

FARMERS' PERCEPTION AND ADOPTION OF AGROFORESTRY PRACTICES IN JEMA'A LOCAL GOVERNMENT AREA OF KADUNA STATE, NIGERIA

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Abstract

This study investigated the level of perception and adoption of agroforestry practices in Jema'a L.G.A, Kaduna State, Nigeria as well as the factors influencing the adoption rate. One hundred and forty one (141) randomly sampled farmers from six communities were interviewed using the semi-structured questionnaire in conjunction with focus group discussions and field observations. The study employed the use of descriptive and inferential statistics. The binary regression model was employed to determine the factors influencing agroforestry adoption rate in the study area. A larger percentage (53%) of the farmers was non adopters while 47% adopted the practice. Major trees planted and/or retained were teak, oil palm, gmelina, mango, oha, banana, black plum, locust bean, guava, orange, pawpaw, moringa and iroko. The most adopted practice was tree planting in boundaries (46%), followed by scattered trees on farm lands (40%), alley-farming (about 36%) and home gardening (30%). The study revealed that though the farmers have favourable perceptions about the benefits of agroforestry such as its economic advantage (4.58), improvement in soil output (3.82) and reducing soil erosion (3.75), a large number with an index of 4.11 perceived it as a practice that limits the growth of crops because of the shade the trees provided and a practice that is expensive (3.65). The binary regression model showed that landownership and agroforestry knowledge with coefficients 3.633, and 0.478 respectively, at $P < 0.05$; age (2.175), marital status (0.236) and farming experience (0.487) at $P < 0.01$ influenced agroforestry adoption significantly. Though the level of agroforestry adoption is low, with a favourable perception it is recommended that the government and other relevant stakeholders provide improved agroforestry extension services and training programmes for farmers thereby exposing the practical aspects of the practice.

Keywords: Perception, Agroforestry, Biodiversity, Conservation

INTRODUCTION

The world's population is increasing at an unprecedented rate with its antecedent environmental degradation. Rapid population growth especially in sub-Saharan Africa has put a lot of pressure on limited arable land as large number of mouths needs to be fed. Ausubel, Wernick, and Waggoner (2013) pointed out that increasing population will lead to expansion of urban areas and an increased demand for food production, and associated demand for agricultural land. Even though Africa's population is largely rural whose livelihoods depend primarily on agriculture and exploitation of forest resources, in recent years there has been a more recent influx of urban dwellers to rural areas acquiring and developing land for agricultural purposes to feed the teeming population. This pressure has led to shortened fallow cycles on the already scarce

lands and extensive use of marginal lands causing constraint to future food and wood production. The assertion by Ausubel *et al.*, (2013) that the area of agricultural land available for food production appears to have peaked and the proportion of wood sourced from native forests declined and will decline further to ensure that global challenges of biodiversity loss and climate mitigation can be addressed might be an illusion. A large percentage of both rural and urban people are still dependent on fuelwood sourced from native forests causing biodiversity loss and climate change. In order to make wood available, restore fertility and improve land productivity, trees, crops and/or livestock have over the years been integrated in farm lands (Cook and Grut, 1989). Such systems have now been referred to as agroforestry systems. The

International Council for Research in Agroforestry (ICRAF) defined agroforestry as a land-use system and practice in which woody perennials are deliberately grown on the same land with crops and/or animals (Lundgren, cited in Cook and Grut, 1989). This

can be either in some form of spatial arrangement or in a time sequence. Though agroforestry "systems" and "practices" are often used synonymously, Nair (1993) defined system as a specific local example of a practice, characterized by environment, plant species and their arrangement, management, and socioeconomic functioning, and practice as a distinctive arrangement of components in space and time. He classified agroforestry into agrisilviculture, silvo-pastoralism and agro-silvi-pastoralism. Agrisilviculture combines agronomic and forest tree crops/woody perennial e.g. taungya system, alley cropping, alternate row planting, random mix or scattered tree farm or parkland system, live fencing and planting, Silvo-pastoralism refers to trees with pastures and livestock, and agro-silvi-pastoralism is trees, crops and pasture/animals.

Over the years, agroforestry has increasingly been recognized as a useful and best approach to natural resource management that combines the goals of sustainable agricultural development with greater environmental benefits. These include biodiversity conservation, improved soil fertility, providing shade and windbreakers (Nair, 2007, Gold and Garrett, 2009) as well as moderating the effect of climate change variations (Oelbermann and Smith, 2011). Mbow, Noordwijk, Prabhu, and Simons (2014) and van Noordwijk, Mbow and Minang (2015) reiterated its importance in sustainable land use intensification and achieving the United Nations Sustainable Development Goals. While its emphasis in developing countries is on alleviating poverty, securing nutritional security and arresting land degradation (Jose, 2009; Nair, Kumar and Nair, 2009), in developed nations it's in providing ecosystem services (Nair, Kumar and Nair, 2009).

MATERIALS AND METHODS

Study Area

Jema'a Local Government Area is located between latitudes 9° 11' and 9° 30' N and longitudes 8° 00' and 8° 30' E. It is bounded in the East by Kaura Local Government, in the North by Zangon Kataf LGA, in the West by

In view of these, the willingness to adopt or not to adopt agroforestry is dependent on its perception, a process where individuals organize and interpret their sensory impression in order to give meaning to their environment (Robbins, Levesque, Redding, Johnson, Prochaska, Rohr, and Peters, 2001). Farmers' perception therefore on any technology depends on their decision-making on the perceived usefulness of such technology. According to Duvel (1991, 1994) household perception about a technology influences its adoption. He explained that adoption is influenced by socio-economic, environmental and mental processes; which are intervened by knowledge about agroforestry, needs and the methods to acquire these needs. To Buyinza, Banana, Nabanoga and Ntakimanye (2008) farmers' decisions to adopt certain agroforestry systems is based on gender, household size, farm size, fuel wood scarcity and income of the household.

According to Kaczan, Arslan and Lipper (2013) agroforestry over the years received little or no attention not until recently as a result of agricultural and environmental concerns. How is the case of Jema'a LGA. Jema'a, by observation has suffered deforestation over the years due to crop cultivation and overexploitation of forest resources which have intensified with increase in human population. For example, a study by Musa, Yakubu, Ya'u, Muhammad, Ishaya and Vivan (2014) revealed that the size of the Nimbia forest reserve in the study area reduced from 75.59% area coverage in 1998 to 48.66% in 2010 as a result of illegal tree felling and farming activities. This encroachment signifies a reduction in available agricultural land and wood. Achieving sustainability of these in the area can be through agroforestry. The study therefore seeks to determine the level of agroforestry perception and adoption by farmers in the area as well as examining factors influencing their adoption or non adoption.

Jaba LGA, in the South-East by Sanga LGA and in the South by Nassarawa State (figure 1). With a land mass of 1,661 km² it has witnessed a tremendous population growth in the last 30 years (Abaje, Ati and Ishaya, 2009).

The area is characterized by wet and dry seasons typical of the Aw type of climate as

classified by Koppen. Rainfall occurs between the months of April and October with a peak in August and a mean annual rainfall of about 1800 mm. The mean monthly temperature is 25°C while the average relative humidity is about 62% (Abaje *et al*, 2009). The orographic effects of the Jos-Plateau and the Kagoro Hills have influence on the climate of the area in particular on rainfall, temperature and relative humidity. The area is relatively flat with sparse undulating hills. The soil is tropical Ferruginous with clayey and sandy soils found along river banks. The vegetation is Guinea Savanna characterized by clustered trees, shrubs and grasses in abundance. The people are predominantly farmers though some are civil servants and traders and majority taking farming as a minor occupation. The crops cultivated are mostly maize, yam, ginger and cocoyam (Abaje *et al*, 2009).

Methods of Data Collection and Analysis

A multi-stage sampling technique was used. The study sampling frame constitutes the eight (8) districts of the area. Firstly, the simple random was used to select four (4) districts (50%) (Kafanchan Kewaye, Godogodo, Fadan Kagoma and Bakin Kogi). The random

selection was based on the fact that the population is predominantly farmers. Thirdly, five (5) wards (Maigizo, Takau, Gidan Waya, Kagoma and Kaninkon) out of the ten (10) wards were selected randomly using the hat and draw method.

The simple random sampling based on Zhen, Zoebisch and Feng (2006) and Saha, Sharmin, Biswas and Ashaduzzaman (2018)'s methods was used to select seven (7) communities out of a total of sixty five (65) communities. These communities are Zikpak, Unguwan Yanshi, Anguwa Fari, Unguwan Baki, Unguwan Shuwaka, Unguwan Rana and Unguwan Toro. Due to the homogeneity of the population all being farmers, five percent sampling was used to sample one hundred and forty one household heads out of the 2779 using the table of random numbers. The semi-structured questionnaire was used to collect data on the socioeconomic characteristics of the farmers, their knowledge about agroforestry, the type of agroforestry practices employed, tree species planted and their perceptions about agroforestry. Field observations as well as focus group discussions (FGD) were also employed to complement data collected using questionnaire.

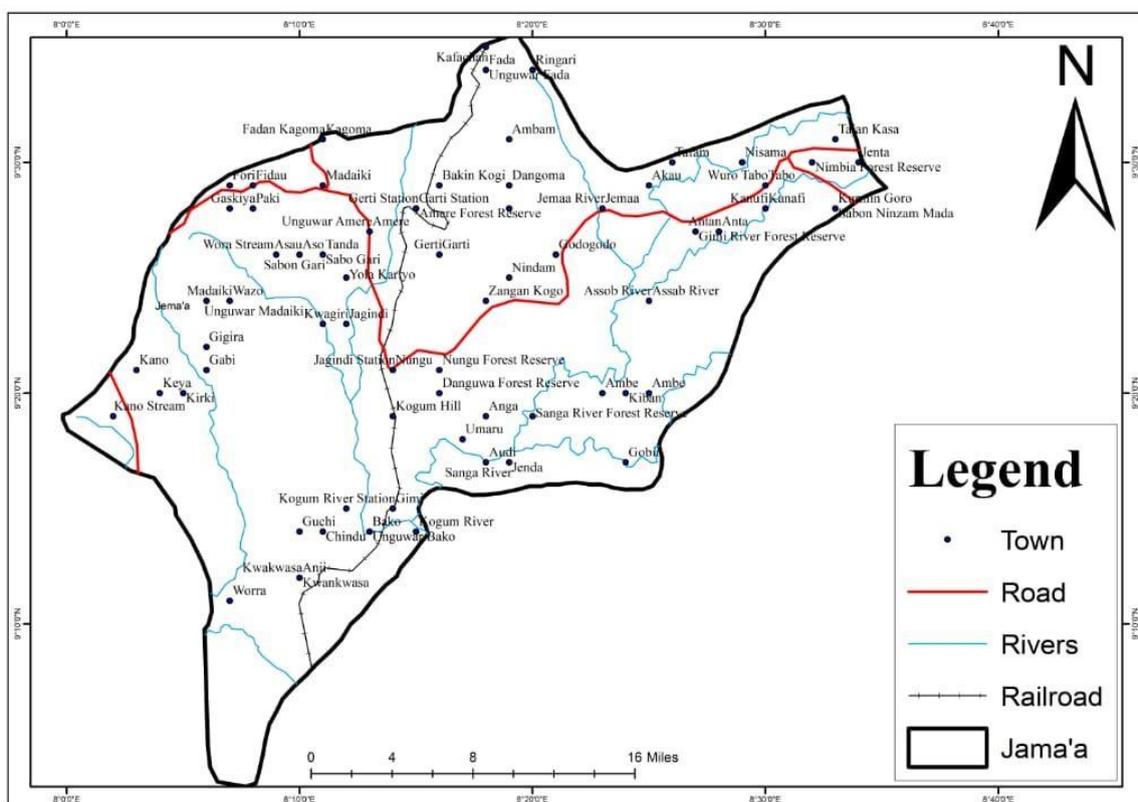


Figure 1 Jema'a LGA showing the communities

RESULTS AND DISCUSSION

Socio-economic Characteristics of Farmers in the Study Area

Results on the socio-economic characteristics of respondents are presented on table 1. Out of the 141 farmers, majority of them constituting 66.7% were males while 33.3% were females. The results also showed that 68% of them were married and falling within the active age groups

with majority (62%) having a post-primary level of education. Majority of the farmers (84%) own land and all have farming experience though this varies from one individual to the other. The table also revealed that majority (52.5%) of them non adopters of agroforestry.

Table 1 Socio-Economic characteristics of respondents in the study area

Socio-Economic Characteristics	Frequency		Percentage (%)
	Agroforestry adopters	Agroforestry non adopters	
Gender			
Female	23 (34.3%)	24 (32.4%)	33.3
Male	44 (65.7%)	50 (67.6%)	66.7
Marital Status			
Single	14 (20.9%)	31 (41.9%)	31.9
Married	53 (79.1%)	43 (58.1%)	68.1
Age			
20-29	4 (6.0%)	6 (8.1%)	7.1
30-39	13 (19.4%)	20 (27.0%)	23.4
40-49	15 (22.4%)	17 (23%)	22.7
50-59	18 (26.9%)	19 (25.7%)	26.2
60-69	11 (16.4%)	7 (9.4%)	12.8
70-79	6 (8.9%)	5 (6.8%)	7.8
Level of Education			
non formal	3 (4.5%)	13 (17.5%)	11.3
Primary	11 (16.4%)	27 (36.5%)	27
Secondary	20 (29.9%)	22 (29.7%)	29.8
Tertiary	33 (49.2%)	12 (16.2%)	31.9
Farming Experience			
1- 4	15 (22.4%)	19 (25.7%)	24.1
5 - 9	33 (49.2%)	42 (56.7%)	53.2
10 - 14	13 (19.4%)	10 (13.5%)	16.3
15 - 19	5 (7.5%)	2 (2.7%)	5.0
20 -	1 (1.5%)	1 (1.3%)	1.4
Land Ownership			
Borrowed/rented	2 (3.0%)	20 (27.0%)	15.6
Owned	65 (97.0%)	54 (73.0%)	84.4

Source: Field Survey, 2019

Farmers' Perception of Agroforestry

There is a variation in the farmers' perception on agroforestry practices among farmers as presented on tables 2 and 3. Results on table 2 revealed high mean scores (3 and above) implying a positive perception on the benefits of agroforestry with exceptions for bush fires and carbon absorption where the mean scores were below average. This could be due to lack

of knowledge of such benefits by the farmers. This is in line with Wireko (2011), Adedayo and Sobola (2014) and Akinwalere (2017) who revealed that farmers perceptions on agroforestry vary greatly thus affecting the adoption rates.

From the focus group discussions, most non adopters perceive it as an expensive practice with trees also limiting crop growth

due to the shade they provide. From the results presented on table 3, there is a higher perception index (3.88) which means that their negative perception was higher.

Adoption of Agroforestry Practices among Respondents in the Study Area

Out of the 141 respondents, majority of the farmers constituting 52.5% did not adopt any agroforestry practice while only 67 of them

constituting 47.5% of the total respondents did adopt. Information gathered from both questionnaire and focus group discussions revealed that the non adoption is due to inadequacy of farmland, tenant farming and lack of access to credit facilities, inadequate contact with extension agents, inadequate knowledge on agroforestry and high cost of establishing such farms.

Table 2 Farmers' Perceptions on the benefits agroforestry adoption

Items	Min	Max	Mean score	Std.	D%	N%	A%	SA%
Has economic value	4	5	4.58	0.495			31.80	58.20
Improves yield/output	2	5	3.75	0.911	14.90	12.10	56.00	17.00
Improves soil nutrient	2	5	3.82	0.909	13.50	10.60	55.30	20.60
Improves water conservation	2	5	3.26	0.966	30.50	19.90	43.30	6.40
Prevents bush fire	2	5	2.85	0.869	44.00	29.10	24.80	2.10
Reduces soil erosion	2	5	3.01	1.018	44.00	18.40	30.50	7.10
Improves food security	2	5	3.31	1.147	36.20	14.90	30.50	18.40
Can improve carbon	2	5	2.86	0.946	48.90	19.90	27.70	3.50
Overall perception index			3.43					

Source: Field Survey, 2019.

Table 3 Farmers' perceptions on the disadvantages of agroforestry adoption

Statement on Agroforestry System	Min	Max	Mean Score (Perception)	Std	D%	N%	A%	SA%
Agroforestry limits plant growth	2	5	4.11	0.837	8.50	4.30	54.60	32.60
Agroforestry is expensive	2	5	3.65	1.817	19.10	21.30	46.80	12.10
Overall perception index			3.88					

Source: Field Survey, 2019.

As presented on table 1, males constitute the highest percentage of those practicing agroforestry in the study area, accounting for over 60% while females made up just above 30% of the respondents. Married people practiced agroforestry more than single people in the study area. This can be attributed to the fact that married people have more responsibilities when it comes to family issues.

Majority of the respondents (32.6%) were middle aged, 4.3% were old and less than 3% of the respondents were young. The table indicates that majority of the respondents (49%) have studied up to tertiary level, followed by

about 30% secondary level and more than 15% primary with only less than 5% being illiterate. Different studies revealed that the socio-economic characteristics had much influence on the adoption behaviour regarding new practices.

Types of Agroforestry Practices Adopted in the Study Area

The adopted agroforestry practices presented on table 4 revealed that almost half of the adopters practiced tree planting on boundaries (plate i). This is to avoid conflicts pertaining to farm ownership and shade that limits crop

growth limit at the same time, benefiting from their economic value. This is closely followed by scattered trees on farmlands (plate ii) with over two-fifths of the adopters practicing it. This is because some of the plants provide food, fuelwood, income as well as shade during periods of harsh weather. Examples of such

species include locust bean tree, gmelina, teak and mango trees. A study by Alao and Shuaibu (2013) presented similar results. Alley farming (for food and soil fertility) and home gardening (for food) were equally adopted though lower compared to the former two.

Table 4 Adopted agroforestry practices

AGROFORESTRY PRACTICES	FREQUENCY	PERCENTAGE (%)
Tress on boundaries	31	46.3
Scattered trees	27	40.3
Alley-cropping	24	35.8
Home gardening	20	29.9

Source: Field survey, 2019.

NOTE: Values are not mutually exclusive

Types of Tree Species Planted by Respondents in the Study Area

As presented on table 5, the most common species planted/retained in farms include *Tectona grandis*, *Elaeis guinensis*, *Gmelina arborea*, *Newbouldia laevis*, *Mangifera indica* and *Pterocarpus mildbraedii*. Products from them are used for subsistence and traded to generate income except for *Newbouldia* that is used as a boundary tree. Similar studies by Adedapo (2014) and Adedayo and Oluronke (2014) revealed that the most planted/retained trees were adopted for same reasons though the species types vary from those of the present study. This might be due to the differences in the biogeoclimatic locations of the study areas.

Banana, African black plum, guava, *citrus species*, pawpaw and moringa showed low responses because they are mostly used for household consumption. Though with high economic value, the iroko tree had the lowest response (15%) because crops don't grow well under it as reported by the farmers. Farmers' responses showed that they have knowledge of some of the trees around them, their benefits and disadvantages when it comes to integrating them in their farms. This is in line with Wireko (2011) and Abdallah (2017) who stated that farmers do plant or retain trees on their farm land based on their knowledge of the species.

Level of Agroforestry Adoption in the Study Area

The study revealed that more than half of the farmers (52.5%) did not adopt any agroforestry practice while the remaining (47.5%) adopted (table 1). Farmers reasons for non adoption of agroforestry (as reiterated during FGDs) include inadequacy of farmland, lack of access to credit facilities, inadequate contact with extension agents, the cost of establishing such farms, inadequate knowledge on agroforestry and tenant farming period in descending order of gravity.

The area of farmland allocated for agroforestry practice (table 6) is very small as over 80% of the adopters make use of one (1) or less hectare for the practice while less than one fifth of them allocate 2-3 hectares for agroforestry. Other studies such as Wireko (2011), Adedayo & Sobola (2014), Wanjiru (2015) and Abdallah (2017) showed high adoption of agroforestry which according to them are attributed to high levels of agroforestry awareness and education. The low level of adoption in this study area can be attributed to a low understanding of the working mechanism of agroforestry systems since agroforestry systems as noted by Wireko (2011) are knowledge intensive and therefore require enough education and understanding of the process.

Table 5 Tree species and some of their characteristics in the study area

Common Name	Scientific Name	Desired Characteristics	Undesired Characteristics	Percentage (%)
African Teak	<i>Tectona grandis</i>	Timber for roofing and income generation/firewood, Boundary demarcation	Gives too much shade thereby impeding plant growth	88.1
Gmelina	<i>Gmelina arborea</i>	Provides timber and firewood for use and sales. Decayed leaves add manure to the soil. Boundary demarcation	Gives too much shade	49.3
Oil Palm	<i>Elaeis guinensis</i>	Provides oil for use and sale		65.7
Mango	<i>Mangifera indica</i>	Provides fruits for household consumption/sale Decayed leaves add nutrients to the soil. Provides shade around the house and on the farm	Attracts insects	44.8
Guava	<i>Psidium guajava</i>	Provides fruits for consumption /sale		29.9
Pawpaw	<i>Carica papaya</i>	Provides fruits for consumption		22.4
Oha	<i>Pterocarpus mildbraedii</i>	Tender leaves for food/sale to generate income		43.3
Locust bean tree	<i>Parkia biglobosa</i>	Seeds for soup condiments Leaves improve soil structure		37.3
Orange	<i>Citrus sinensis</i>	Fruits for consumption. Gives shade around the house	Attracts insects	29.9
Lemon	<i>Citrus limon</i>	Fruits for consumption/sale		11.5
Lime	<i>Citrus aurantifolia</i>	Fruits for consumption/sale		9.8
Life tree	<i>Newbouldia laevis</i>	Boundary demarcation		46.3
Neem	<i>Azadirachta indica</i>	Medicine for malaria and typhoid	Leaves dry up easily	29.9
African black olive	<i>Canarium schweinfurthii</i>	Provides fruit for consumption		37.3
Iroko	<i>Milicia excelsa</i>	Timber for sale	Impedes crop growth	14.9
Banana	<i>Musa species</i>	Provides fruit for consumption/ sale to generate additional income		37.3
Moringa	<i>Moringa oleifera</i>	Leaves for food/sale. Leaves, roots and seeds for medicine		22.4

Source: Field Survey, 2019.

Table 6 Area of land occupied for the new technology

Hectares	Frequency	Percentage (%)
<1-1	56	83.6
2-3	11	16.4

Source: Field Survey, 2019.

Factors Influencing Agroforestry Adoption in the Study Area

Several factors tend to significantly influence the adoption of agroforestry. The regression results of factors that influence the adoption of agroforestry practice (table 1) in the study area is as shown on table 7. The results revealed that age, marital status, agroforestry education awareness, landownership, land size, farming experience were significant variables that influence the decision of farmers to adopt agroforestry practices. The farming experience of farmers was found to be significant at $p < 0.05$ implying that an increase in farmers' farming experience will increase adoption by 0.487, a positive coefficient and an odd ratio of 1.628. This means that with other explanatory variables constant in the model, farmers with more general farming experience will adopt agroforestry practices one time more than those with less general farming experience. This result is in line with that of Zerihun, Muchie and Worku (2014). This is connected to the fact that farmers with more farming experience have adequate indigenous knowledge on how to integrate trees with crops on the same farmland.

Age was found to be significant at $P < 0.05$ which implies that with an increase in age of a farmer, agroforestry practice adoption will likely increase by an average of 0.478. Most of the adopters are above 40 years old. The reason for age being significant can be attributed to experiences gained over the years. Thangata and Alavalapati (2003) study is at variance to this with agroforestry adopters being younger than non-adopters. In terms of gender, men were more adopters. Wanjiru (2015) study revealed that sex influences adoption in that women in the study area adopted agroforestry more than men. This was attributed to higher population of females than males in the area.

Marital status was also significant at $P < 0.05$, which connotes that agroforestry practice adoption would increase by 0.236. This confirms the information gathered from farmers as majority of the respondents were married

household heads with a lot of responsibilities in providing for their families and as such the need for diversification to earn more food and income.

Agroforestry education awareness was significant at 1% implying that increase in this factor will increase farmers' adoption by 2.175 which support Wanjiru (2015) findings that agroforestry practices are knowledge intensive and therefore require enough education in the adoption process. However, level of education did not have a significant effect on the adoption of agroforestry practices in the study area. Most of the farmers had formal education but other factors such as land ownership limited their adoption.

However, landownership was significant at $p < 0.05$ implying that increase in individuals' land holdings for agroforestry purposes, will likely increase adoption rate by 3.633. With an odd ratio of 37.821, if the other explanatory variables are constant in the model, farmers who own lands will adopt these practices thirty seven (37) times more than those who do not. Tenants of agricultural lands do not have complete ownership and control to plant and own trees on such lands thereby making it difficult for them to adopt agroforestry practice. Adedayo & Sobola (2014) study recommended that, elimination of unfavourable tenure and land use regulations be considered in order to reduce the risk of tree planting for smallholder farmers, to ensure that they reap the benefits of their efforts. Farm size was not significant in influencing the adoption of agroforestry. Adedayo and Sobola (2014) and Akinwalere (2017) also noted that farm size has no significant influence in agroforestry adoption. According to them, the selection of any agroforestry practice is not based on the size of the farm; no matter what the farm size is, agroforestry could be practiced. This is contrary to studies of Amsalu and de Graaff (2007) and Saha, Sharmin, Biswas and Ashaduzzaman (2018) where farmers with larger farms showed interests in adopting agroforestry than those with smaller farms.

Table 7 Regression results of factors influencing agroforestry adoption

Variable	Coefficient	S.E	Wald	df	Sig.	Exp(B)
Gender	-0.635	0.478	1.766	1	0.184	0.530
Marital status	-0.236	0.573	0.169	1	0.500**	0.620
Age	-0.478	0.238	4.034	1	0.045**	0.620
Level of Education	0.447	0.259	2.972	1	0.085	1.563
Household Size	-0.013	0.253	0.003	1	0.959	0.987
Land Ownership	3.633	0.923	15.488	1	0.000***	37.821
Size of Farmland	0.380	0.298	1.623	1	0.203	1.462
Farming Experience	0.487	0.227	4.598	1	0.032**	1.628
Agroforestry Knowledge	-2.175	0.596	13.314	1	0.000***	0.114
Constant	-2.394	1.134	4.452	1	0.035	0.091
Model summary						
-2Log likelihood				122.7		
				54		
Cox and Snell R Square				0.401		
Nagelkerke R Square				0.536		
Hosmer and Lemeshow			Test Chi-square			
			3.740	8	0.880	
Omnibus tests of model coefficients			72.366	9	0.000	

** and *** are 5% and 1% significant level respectively

Source: Field Survey, 2019.

CONCLUSION

Agroforestry, a type of farming practice is a land use management or farming system where trees and/or shrubs are planted in combination with crops and/or animals on the same piece of farmland. To adopt this practice depends on its perception of having benefits or not. There is a higher perception index for the negative effects which means that the negative perception was higher thus affecting the adoption level negatively. Due to inadequate knowledge of agroforestry and land, tenant farming, lack of extension contact and high cost of establishing agroforestry farms, the adoption level was relatively low. With increase in age, agroforestry education awareness, land ownership, land size and farming experience farmers' decision to adopt agroforestry increased in the study area.

It is therefore recommended that improved agroforestry extension services be provided to help solve the problems of lack of knowledge about agroforestry practices. Training programmes for farmers in the study area should be conducted with practical

demonstration of some agroforestry practices like tree crop interactions, nursery establishment, seed pre-treatment and tree pruning activities. This will help to expose them to some practical aspects of agroforestry.

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