about agroforestry practices.	71	59.2	44	36.7	5	4.2
Inadequate financial resources to invest in agroforestry activities.	62	51.7	51	42.5	7	5.8
High labor costs involved in establishing and maintaining agroforestry systems.	61	50.8	49	40.8	10	8.3
Lack of government support or incentives for agroforestry adoption.	70	58.3	50	41.7		
Land tenure issues, such as insecurity or lack of ownership over land.	56	46.7	54	45.0	10	8.3
Difficulty accessing markets for agroforestry products like timber, fruits, or medicinal plants.	58	48.3	39	32.5	23	19.2
Competition for land and resources between agroforestry and traditional farming activities.	68	56.7	48	40.0	4	3.3
Inadequate infrastructure (e.g., roads, transport) for accessing agroforestry inputs or products.	56	46.7	34	28.3	30	25.0
The impact of pests and diseases on agroforestry crops.	67	55.8	43	35.8	10	8.3
Climate variability and unpredictable weather patterns affecting the success of agroforestry practices.	33	27.5	63	52.5	24	20.0
Cultural or community resistance to adopting agroforestry practices due to traditional farming preferences.	42	35.0	63	52.5	15	12.5
Challenges related to the protection of trees from grazing animals or deforestation.	52	43.3	54	45.0	14	11.7
Limited access to technical or extension services for guidance on agroforestry management.	15	12.5	90	75.0	15	12.5
Negative environmental impacts of agroforestry practices, such as water scarcity or soil degradation	33	27.5	63	52.5	24	20.0

Source: Authors Computation, 2025.

4.0 Conclusion

According to the study's findings, agroforestry techniques are essential for maintaining rural lives in Osho Forest Reserve because they increase land productivity, diversify revenue

streams, improve nutrition, and increase food security. According to the socioeconomic study, the majority of respondents was female, in their prime working years, had completed secondary school, and had medium-sized households. Household dependence on agroforestry was significantly influenced by these traits. Regression analysis demonstrated that age and household size had a significant impact on household dependency on agroforestry, whereas these factors also significantly affected household dependency on agroforestry. Families participated in a variety of agroforestry practices, including commercial use of timber and non-timber products, alley cropping, fruit tree cultivation, livestock–tree combinations, and tree–crop integration, all of which enhanced their resilience and general well-being. However, the study found significant barriers such as little government backing, high labor costs, limited financial resources, and a lack of understanding.

Declaration of conflict of interest

The authors have collectively contributed to the conceptualization, design, and execution of this journal. They have worked on drafting and critically revising the article to include significant intellectual content. This manuscript has not been previously submitted or reviewed by any other journal or publishing platform. Additionally, the authors do not have any affiliation with any organization that has a direct or indirect financial stake in the subject matter discussed in this manuscript.

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