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PERCEPTIONS AND ADOPTION OF AGROFORESTRY TECHNOLOGY AS CLIMATE CHANGE MITIGATION STRATEGY AMONG FARMERS IN OYOSTATE, NIGERIA

By

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ABSTRACT

This study examined the farmers' perception and adoption of agroforestry technologies as a climate change mitigation strategy in Oyo State, Nigeria.A multi-stage sampling technique was applied to identify199 respondents from the study area. Data were analyzed with the aid of descriptive statistics as well as inferential statistics such as Likert scale and Tobit model.Results of analysis showed that47.2% of the sampled respondents were adopters of agroforestry technology.The result further showed the different forms of agroforestry practices adopted by the farmers which include boundary planting, multipurpose trees/shrubs, wind breaks and live fencing.Majority (77.66%) of the adopters' practice only one agroforestry practice and only 22.34% of them adopted two forms of agroforestry technologieswhile none of them adopted more than two forms of agroforestry technologies. Tobit analysis revealed that gender, age, education level, access to extension services, farming experience and farm size were positive and significant(at 5% level) factors in determining the intensity of adoption of agroforestry technologies among the farmers.The respondents agreed that agroforestry improves soil fertility and reduces the microclimate of the area. Many constraints were discovered to militate against the adoption of agroforestry technologies by farmers in the study area. These include lack of knowledge and required skills on agroforestry, long gestation period of trees, scarcity of land for tree planting and lack of planting materials. Others are lack of technical assistance, competition among trees and arable crops on farmland and illegal felling of trees. In view of the findings, the study recommends that efforts should be geared towards increasing adoption of agroforestry technology through enlightenment and sensitization of farmers on the importance of agroforestry and the need for its adoption, so as to enjoy the benefits of agroforestry practices in the study area.

Keywords: Perception, Agroforestry Technology, Climate Change Mitigation, Tobit model and Oyo State.

INTRODUCTION

Pronounced changes in climatic conditions being experienced in recent times have become global phenomenon and cause of grave concern to government and individuals (Lemos and Tompkins, 2008). It is feared that an unmitigated climatic change will adversely affect human beings in various ways ranging from the distribution of vector diseases, non-availability of water, plant growth retardation, and decline in agricultural productivity and food insecurity. Climate change threatens to block pathways out of poverty in developing countries, especially in Africa (Lemosand Tompkins, 2008). Climate change is also expected to intensify disaster risk in the coming decade by causing more frequent and intense hazard events and increasing vulnerability of prone communities to the existing hazards (ISDR, 2008). Necessary measures are already being taken by various national governments, world bodies and agencies as well as individuals to checkmate this overriding environmental problem. One ofsuch measures that have been acknowledged as a panacea to climate change is tree planting alongside with food crops commonly called agroforestry.

Agroforestry practices play a criticalrole in global climate regulation as forest trees absorb carbondioxide, a greenhouse gas believed to be responsiblefor global warming (Akinwalere, 2017).Therefore, Agroforestry has been defined as a dynamic, ecologically based, natural resource management system, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production and contributes to more resilient rural livelihoods (Prabhu*et al*., 2015).Agroforestry systems have the potential to generate cash income and to provide poor households with a more reliable supply of food, home-grown medicines and substitutes for products they cannot afford to buy – for example, nitrogen-fixing tree plants instead of mineral fertilizers; fodder shrubs instead of dairy meal; timber for the construction of buildings; and fuelwood for energy (FAO, 2005).Main agroforestry practices include improved fallows, home gardens, alley cropping, combining trees and crops in multi-storeys, boundary planting, agroforests, woodlots, orchards, windbreaks and other types of shelterbelts, hedges and live fences, fodder banks, trees on pasture, and taungya systems (FAO, 2006).

Agroforestry holds great promise for contributing to sustainable landuse systems which can overcome the problem of land degradation and the "food crisis" which is a pressing problem in Nigeria (Vihi*et al*., 2019). Farmers can benefit from agroforestry technologies that give solutions to issues with soil productivity, environmental remediation, product diversification, and economic problems (Nair, 1996; Franzel and Scherr, 2002). The economic benefits include an increase in farm revenue through the optimization of land production (Gold*et al*., 2009). Agroforestry also produces important environmental benefits including control of wind erosion, reduction of run-off, stabilization of stream banks, improvements in internal drainage and infiltration, and enhancement of aquatic and terrestrial habitats (Gold and Garrett, 2009).

In spite of these benefits, the adoption of agroforestry technologies at the farmer level is low and hence, efforts to increase the adoption of these technologies should take into account the socio-economic issues (Kabwe et al., 2016). However, it has been observedthat some problems are affecting the adoption of agroforestry technologies. Several studies have examined the determinants and constraints to the adoption of agroforestry technologies (Orisakwe and Agomuo, 2011; Franzel *et al*., 2004). Pannell (2003), indicated that several factors aremost likely to affect adoption of agroforestry technologies. These include: risk and uncertainty, household preferences, resource endowments,land tenure, market constraints, inadequate extension work, and policy constraints. It is against this background that this study is conducted to determine farmers' perception of agroforestry adoption in the study area. Because when this is achieved, farmers will acquire practical knowledge to help address their landuse problems as they benefit from the agroforestry technologies.

Adoption of an innovation is influenced by farmers' perception and their socio-economic characteristics (Adesina and Baidu-Forson, 1995). Adoption of new agricultural technology is always at the center of policy interest in developing countries. It is an important option for farmers to increase food production thereby making more food available and accessible to the poor household. There are several factors that influence the adoption of technological innovation, one of which is farmers' perception (Orisakwe and Agomuo, 2011).The perception and views of the farmers is very central to the adoption of the new technologies. Farmers' ability to perceive the effectiveness of a technology as a potential solution to a problem is very fundamental condition for the decision to adopt such technology. Farmers' decision about a particular technology is also dependent on their subjective preference of the technology in terms of perceived impacts on output (Owombo and Idumah, 2017).

Evidence shows that the adoption of agroforestry as a component of a multifunctional landscape management can be a viable land-use option that contributes to poverty alleviation and multiplicity of ecosystem services and environmental benefits (Buttoud*et al.*, 2013). The importance of adopting agroforestry as a land-use system is receiving wide recognition not only in the area of agricultural sustainability but also as a strategy for the mitigation of climate change (Albrecht and Kandji,2003). The adoption of agroforestry technology may be influenced by a number of factors which include the perception of the technology and socio-economic characteristics of the farmers. Sofoluwe*et al.* (2011) posited that farmers' perception of a technology as well as the change in the climate conditions are also important variables in climate change mitigation and adaptation.

Perception of farmers about theadoption ofagroforestry is diverse (Wireko, 2011). Fregene (2007) proved that the economic benefits of agroforestry had a positive effect in adopting agroforestry while Valdivia and Poulos (2009) found that they were not a driving factor.

Meanwhile, Owombo*et al.* (2018) in their study on the perception and adoption of agroforestry technology as a climate change strategy by farmers in Edo state, Nigeria reported thatfarmers perceived agroforestry as soil enhancing technology that also has the ability to mitigate climate change. Kareem *et al*. (2017) reported that farmers in Ogun state, Nigeria are aware of changes in climate variables like rainfall and temperature and that there is a significant associationbetween age and some other socioeconomic variables of the respondents and the need to mitigate the effects of climate change.

Olajuyigbe (2016) in a study on the potential role of traditional agroforestry in climate change mitigation in rural communities of Oyo State, Nigeriareported that agroforestry is becoming widely recognized not only in terms of agricultural sustainability but also in issues related to climate change adaptation and mitigation. In the study, farmer's awareness and participation in agroforestry practices as well as their knowledge of the importance of trees in mitigating the impacts of climate change were assessed.

Efforts have been made over the years to ensure that improved agroforestry practices are adopted, to reduce some of the environmental and economic problems or challenges facing the farmers. This study therefore, attempts to fill the gaps in the previous studies by assessing the factors that influence the adoption level of agroforestry and the intensity of adoption among the rural communities in Oyo state. This study goes further to examine the perception of farmers and their adoption of agroforestry technology as climate change mitigation strategy in Oyo State, Nigeria, under the following specific objectives:

Specific Objectives

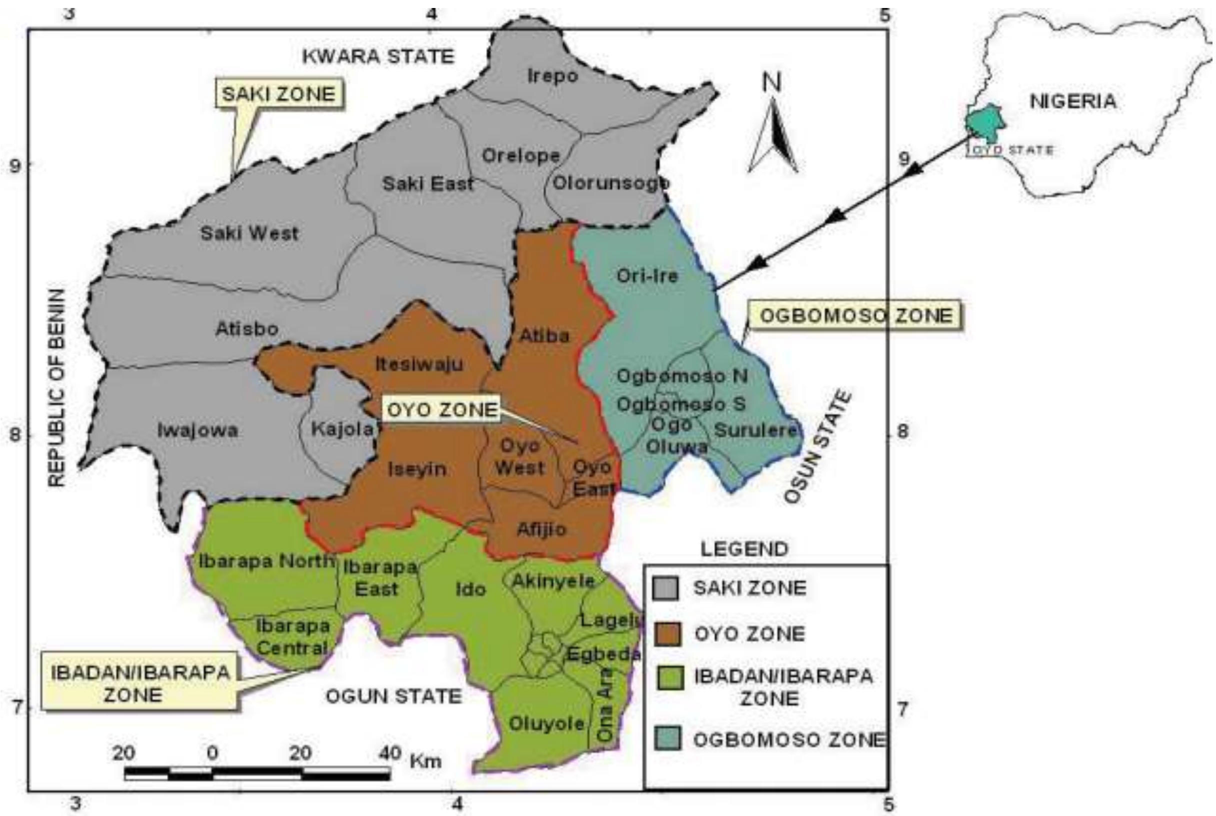
1. To determine the various forms of agroforestry technologies adopted by the farmers and assess the level of adoption in the study area.
2. To determine factors influencing the intensity of adoption of agroforestry technologies among farmers in the study area.
3. To examine the perceived effects of the adoption of agroforestry technology on climate change mitigation in the study area.
4. To identify factors militating against the adoption of agroforestry in the study area.

MATERIAL AND METHODS

Study Area

The study was carried out in Oyo State, Nigeria, which lies between latitudes 6.5 ˚ and 9 ˚ north of the Equator and between longitudes 3 ˚ and 5 ˚ east of the Greenwich Meridian. Oyo State is located in the South-west zone of Nigeria (NPC, 2006). The state consists of thirty-three (33) Local Government Areas and covers an area of 28,454 square kilometers. Agriculture is the main occupation of the people and small-scale traditional farming system predominates in the area. The bulk of the produce come from annually cultivated rain-fed farms. Oyo state has four Agricultural Development Programme (ADP) zones, namely: Ibadan/Ibarapa zone, Oyo zone, Saki zone and Ogbomoso zone. Ibadan/Ibarapa zone has fourteen LGAs/Blocks, Oyo with only five, Saki zone with nine zones and Ogbomoso has only five LGAs/Blocks in their zones

Fig.1: Map showing the Four ADP zones in Oyo State, Nigeria.



Source: Cartographic Laboratory, IFSERAR, FUNAAB, 2016

Sampling Procedure

A multi-stage sampling technique was used to select the respondents from the study area. The first stage was the random selection of two Agricultural Development Project (ADP) zones out of the four agro-ecological or ADP zones in Oyo state since they all have a dominance of rural farmers. The selected zones were Ibadan/Ibarapa and Saki zones. The second stage was the random selection of Local Government Areas also known as ADP Blocks from the selected zones. Six Local Government Areas (LGAs) were selected from Ibadan/Ibarapa zone while four LGAs were chosen from Saki Zone. The selection was done based on the proportion of number of LGAs in each of the selected zones. The third stage was the random selection of two communities in each Local Government Area, making a total of twenty communities in all. The fourth stage was the random selection of ten (10) farmers from each community making a total of two hundred (200) copies of questionnaires. However, only 199 copies of the questionnaire were eventually utilized for the analysis due to non-recovery of a copy of the administered questionnaire.

Method of Data Analysis

To determine the level of adoption of agroforestry among the adopters of agroforestry technologies in the study area, the method utilized by Ajayi*et al* (2006) was adopted in equation 1

$$\text{Level of Adoption} = \frac{\text{Number of technologies adopted}}{\text{Total number of technologies introduced}} X100 \quad (1)$$

Tobit Model

Tobit model was applied to determine factors that influence the intensity of adoption of agroforestry technologies among farmers in the study area. Farmers who have been introduced to different agroforestry technologies are assumed to have full information about the new technologies and may choose to apply all the technologies introduced to them or apply part of them or may not even apply any. It is known that a number of factors could affect the farmer's decision to adopt or not to adopt a technology. In the context of this study, the values of the dependent variable (the intensity of adoption) range from 0.14 to 1.0 for farmers that adopted only one of the technologies and those that adopted all the technologies introduced. This is because seven agroforestry technologies were introduced to them as shown in Table2. Therefore, a farmer that adopts only one of the seven technologies has intensity of adoption of 0.14 and any farmer who adopts all the seven technologies has intensity of adoption of 1. Any value that falls below the minimum intensity of adoption, which is 0.14, becomes zero and represents non-adopters. In this type of situation, the appropriate tool for analysis is the Tobit Model. The model measures the probability and intensity of adoption (McDonald and Mottif, 1980). This model is preferable to binary adoption models when the decision to adopt involves simultaneously the decision regarding the intensity of adoption (Feder and Umali, 1993). According to Gujarati (1995), the model is presented as:

$Y_i = \beta_i X_i + U_i$ if RHS >0

2

=0, otherwise

Where RHS is Right Hand Side

Y_i = observed intensity of adoption of agroforestry practices or technologies

β_i = vector of parameters to be estimated

X_i = vector of explanatory variables

U_i = normally and independently distributed error term

The model is explicitly expressed as

$$Y_i = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 = u_i \quad 3$$

Where Yi = intensity of adoption (proportion of agroforestry technologies applied out of the total number of technologiesa farmer was introduced to)

b_0 = Intercept

X_1 = Gender

X_2 = Age (in years)

X_3 = Household size

X_4 = Educational status

X_5 = Farm size (in ha.)

X_6 = Membership of cooperative society (1= member; 0, if otherwise)

X_7 = Access to extension services (1= yes, 0, if no)

X_8 = Access to credit (1= yes, 0 if no)

X_9 = Farming Experience (in years)

b_1-b_9 = Coefficients of the independent variables

In a Tobit model, the coefficients were not interpreted directly as estimates of the model, but rather as marginal effects of changes in the explanatory variables on the expected value of the dependent variable. According to Gould *et al* (1989), each marginal effect includes both the influence of the explanatory variable on the probability of adoption as well as on the intensity of adoption.

RESULTS AND DISCUSSION

Table 1 shows that majority (about 65%) of the adopters of agroforestry technology were between 40 and 59 years of age while 68.61% of non-adopters were within the same age range. Majority (38.29%) of the adopters had secondary education while majority (35.23%) of non-adopters had tertiary education. Large proportion (95.74%) of the adopters was male while about 85% of the non-adopters were male, with female accounting for 4.26% and 15.24% of the adopters and non-adopters respectively. In addition, majority (72.68%) of the adopters had farm size of 8ha and below while 83.81% of the non-adopters had equivalent land holdings. This is an indication that majority of the farm households in the study area are small scale farmers. This is because, according to Ozowa (2005), farm households with less than 10ha of farmlands are regarded as small-scale farmers according to international standards measurement for farm sizes. It was also observed that the adopters of agroforestry technology had larger household size than the non-adopters with 73.4% of the adopters having household size from 6 to 15 while 64.76% of the non-adopters had same household range. This may not be unconnected to the fact that adopters with larger household sizes realized that they had more people to cater for, hence the need to add tree planting (especially multipurpose and fruit trees) to their farming activities so as to have additional sources of income to cater for family needs.

Adoption Level of Agroforestry Practices

Table 2 shows the different forms of agroforestry practices adopted by the farmers in the study area. Prominent among the agroforestry practices were boundary planting, multipurpose trees/shrubs, wind breaks and life fencing with 38.30%, 30.85%, 24.47% and 17.02% of the farmers practicing them respectively. It was also discovered that 77.66% of the adopters practiced only one agroforestry technology and only 22.34% of them adopted two forms of agroforestry technologies. None of them adopted more than two forms of agroforestry technologies out of the seven available technologies. This explains the low level of adoption in the study area which was found to be 17.47%. This, therefore, calls for more enlightenment and sensitization, on the part of extension workers and subject matter specialists in the area of agroforestry, on the need for farmers to embrace agroforestry practices so as to enjoy the benefits of agroforestry practices.

Table1: Socioeconomic Characteristics of Respondents

	Adopters (N=94)		**Non-adopters (N=105)**	
Variable	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Age (Years)				
≤ 39	02	2.13	11	10.48
40-49	20	21.27	31	29.52
50-59	41	43.62	40	38.09
60-69	21	22.34	20	19.05
>70	10	10.64	03	2.86
Gender				
Male	90	95.74	89	84.76
Female	04	4.26	16	15.24
Educational Status				
No Formal	02	2.13	09	8.57
Primary	10	10.64	14	13.33
Secondary	36	38.29	33	31.43
Tertiary	31	32.97	37	35.23
Vocational	15	15.96	12	11.43
Farm Size (Ha)				
≤2	20	21.27	24	22.86
2.1 – 5.0	34	36.17	54	51.43
5.1 – 8.0	16	15.24	10	9.52
≥8.1	24	25.53	17	16.19
Household Size				
≤ 5	23	24.47	36	34.29
6-10	56	59.57	64	60.95
11-15	13	13.83	04	3.81
≥16	02	2.13	01	0.95
Marital Status				
Single	01	1.06	02	1.90
Married	91	96.80	97	92.38
Widowed	01	1.06	04	3.81
Divorced/Separated	01	1.06	02	1.90
Farming Experience Years)				
≤ 10	05	5.32	10	9.52
11-20	41	43.62	50	47.62
21-30	23	24.47	25	23.80
≥31	25	26.59	20	19.05
Access to Extension				
Yes	55	58.51	68	64.76
No	39	41.49	37	35.24

Source: Field Survey, 2021

Table 2: Agroforestry Technologies Adopted by Respondents (N=94)

Agroforestry Technology	No of Respondents	Percentage
Taungya	11	11.70
Home Gardens	10	10.64
Multipurpose Trees/Shrubs	29	30.85
Farm woodlots	5	5.32
Life Fencing	16	17.02
Boundary Planting	36	38.30
Wind Breaks	23	24.47

Source: Field Survey, 2021

Factors influencing the intensity of adoption of agroforestry technology

The results of the analysis of the factors that influence the intensity of adoption of agroforestry technologies among rural farmers in Oyo State are presented in Table3.Only six of the nine variables included in the model were significant in determining the intensity of adoption of agroforestry technologies among the farmers. These were gender, age, education level, access to extension services, farming experience and farm size.

It was discovered that gender of farmer was statistically significant at 5% level and had a positive relationship with the intensity of adoption of agroforestry technology among the farmers. This implies that men had higher tendency to adopt more agroforestry technologies than women. The result of the marginal effect with a value of 0.1649 is an indication that being a male farmer will lead to about 16.5% increase in the likelihood of increasing the intensity of adoption of agroforestry technologies in the study area. That is, male farmers have higher chance of adoption more agroforestry technologies in the study area. In other words, gender is a significant factor determining farmers' level of adoption of agroforestry technologies in the study area. This corroborates the findings by Ogada*et al.* (2010) who discovered that male household heads have a positive relationship in adoption of manure and fertilizer and intensity of their use in Kenya.Buyinza and Wambede (2008) however, attributed the lower agroforestry adoption among women to lack of control over land due to largely patrilineal inheritance systems in Kabale District of Uganda.

Likewise, age of farmer was also positively related to the intensity of adoption of agroforestry technologies and statistically significant at 5% level. This implies that an increase in farmer's age by one year would cause a 4.4% increase in the probability of increasing the level of adoption of agroforestry technologies among the agroforestry farmers. This is in agreement with study by Basamba *et al.* (2016) who reported that age of farmers plays significant role in enhancing the adoption of agroforestry in the Eastern Agro-ecological zone of Uganda.

In addition, the positive and significant coefficient on the education level of the farmer implies that educated farmers were more likely to increase their level of adoption of agroforestry technologies. The value of marginal effect of 0.0376556 suggests that a unit increase in years of education of the farmers will result to about 3.8% increase in farmers' likelihood of increasing their level or intensity of adoption of agroforestry technology in the study area. This may not be unconnected to the fact that education improves the understanding of technologies and access to information among the people. It also indicates that education empowers a farmer to make informed decisions and identify farm-related opportunities where they exist for the benefit of their families.

The study further shows that farming experience was positive and significantly related to the intensity of adoption of agroforestry technologies by farmers in the study area. This is likely so because experienced farmers are more informed about making decisions that affect their farm activities and output. The result of the marginal effect shows that a unit increase in years of experience of the farmer would lead to 7.6% increase in the level of adoption of agroforestry technologies. This is in line with study by Alam (2015) that farmers with more experience of farming are more likely to adopt alternative adaptation strategies. Farm size is also positively and significantly related to the intensity of adoption of agroforestry technologies, which implies that the larger the farm size, the higher the probability of increasing the level or intensity of adoption of agroforestry, since the farmers will have enough land to accommodate both their tree and arable crops for optimal benefits.

Furthermore, there was also a positive and significant relationship between extension access and the level of adoption of agroforestry technologies. This implies that with increase in extension visits to agroforestry farmers the likelihood of the farmers to increase their level of adoption of agroforestry technologies increases by 5.3%. This is because access to extension education exposes farmers to different farming techniques and systems, including agroforestry information, and as well enhances their adoption decision making. This study therefore corroborates the findings of Adesina*et al*. (2001) and Basamba*et al* (2016) thatfarmers with higher extension contact are more likely to adopt agroforestry technology.

Table3: Determinants of the Intensity of Adoption of Agroforestry Technologies

Variable	Marginal effect	z-value	p-value
Gender	0.1649365	2.56	0.010*
Age	0.0436930	3.31	0.002*
Household size	0.0133633	1.38	0.168
Educational status	0.0376556	2.58	0.015*
Farm size	0.0211993	4.38	0.000*
Cooperative membership	0.0521832	1.11	0.267
Extension services	0.0528838	2.91	0.024*
Credit facilities	0.0687316	1.49	0.138
Farming experience	0.0729200	2.08	0.036*

Source: Stata 12 Output

In order to examine the perception of the farmers about the effect of agroforestry on climate change mitigation, a 5-point Likert Scale ranging from *strongly agree (5), agree (4), undecided (3), disagree (2) and strongly disagree (1)*was administered to the respondents as shown in Table4. It was observed that 121 of the respondents, representing 60.80%, *strongly agreed* that agroforestry plays a significant role in reducing flooding occasioned by climate change, while 39.20% of them also *agree* that agroforestry plays important role in the reduction of flooding. Therefore, with a weighted mean of 4.61, it can be deduced that farmers in the study area *strongly agreed* that agroforestry practices is very significant in the reduction of flooding occasioned by climate change. Similarly, 54.77% of the farmers *strongly agreed* that agroforestry helps to improve soil fertility which might have been affected as a result of the impact of climate change on soil nutrients. With a weighted mean of 4.55, it can be observed that farmers in the study area *strongly agreed* to the effectiveness of agroforestry in enhancing soil fertility. In addition, it was discovered that 49.75% of the respondents *strongly agreed* that agroforestry helps in reducing carbon emission that also brings about climate change, while 48.24% of them *agreed* that agroforestry helps in the reduction of carbon emission. Since the weighted mean for this is 4.48, it can therefore be inferred that farmers in the study area *agreed* that agroforestry practices help in the reduction of carbon emission. Furthermore, 45.23% of them *strongly agreed*thatagroforestry contributes to the improvement of microclimate by helping in reducing extreme temperature, while 46.73% of them also *agreed* to this. This shows that farmers in the study area *agreed* that agroforestry plays important role in improving microclimate through the reduction of extreme temperature, given the weighted mean of 4.33.Eighty-seven(43.72%) of the respondents *strongly agreed* that agroforestry helps in reducing evaporation losses while 49.75% of them also *agreed* to the effectiveness of agroforestry in the reduction of evaporation losses. Therefore, given a weighted mean of 4.47, it can be said that farmers in the study area *agreed* that agroforestry is helpful in the reduction of losses due to evaporation. This is in line with the studies by Ajayi and Catacutan (2012), Chitakira and Torquebiau (2010), Masangano and Mthinda (2012), Mutua*et al.* (2014) and Kennedy *et al.* (2016) where they all stated that agroforestry contributes to food and income security, amelioration of environmental hazards, improvement of crop productivity and mitigation of climate change. This, therefore, implies that farmers in the study area believe that agroforestry practices play prominent role in climate change mitigation.

Table 4: Perceived Effect of Agroforestry on Climate Change Mitigation

S/N	PERCEPTION	SA(5)	A(4)	U(3)	D(2)	SD(1)	WM
1	Agroforestry improves microclimate by reducing temperature extremes	90	93	9	5	2	**4.33**
2	Agroforestry provides shade for crops and animals	101	96	2	0	0	**4.50**
3	Agroforestry helps in retaining soil moisture	105	88	3	2	1	**4.48**
4	Agroforestry helps to reduce carbon emission	99	96	4	0	0	**4.48**
5	Agroforestry improves soil fertility	109	90	0	0	0	**4.55**
6	Agroforestry helps to reduce soil erosion	111	80	4	2	2	**4.49**
7	Agroforestry helps to reduce flooding	121	78	0	0	0	**4.61**
8	Agroforestry helps to reduce evaporation losses	87	99	10	2	1	**4.47**
9	Agroforestry helps to protect crop from excessive heat on the field	103	90	4	1	1	**4.47**

Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), Strongly Disagree (SD), and Weighted Mean(WM).
Source: Field Survey 2021

Problems Militating against the Adoption of Agroforestry

There are many constraints militating against the adoption of agroforestry technologies among the adopters and non-adopters of the technologies in the study area. This study therefore highlighted some of the problems faced by the adopters as well as the reasons given by non-adopters of agroforestry for their non-adoption. Some of the problems examined includes; insufficient land for tree planting, illegal felling of trees, long gestation period of trees, lack of technical assistance, lack of planting materials, lack of knowledge and skills as well as competition among trees and arable crops on farmland. It was discovered that 56.38% of the adopters stated that lack of knowledge and required skills on agroforestry was a constraint to their adoption of agroforestry while 61.90% of the non-adopters gave that as a reason for not adopting agroforestry technologies. This therefore ranked highest among the constraints for both the adopters and non-adopters, as shown in Table 5. This possibly explains why the adopters of agroforestry technology in the study area could not efficiently explore the potentials of agroforestry technology. This therefore accounted for the reduction in farm outputs of the adopters relative to the non-adopters. Furthermore, ranking second highest among the reasons given by non-adopters in the study area is the gestation period of agroforestry trees as 58.09% of them described the long gestation period of agroforestry trees as reason why they have not adopted the technology. But the adopters cited insufficient land as the second highest constraint to their effective adoption of agroforestry technologies. This is where expertise of the extension agents and some subject matter specialists are needed to train and enlighten the farmers on how to make effective use of their land to accommodate both their tree crops and arable crops. This work is therefore in line with the study by Amonum and Bada (2019) where lack of land, lack of tree seedlings as well as inadequate extension personnel were stated as some of the constraints affecting the adoption of agroforestry in Katsina State of Nigeria.

Table 5: Constraints to the Adoption of Agroforestry in the Study Area

S/N	Constraint	Adopters(N=94) *Frequency	Percentage	Rank	Non-Adopters(N=105) *Frequency	Percentage	Rank
1	Insufficient land for tree planting	42	44.68	2ND	57	54.29	3RD
2	Illegal felling of trees	37	39.36	5TH	40	38.10	7TH
3	Long gestation period of trees	41	43.62	3RD	61	58.09	2ND
4	Lack of technical assistance	31	32.98	7TH	49	46.67	4TH
5	Lack of planting materials	39	41.49	4TH	45	42.86	6TH
6	Lack of knowledge and skills	53	56.38	1ST	65	61.90	1ST
7	Competition among trees and arable crops on farmland	32	34.04	6TH	47	44.76	5TH

Multiple Responses
Source: Field Survey, 2021

CONCLUSION AND RECOMMENDATION

This study determined the various forms of agroforestry technologies adopted by the farmers, assessed the factors influencing the intensity of adoption of agroforestry technologies, examined the perceived effects of the adoption of agroforestry technology on climate change mitigation and identified the factors militating against the adoption of agroforestry among farming households in Oyo State, Nigeria. The study revealed that adopters of agroforestry technology accounts for 47.2% of the sampled respondents. It was discovered that majority of the adopters of agroforestry technology as well as the non-adopters were between 40 and 59 years of age. The result further shows the different forms of agroforestry practices adopted by the farmers in the study area whichincludes boundary planting, multipurpose trees/shrubs, wind breaks and live fencing. It was also discovered that majority (77.66%) of the adopters' practices only one form of agroforestry technology while only 22.34% of them adopted two forms of agroforestry technologies, none of them adopted more than two forms of agroforestry technologies out of the seven available technologies.

Meanwhile, the result of the Tobit analysis on factors that influence the intensity of adoption of agroforestry technologies among rural farmers revealed that gender, age, education level, access to extension services, farming experience and farm size were positive and significant factors in determining the intensity of adoption of agroforestry technologies among the farmers.The perceived effect of agroforestry on climate change using the 5-point Likert scale indicated that all the respondents agreed that agroforestry plays a significant role in reducing flooding and helps to improve soil fertility. Majority of the respondents also perceived that agroforestry helps in reducing carbon emission, improve microclimate by helping in reducing extreme temperature and also helps in reducing evaporation losses.

This study also revealed that the constraints militating against the adoption of agroforestry technologies by the adopters and non-adopters in the study area include lack of knowledge and required skills on agroforestry, long gestation period of trees, insufficient land for tree planting, lack of planting materials, lack of technical assistance, competition among trees and arable crops on farmland and illegal felling of trees.

Based on the findings from the study, it can therefore be concluded that the adoption of agroforestry practices is low and that inadequate knowledge and skills about agroforestry technologies hinders effective adoption of agroforestry technologies in study area. Therefore, it is recommended that government should put in place policies that increase the adoption of agroforestry technology among the farmers, through farmers' access to by extension service and the provision of technical assistance and material resources that will encourage them to adopt agroforestry technology.

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