Adoption of Agroforestry Practices among Farmers in Gwaram Local Government Area of Jigawa State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author SKV designed the study, wrote the protocol and supervised the work. Authors OA and BKN carried out all laboratories work and performed the statistical analysis. Authors SKV, BKN and AO managed the analyses of the study. Authors BKN and AO wrote the first draft of the manuscript. Author SKV managed the literature searches and edited the manuscript. All authors read and approved the final manuscript.

Article Information

ABSTRACT

This study assessed the adoption of agroforestry practices among farmers in Gwaram Local Government Area of Jigawa State, Nigeria. The multistage sampling procedure was used to select 120 farmers from four (4) out of the six (6) districts in the Local Government Area for the study. Primary data were collected through the use of questionnaires and oral interview and were subjected to both descriptive and logit regression analysis. Findings from the study revealed that the mean age of the farmers was 39 years. Majority of the farmers were male and mostly married. The study also showed that majority of the respondents had at least one form of education with a

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mean farming experience of 7 years and a mean farm size of 3.5 hectares. A greater percentage of the respondents acquired their farmlands through inheritance. The greater proportion of the farmers affirmed to have had contact with extension agents three times in a year and the majority of them aware of agroforestry. The average number of agroforestry practices adopted by the farmers is approximately 2 with home garden adopted by the majority of the farmers. The results also revealed that the mean annual income of respondents is N113,529. The logit regression result showed that educational level, income, membership of cooperatives and land tenure had a significant relationship with the adoption of agroforestry practices at different levels of probabilities. The major constraints to agroforestry practices as opined by the respondents include; land and tree tenure rights, long gestation period to obtain benefits, lack of knowledge and skills in agroforestry, low awareness of agroforestry practice and the high cost associated in adopting agroforestry. The study recommended the formulation of a good land use policy so that farmers can acquire land titles to guarantee the security of their land.

1. INTRODUCTION

Agricultural land use and management present major development challenges throughout sub-Saharan Africa. The area under cultivation has expanded notably, total yields are rising, and there is the large-scale conversion from fallow-based cropping systems to continuous cultivation [1]. Environmental problems associated with agricultural production have also become a major concern. With the marked expansion and intensification of farming, total forested area in Africa declined by 50 million hectares during the 1980s, reducing the availability of wood products for fuel and construction, degrading range resources, and exposing vulnerable soils to degradation [1]. For a long time, crop farming and animal husbandry have been the occupation of man around the globe including Nigeria. This has given rise to competition for space due to the increase in the population of both man and animals. But issues around ownership, accessibility and land administration have complicated these challenges. Recently, there are so many problems associated with farming and animal husbandry in Nigeria. The problems vary across the country in scope, scale and trend. While in the southern part of Nigeria and urban areas, it is land scarcity, while in the north and rural areas it is more of poor and dwindling pasture resources [2].

One of the challenges facing Nigeria is the production of sufficient food and fibre to meet the need of her ever-increasing population [3]. With rapid population increase and land-use pressure, natural fallows and shifting cultivation have been reduced to below the minimum threshold required for the system to sustain itself [1]. These have led to land shortages and continuous arable cultivation without fallowing. As a result of this, land does not have enough time to replenish its fertility. However, attempts to resuscitate land and hence promote yield with the use of chemical fertilizers have resulted in soil toxicity and environmental pollution. In the face of the growing population, higher food demand and fixed agricultural land, sustainable intensification is widely viewed as an important strategy to respond to the challenges of low yields, environmental degradation and adaptation to climate change [1]. It is imperative to introduce practices that would not only be an additive to traditional land-use practices but also ensure the sustainability of production and socially acceptable without damage to the ecosystem [4]. Agroforestry practices represent such land-use practices as it offers a solution to the problem posed by the high demand on land and stands as a means of halting the vicious circle of deforestation, soil erosion and other environmental problems facing Nigeria. It is one of the sustainable agricultural practices in soil fertility practice that uses natural resource management principles to replenish soil fertility [5].

According to International Center for Research in Agroforestry [6], agroforestry is defined as a dynamic, ecologically-based natural resources management system that through the integration of trees on farmland and rangeland diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels. It is a collective name for all land-use systems and technologies in which woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately combined on the same management unit with the herbaceous

plant (crops or pasture) and/or animals, in some form of spatial arrangement or temporal-sequence [7]. Agroforestry is a concept that harmonizes agriculture with forestry and pastoralism. The integration of trees into the farming system could go a long way to help ameliorate environmental problems and can help protect soil erosion and moderate extreme temperatures [8]. According to [9], agroforestry is multiple land-use systems in which crops and woody perennials are grown on the same land unit. It includes both traditional and modern land-use systems where trees are managed together with crops and/or animal production systems in agricultural settings. Agroforestry has considerable potential to contribute towards solving some of these problems. Nitrogen-fixing trees, as substitutes or complements for chemical fertilizer, can increase smallholder incomes, conserve foreign exchange and improve regional food security. By supplying fuelwood from the farm, agroforestry can help reduce pressure on forests and communal woodlands. Moreover, agroforestry trees can supply farm households with a wide range of other products, including food, medicine, livestock feed, and timber for home use and sale. Other services that trees provide, such as boundary markers, windbreaks, soil erosion barriers, beauty and shade, are difficult to quantify but are none the less of substantial importance to farm families and for natural resource protection. Agroforestry practices have the potential of improving agricultural land-use systems, providing lasting benefits and alleviating adverse environmental effects at local and global levels.

The foundation of agroforestry is putting trees to work in conservation and production systems for farms, forests, ranches, and communities. Agroforestry begins with placing the right plant, in the right place, for the right purpose [10].

The rapidly expanding population and consequent pressure on land for socio-economic, agricultural and industrial development as well as increasing human interference on the forests and the environment have put the future of Nigeria forest and agricultural land in great danger [11]. Increase in population has equally led to heavy dependence on fuelwood especially by rural people and urban poor in developing countries like Nigeria leading to increased deforestation. Continuous depletion of the forest reserve base and agricultural land has major effects on the agricultural segments of Nigeria economy. It

causes a decline in the productive capacity of soils, accelerated erosion, destruction of wildlife habitats and loss of plant genetic diversity, climate change, landslides, soil degradation, and unfavourable hydrological changes. According to Global forest resources assessment 2010 report by Food and Agriculture Organization [12], Nigeria is classified among the countries with a low forest cover of less than 2.3% of the total land area [12]. Considering the rate at which the country has been losing her forest and agricultural land areas, there is a need for maintenance and enhancement of soil fertility for global food security and environmental sustainability. Therefore, the drive towards ensuring food security should be channelled towards developing agricultural practices and system that will be environmentally friendly and also focus on productivity on the long term rather than immediate production and accruing returns [13]. Agroforestry holds great promise for contributing to sustainable land-use systems which can overcome the problem of land degradation and the "food crisis" which is a pressing problem in Nigeria.

However, increased investment in the development of agroforestry practices has not been sufficiently addressed in policy formulation nor has it been integrated into land-use planning and rural development programmes [14]. The absence of articulated environmental and agricultural policies has led to the derailing of agroforestry initiatives and created impactful environmental degradation [15]. Even though agroforestry practices show great promise, the record of adoption has not been impressive and in most cases unsuccessful. Agro-forestry projects failed for several different reasons but one common factor is the inadequate attention given to socio-economics in the development of systems and projects [16]. According to [17], many agroforestry projects failed because producing benefits for farmers was rarely an important objective. Agroforestry systems are practices that may be influenced by several factors such as socio-economic characteristics of farmers, access to resources, provision of extension services, preference and attitude of a farmer and market availability. These may result in different levels of adoption among individuals, groups and different communities, thus leading to different adoption status. Although the people of Gwaram local government area for years have been practising Agroforestry, the level of adoption of various Agroforestry systems and technologies by the communities has not been

determined and documented. It is against this background that the current study seeks to fill this significant gap. Consequently, the study seeks to assess the adoption of agroforestry practices in Gwaram Local Government Area, Jigawa State, Nigeria. The specific objectives are to; describe the socio-economic characteristics of farmers in the study area, assess the farmers' awareness level of the agroforestry practices in the study area, examine the level of adoption of agroforestry practices in the study area and determine the factors influencing the adoption of agroforestry practices by farmers in the study area and identify the problems facing farmers in adopting agroforestry practices in the study area. The information gathered can make a significant contribution to Agroforestry promotion and provide useful feedback to researchers, policymakers and other stakeholders in terms of developing and providing strategies related to Agroforestry scaling up interventions and associated local development about community needs.

1.1 Test of Hypothesis

Ho: There is no significant relationship between farmers' socio-economic characteristics and the adoption of agroforestry practices.

2. MATERIALS AND METHODS

Gwaram is one of the Local Government Areas of Jigawa State, Nigeria. Gwaram L.G.A came into being in 1989 when it was carved out from the then Birnin- Kudu Local Government Area. Its headquarters are in the town of Gwaram and is situated in the Sudan Savannah agro-ecological zone of Nigeria located between latitude 10°13.977 North and longitude 10°17.14 East. The Local Government occupies a total landmass of about 1,912 km² and a population of 272,582 at the 2006 census. Gwaram Local Government is believed to be the second most populated Local Government Area in Jigawa State. Rainfall begins in April and ends in October. The temperature ranges between 25^0c - 40^oc and could be as low as10-15°c during the harmattan period. Gwaram shares common borders with Birnin-Kudu Local Government on the west, Buji Local Government by the Northwest, Jama'are and Shira Local Government by the North-east, Ningi Local Government by the South- West, Darazau Local Government by the South-East and Ganjuwa Local Government by the South all in Bauchi State. The Local Government is considered to be a semi-urban area with a greater number of the population residing in rural areas. The predominant occupations of the people in the area are farming, fishing, animal rearing, handcraft and trading. The State enjoys vast fertile arable land to which almost all tropical crops could adapt, thus constituting one of its highly prized natural resources. The Sudan Savannah vegetation zone is also made up of vast grazing lands suitable for livestock production. The Local Government in blessed with several natural resources such as black clay, quartz, tin, gum Arabic, kaolin, honey, cassava, date palm, etc. The people of the area are predominantly Hausa/Fulani with some (Kanuri) Bare-bari and Warjawa.

A multi-stage sampling technique was used for this study. In the first stage, four [4] out of the six [6] districts in Gwaram Local Government Area were purposively selected for the study based on their massive involvement in agriculture. The districts selected were; Zandam, Galambi, Fagam and Basirka. In the second stage, two villages were randomly selected from each of the four districts to give a total number of eight [8] villages. Lastly, at the village level, fifteen [15] farmers were randomly selected giving a total of 120 respondents for the study. Primary data was the main source of information for this study. The data was collected through the administration of questionnaires and oral interview.

2.1 Method of Data Analysis

Data for this study were subjected to descriptive statistics such as frequency, percentages, mean and Binary Logit regression.

2.1.1 Logit regression

The expressions of the equation in explicit and implicit forms are as follows:

Ln (i) = ln (Pi/1− Pi) = β0+βiXi + µi (implicit form)

Y = a+b$_1$x$_1$+b$_2$x$_2$+b$_3$x$_3$+b$_4$x$_4$+b$_5$x$_5$+b$_6$x$_6$+b$_7$x$_7$+e (explicit form)

Where:

Y = Adoption of agroforestry practices (1 if adopted, 0 if otherwise)
X$_1$ = Age (years)
X$_2$ = Education of respondents (years spent in school)
X$_3$ =Household size (Number of persons in the household)

X_4 = Annual income (naira)
X_5 = Membership of social groups (1 if yes, otherwise)
X_6 = Land tenure (1 if own land through inheritance/ purchase, 0 if otherwise)
X_7 = Contact with extension agent (Number of visits)
a = constant term
U = Error term (explicit)
e = Error term (implicit)
b_1 to b_7 = Regression coefficient of x1 to x7
x_1 to x_7 = Independent variables as defined in the general and explicit equations above

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of Farmers

The results presented in Table 1 shows that the mean age of the farmers in the study area was 39 years. This finding implies that a large proportion of the farmers' in the study area were in their middle age and can adequately be regarded as active, agile and physically disposed to farming activities. Age is an important determinant of socio-economic status of a population since people wear in energy as they advance in age. This result is similar to the findings of [18] who in their study on the determinants of access to credit for agricultural production among crop farmers in Bassa Local Government Area, Plateau State, Nigeria found the mean age of maize farmers in the study area to be 38 years.

Sex of the respondents reveals that 78.0% of the farmers were males while 22.0% were females. The predominance of male farmers in the study area could be attributed to the fact that men always have the right to land as a productive resource where agroforestry is practised more than females. The finding corroborates the study of [19] who found in their study on the adoption of improved agroforestry technologies among contact farmers in Imo State, Nigeria that, majority of the agroforestry farmers in the study area were males.

The result in Table 1 also reveals that greater (92%) percentages of respondents in the study area are married while 8% of respondents are single. This may be as a result of high labour requirement in agricultural production in which they use members of their family as labour force and partly due to the expected benefits derived in feeding members of their family from what they produce. This result collaborates the findings of [20] and [19] who found in their separate studies that the majority of agroforestry farmers in Nigeria were married.

The result from Table 1 further shows the mean household size of the respondents to be ten [10] persons. These are particular situations in rural areas as most of these farmers believe that it is better to have more children who would work on the farm than hiring external labour. The polygamous nature of the community, which allows a man to marry more than one woman, could be another reason why they have more children.

Farmer's educational attainments showed that (41%) of the farmers had primary education, 25% had secondary education, 22% had tertiary education respectively while 12 % had no formal education. This in effect shows that majority of the farmers in the study area have at least one form of education. According to [20] the level of education of a person not only increases his farm productivity but also enhances his ability to understand and evaluate new production technologies.

The result also shows that the majority (67%) of the respondent's main occupation is farming and the remaining were either civil servants or business people. This result is not strange as the study area is predominantly agrarian. This implies that most of the respondents rely on farm products (such as yam, pumpkin, cassava) and tree products (such as fruits, timber, herbs) as their major source of food and income.

Table 1 also revealed the farmers mean years of farming experience as seven [7] years. The implication is that they are capable of adopting agroforestry technologies since many may have been practising it for a long time.

The result from Table 1 also showed a mean farm size of 3.5 hectares. This implies that most of the farmers were smallholders and subsistence farmers, a situation that may not allow them to engage in the cultivation of permanent tree crops as the small landholdings are usually kept for arable crop production.

The result of the annual income of farmers in the study area reveals that farmers earned a mean annual income of ₦113529 in the study area. It can be seen from this result that the annual income of farmers in the study area is fair enough to enable them to adopt agroforestry

practices. With this result, the adoption of agroforestry technologies will likely be favourable

because income is very important in the adoption process.

Table 1. Socioeconomic characteristics of the respondents (n=120)

Variable	Frequency	Percentage	Mean
Age			
21-30	28	23.0	
31-40	52	43.0	
41-50	20	17.0	
51-6-	13	11.0	
>60	7	6.0	39
Sex			
Male	94	78.0	
Female	26	22.0	
Marital status			
Married	110	92.0	
Single	10	8.0	
Household size			
1-5	10	8.0	
6-10	78	65.0	
11-15	26	22.0	
>15	6	5.0	10
Educational status			
Primary	49	41.0	
Secondary	30	25.0	
Tertiary	27	22.0	
Non-formal	14	12.0	
Major occupation			
Civil servant	7	6.0	
Business	23	19.0	
Farming	80	67.0	
Others	10	8.0	
Farming experience			
1-5	24	20.0	
6-10	65	54.0	
11-15	20	17.0	
>15	11	9.0	
Farm size			
0.1-2.0	6	5.0	
2.1-4.0	79	66.0	
>4	35	29.0	3.5
Annual income			
1000-50000	3	3.0	
51000-100000	52	43.0	
101000-150000	37	31.0	
151000-200000	27	23.0	
201000-250000	1	0.8	
Land tenure			
Hired	33	27.0	
Inheritance	80	67.0	
Purchased	7	6.0	
Membership of Association			
Yes	68	57.0	
No	52	43.0	
Extension visit			
No visit	55	46.0	
1-3 times	48	40.0	
4-6 times	11	9.0	
7-9 times	6	5.0	3.0

Source: Field survey, 2019

On land tenure, a greater percentage (67%) of the respondents said they acquire their farmlands through inheritance, 27% of the respondents acquired their farmlands through rent while the remaining 6% acquired their land through purchase. The negative effect of the majority using inherited land is that it would lead to fragmentation of farmland as a result of sharing among siblings hence reducing the size of farmland for agricultural practices. Farmlands in most traditional societies are not communally owned and this leads to fragmentation, leaving farmers with small farmland. This small landholding is not favourable for agroforestry practices.

Table 2. Distribution of Respondents according to awareness of agroforestry

Awareness	Frequency	Percentage
Yes	71	59.0
No	49	41.0
Total	**120**	**100**

Source: Field survey, 2019

From Table 1, the majority (57%) of the respondents were members of cooperative societies and farmers association while the remaining 43% were not members of farmers association. The membership of clubs, associations or cooperatives could avail farmers the opportunity to obtain credit, receive inputs and obtain information on important and recent information concerning their farming activities. The possible reasons why majority joined social organization could be as a result of satisfying their basic need which sometimes could be achieved collectively.

Table 3. Distribution of respondents based on agroforestry practices adopted

Agroforestry	Frequency	Percentage
Home garden	89	74.0
Taungya	77	64.0
Alley farming	68	57.0
Boarder planting	55	46.0
Multipurpose Trees	35	29.0
Shelterbelt	17	14.0
Woodlot establishment	11	9.0
Aquaforestry	4	3.0

Multiple responses

The result further revealed that the average number of contacts farmers had with extension agents was approximately 3 times a year. This is considered low. The implication is that farmers may not be properly informed about agroforestry practices and other improved farm practices. [19] noted that regular contact with extension agents motivates and exposes the farmers to innovations and gives them information on how to use the technologies.

Table 4. Distribution of respondents based on the average number of agroforestry practices adopted

No. of agroforestry	Frequency	Percentage
1-3	106	88.0
4-6	11	9.0
>6	4	3.0
Mean	**2**	

Multiple responses

3.2 Awareness of Agroforestry

The level of awareness of agroforestry practices among the farmers revealed that 59% claimed to be aware of the potential of agroforestry while 41% claimed not to be aware. This indicates that agroforestry is not a new system of agricultural practice to the farmers in the study area. There is a growing concern that agroforestry technologies are not reaching poor farmers. The main reason is the poor linkages between research organization and extension.

3.3 Extent of Adoption of Agroforestry

Data in Table 3 showed that the majority (74%) of respondents practised home garden followed by Taungya farming (64%). of the respondents. Alley farming was practised by 57% of the respondents while border planting was practised by 46% of the respondents. 29% of the farmer's practice adopted multipurpose trees. 9% of the farmers established woodlots and 3% practised aqua-forestry.

3.4 Average Number of Agroforestry Practices Adopted

The distribution in Table 4 shows the average number of agroforestry practices adopted by a farmer. The result reveals that 88% of the farmers adopted 1-3 agroforestry practices on their farms, 9% adopted 4-6 agroforestry practices while only 2% of the farmers adopted more than six (6) agroforestry practices. The average number of agroforestry practices adopted by the farmers is approximately 2 implying that adoption of the technologies is not satisfactory. This could be due to poor delivery

system of the extension agents and the high cost of adopting the technologies.

Table 5. Distribution of respondents based on arable crops combined with trees

Arable crops	Frequency	Percentage
Yams	35	29.0
Rice	21	18.0
Maize	56	47.0
Cowpea	66	55.0
Millet	86	72.0
Sorghum	83	69.0
Wheat	65	54.0
Cassava	29	24.0
Soya beans	46	38.0
Groundnut	55	46.0
Vegetables	46	38.0
Sesame	45	38.0
Others	14	12.0

Multiple responses

3.5 Common Arable Crops Integrated with Trees in the Study Area

Results in Table 5 indicated that millet (72%), sorghum (69.0%), cowpea (66%) wheat (54%), maize (47%) and groundnut (46%) were the most common arable crops the farmers usually combined in their agroforestry farms. These are major staple food available in most Northern Nigeria. Millet, for example, is considered as the king of all crops in the area because of the position it occupies in peoples diet. Apart from its cultivation potential, pearl millet is also known to have nutritional value and health benefits. It is rich in iron and zinc and contains a high amount of antioxidants both of which may be beneficial for the overall health and human wellbeing. Pearl millet is not only nutritionally unmatched, but its grains are also superior to major cereals in terms of energy, minerals, protein and vitamins contents [21]. Sorghum is the fourth most important world cereals crop following wheat, rice, and maize. It is a staple food in the drier part of Africa, China and India [22]. In almost all parts of Northern Nigeria, it is grown in large quantity and used as the primary food crop in diverse forms [23]. It is industrially used for brewing alcoholic and non-alcoholic drinks and other confectionery in Nigeria. Researchers have also reported health benefits of sorghum as strong anti-proliferative activity against colon cancer cells has higher antioxidants compared to other grains and fruits and slows the growth of cancer generally in human [24]. Cowpea is a major protein crop consumed by the majority of the rural populace, most of whom are poor and unable to afford the commodity at reasonable

prices throughout the year. Globally, wheat is an important industrial and food grain. It ranks second among the most important cereal crops in the world, after rice [25]. It is the most important cereals traded on international markets. In Nigeria, wheat is consumed in one form or the other in virtually every home, restaurants and hotels throughout the country. Besides, the crop is the main raw material in the Nigeria flour mills. Its flour is used for making bread, confectioneries, biscuits and other snacks. The offal (residue) is used in the feed-mills in compounding livestock feeds [26]. Groundnut is an important crop in many developing countries where it serves as a protein source, vitamins and cooking oil. Groundnut is the 13thmost significant food crop in the world. It is the world's 4thmost vital source of edible oil and 3rdmost important source of vegetable protein [27]. Maize is a source of carbohydrate and protein. It serves as feed for animals. Its preference by many could be due to the benefits obtained from it such as food and fodder for livestock.

Table 6. Distribution of respondents based on common trees integrated with arable crops

Trees	Frequency	Percentage
Mango	89	74.0
Sugar cane	85	71.0
Neem	66	55.0
Guava	61	51.0
Locust bean	61	51.0
Cashew	58	48.0
Teak	41	34.0
Gmelina	35	29.0
Bitter leaf	35	29.0
Coconut	28	23.0
Banana	20	16.0
Oil palm	20	16.0
Eucalyptus	18	15.0
Orange	5	4.0
Others	11	9.0

Multiple responses

3.7 Perceived Benefits of Agroforestry Practice by Farmers

Data in Table 7 show that major benefits of agroforestry practices as expressed by the farmers were improved food production (91%), improved soil fertility (87%), Provision of fuelwood/timber (65%), Provision of shade for workers (65%), Conservation of soil moisture (51%). Agroforestry practices have the potential to improve soil fertility. This implies that the use of agroforestry practices could help the soil to regain their fertility without the use of inorganic

fertilizer. Nitrogen-fixing trees increase the soil fertility and by incorporating more biomass into soils, enables more efficient use of inorganic fertilizers. Incorporating trees with crops helps in protecting soil from damaging impact of rain. Trees may prevent wind and water erosion by acting as a windbreak and by intercepting the raindrop impact on the soil. Trees situated in farms provide shade to farmers and animals against the scorching effect of the sun. Trees also serve as a source of fuelwood to farm families and timber for residential and industrial purposes.

3.8 Factors Influencing Farmers Adoption of Agroforestry Practices

The coefficient of multiple determination (R^2) has a value of 0.6866 (68.66%) indicating that the independent variables (X_1, X_2,…X_7) jointly contributed 68.66% of the variation in the dependent variable (Y). The overall regression equation was significant at 10% level of probability, indicating that the independent variables significantly influenced the adoption of agroforestry practices by the farmers. Five out of eight predicators namely; the level of education, income, membership of cooperative, land tenure system as well as access to extension visit were statistically significant at various levels of probabilities while age and household size were not statistically significant.

3.8.1 Level of education (X_2)

The respondents' level of education was significant at 1% level of probability with a positive coefficient (1.0334) implying that more educated farmers are more likely to adopt agroforestry practices than those with little or no education. This result agrees with [29] who in their study on analysis of farm risk and coping Strategies among maize farmers in Lere Local Government Area of Kaduna State, Nigeria also found a positive and significant relationship between education and adoption of risk management strategies. The level of formal education attained by an individual goes a long way in shaping his personality, attitude to life and adoption of new and improved agricultural practices.

3.8.2 Annual income (X_4)

Farmers' income was also found to be significant at 5% level of probability with a positive coefficient of 0.9999. Thus it is apparent that the adoption of agroforestry practices by farmers will increase with an increase in their income. This is because farmers who are relatively well to do are more prone to risk-taking.

3.8.3 Membership of cooperative (X_5)

The results also showed that cooperative membership has a positive coefficient (2.4975) and is significant at the 5% probability level. This result implies that farmers who are members of cooperatives are more likely to adopt agroforestry practices, this is indicated on the Table 8.

3.8.4 Land tenure (X_6)

Land tenure systems were also found to be significant at 5% level of probability with a coefficient of 2.5237. The result implies that farmers with a greater claim to land ownership are more likely to adopt Agro-Forestry practices as compared to their other counterparts.

3.8.5 Extension access (X_7)

Farmers' contact with extension agents was found to be significant at 5% level of probability with a positive coefficient of 0.8102 implying that farmers with the higher number of contacts with extension agents will adopt agroforestry technologies more than farmers with less contact with extension agents.

3.9 Constraints to Adoption of Agroforestry

The major constraints to agroforestry practices as opined by the respondents in Table 9 were the problem of land and tree tenure rights, long gestation period to obtain benefits, lack of knowledge and skills in agroforestry, low awareness of agroforestry practice and the high cost associated in adopting agroforestry. A constraints associated with land tenure could be a problem in agroforestry practices especially in areas where farmers cultivate communal land under traditional tenure arrangements that do not allow them to claim ownership or exclusive use rights to the trees on their fields. Food and Agriculture Organization [14] documented on land tenure and tree rights reported that rights to trees may be separate from rights to land and both land and tree tenure insecurity may discourage people from practising agroforestry. This could discourage farmers from planting new trees since they may not be the ones to harvest them after establishing them on the farm.

Insufficient knowledge and skills in different agroforestry practices can affect the use of the practice by agroforestry farmers. Agroforestry farmers often lack skills to establish tree and shrub nurseries, pre-treat the seeds and carry out tree pruning activities. According to Vihi et al. [30], when rural farmers lack access to knowledge and information that would help them achieve the maximum agricultural yield, they not only grope in the dark but are also driven to the urban centres in search of formal employment, as the only option for survival.

The inability to wait for long years to see the benefits of trees planted could discourage farmers from planting trees. The relative advantage of agroforestry practices is considerably reduced when considered in terms of the slow growth rate of most tree crops and the considerably lengthened period over which benefits are realized [5]. Farmers are more concerned with short term gains and are not interested in non-measurable advantages like prevention of erosion, soil conservation etc.

Lack of awareness could be one of the major constraints to adoption of improved forest management practices. These practices may not be widely recognized or understood by farmers. The opportunity of agroforestry practices to provide some medium and long term benefits to individuals and the public simultaneously is not as yet well communicated to many stakeholders. This implies that a lack of awareness and lack of interest could be one of the reasons for farmers' inability to assess the profitability of agroforestry practices about other alternatives. Farmers, therefore, need more information and training on agroforestry relative to other agricultural activities, which limits the spread of some practices, to increase their awareness and interest in agroforestry practices.

3.10 Test of Hypothesis

3.10.1 Decision

From the result of the logit regression two of the predicators namely; the level of education and income were statistically significant at various levels of probabilities. Therefore we reject the null hypothesis which stated that there is no significant relationship between farmers' socio-economic characteristics and adoption of agroforestry practices.

Table 7. Distribution of respondents based on benefits of agroforestry practices

Benefit	Frequency	Percentage
Increased food production	110	91.0
Increased soil fertility	105	87.5
Provision of fuelwood/timber	78	65.0
Provision of shade for workers	66	55.0
Conservation of soil moisture	61	51.0
Control of soil erosion	55	46.0
Biodiversity conservation	48	40.0
Provision of fodder for livestock	46	39.0
Reduced effect of climate change	39	33.0
Source of medicinal herbs	37	31.0
Lowering soil surface temperature	31	26.0

Multiple responses

Table 8. Factors influencing farmers adoption of agroforestry practices

Variables	Odds Ratio	Std. Err.	Z
Constant	0.1386487	0.2092621	-1.31
Age	1.021845	0.0186933	1.18
Education	1.033388	0.1920734	3.15***
Household size	1.126462	0.3679022	0.36
Income	0.999994	2.190	2.89**
Membership	2.49749	1.030907	2.22**
Land tenure	2.52369	1.033833	2.26**
Extension visit	0.8102216	0.3362964	2.65**
Log-likelihood: -71.516633			
Pseudo R^2: 0.6866			
LR chi^2 : 23.56			
Prob > chi^2: 0.0597			

*** and ** represent 1% and 5% probability levels respectively

Table 9. Distribution of respondents based on constraints to adoption of agroforestry

Constraint	Frequency	Percentage
Government policies	9	7.5
Land and tree tenure rights	86	71.0
Low awareness of agroforestry	50	42.0
Lack of knowledge and skills	55	46.0
Long gestation period to obtain benefits	65	54.0
The high cost involved in adoption	51	43.0
Increased demand for arable land	23	19.0
Traditional beliefs and taboos	13	11.0
Complexity	31	26.0

Multiple responses

4. CONCLUSION

Based on the findings of the study, it can be concluded that majority of the respondents were married and within their active ages. Majority of the respondents had one form of education or the other with reasonable years of farming experience. The mean annual income of respondents is N113,529. The logit regression result showed that that educational level, income, membership of cooperatives and land tenure had a significant relationship with the adoption of agroforestry practices at different levels of probabilities. The average number of agroforestry practices adopted by the farmers is approximately 2 with home garden mostly adopted by the farmers. The adoption of agroforestry by farmers in the study area is not satisfactory. The major constraints to adoption of agroforestry practices include; land and tree tenure rights, long gestation period to obtain benefits, lack of knowledge and skills in agroforestry and low awareness of agroforestry practices amongst the farmers.

5. RECOMMENDATIONS

Based on the findings of this study, the following recommendations among others are put forward:

There should be a formulation of a good land use policy so that farmers can acquire land titles to guarantee the security of their land. Women in Africa have limited rights to land. It is because land tenure systems in many parts of Africa grant rights to own and dispose of land to adult males. Therefore harmonization of policies and regulations are required since it will grant women access to land.

An awareness campaign on increasing the number of trees to be planted in homestead should be embarked upon by extension agents through personal contact and mass media since the number of trees planted and/ or protected were reducing annually. The efforts of the extension agents in creating awareness could also be complemented by the various organizations working with farmers' organizations and government agencies in rural areas.

The number of extension visit to farmers is not encouraging and this could affect the dissemination of agroforestry practices. Therefore, there is a need for the three tiers of government to improve the extension-farmers ratio so that more farmers could be reached and the contract period could be enhanced for sustained production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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