ASSESSMENT OF SOCIO-ECONOMIC FACTORS INFLUENCING THE ADOPTION OF AGROFORESTRY PRACTICE AS ADAPTATION STRATEGY TO CLIMATE CHANGE HAZARDS IN SUDAN SAVANNA AGRO-ECOLOGICAL ZONE OF KADUNA STATE

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Abstract
This paper adopted a well-structured questionnaire to collect primary data from 225 farmers from Kubau LGA of Kaduna State. Twenty-Four Socio-economic factors were formulated and grouped into four major categories namely – demographic, agro-based, economic and locational factors. The study was presented in form of frequency table, and mean in some cases. The result from the study under demographic characteristics showed that the farmers have the mean value of 39 years in age, with 96% male farmers, and 94% were married in which only 8% have tertiary education. The result from the agro-based characteristics revealed that the farmers have mean value of 13.2 years' experience, with the mean value 3.8 hectares for farm-land size, with 54% have untarred road access to the farm while 58% were visited by extension officers quarterly. Results of the economic factors revealed the mean monthly income value of the farmers were #96,000, with 46% had access to government grant and 71% also had access to credit facilities. While the result of the locational factors showed that 71% had their farms farther than 10km from the forest reserves, and 82% had their farm less than 10km from the market while 68% had their farm farther than 10km from urban center. The result indicated that low level of education, lack of good road, lack of formal agroforestry training and lack of access to extension officers regularly were greatly influenced the adoption of agro-forestry and recommended to be improved so as to encourage adoption of agroforestry.

***Keywords**: Socio-economic Factors, Agroforestry Practice, adoption, Adaptation Strategy, Climate Change.*

Introduction
Climate change phenomenon is rapidly emerging as a global critical development affecting many sectors and is one of the most serious problems to sustainable development. An increase in greenhouse emissions has led to climate change impacts. Agricultural activity is ranked third after energy consumption and chlorofluorocarbon production in contributing immensely to climate change by enhancing greenhouse emissions because it accounts for some 15% of recent anthropogenic activities in greenhouse gas emissions (Ozor and Nnaji, 2011).
The impacts of climate change on agriculture, economic growth and sustainable development, are the growing interest in sub-Saharan Africa as a result of increased drought, increased temperature and reduced rainfall in recent times. The adversely impacts of climate change on agricultural activities include crop resilience, timing/length of growing seasons, changes in soil moisture and soil quality, yield of crops and animals, weed insurgence, sea level rises, unprecedented flooding and droughts, atmospheric temperatures and many more (Ozor and Nnaji, 2011). Another similar worst factors include over dependence on rain fed agriculture, inadequate research and extension, inequitable land distribution, widespread poverty, limited access to capital and technology, long term weather forecasts and lack of good roads (IPCC, 1998). Adapting to climate change entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the appropriate adjustments and changes. The Intergovernmental Panel on Climate Change defines adaptation as adjustments in natural or human systems in response to actual or expected climatic stimuli or effects, which moderates harm or exploits beneficial opportunities (IPCC, 2007). It also refers to actions that people, countries, and societies take to adjust to climate change that has occurred. Adaptation has three possible objectives: to develop the capacity to cope with unavoidable damages; to reduce exposure to the risk of damage and to take advantage of new opportunities.
Agroforestry provides a set of innovative practices that are designed to enhance productivity in a way that often contributes to climate change hazards mitigating through enhanced carbon sequestration, and can also strengthen the system's ability to adapt to adverse impacts of changing climatic conditions. This study tried to assess the socio-economic factors influencing adoption of agroforestry practice as adaptation strategy to hazards associated with climate change in sudan savanna agro-ecological zones in Kaduna State, and explores sustainable agroforestry practices that will enhance resilience and thereby reduce vulnerability of small land farmers, with a view to providing information to natural resources planners and managers for mitigating the impact of climate change in the study area.

Materials and methods

Study Area

The study was carried out in Sudan Savanna agro-ecological zones in Kaduna state which lies within the Latitude 8º 55'N - 11º27'N of Equator and Longitude 5º55'E - 9º45'E of Greenwich Meridian. Sudan savanna comprises of eight local government areas of the state namely: Lere, Zaria, Sabon Gari, Kubau, Soba, Kudan, Markafi and Ikara.

Kaduna state generally falls under the Tropical Continental climate which is considered as seasonal variations with alternation of moist maritime, air mass and dry continental air mass resulting into two major different seasons.

The ethnic group in the zone predominantly comprises of Hausa, Kataf, Igbo, Fulani, Yoruba. The main occupations are farming, trading, self-employment, civil service. The major economic activities of the people in the rural areas are cultivating, processing and marketing of agricultural products. The major crops cultivating, processing and marketing are rice, guinea corn, millet, maize, groundnut, millet, soya beans and pepper.

Research Methodology

The study basically adopted primary data with the use of well-structured questionnaire to collect information about the farmer's socio-economic characteristics influencing the adoption of agroforestry in the study area. The questionnaire was designed to contain open-ended and close- ended format, to obtain adequate information. The respondents for this study was the crop farmers in Kubau Local government area of Kaduna State.

The study used multi-stage sampling technique, the first stage was purposive sampling method which was used to select the local government that has most populous number of registered farmers in Sudan Savanna ecological zones. Out of eight local government areas in the zone Kubua Local Government has the highest number of registered farmer with the total number of registered farmers of One Thousand, nine Hundred and Thirty-Six (1936). It was from this that Two hundred and Fifty- Two (252) respondents were selected for the administration of questionnaire out of sampled population of 1936, through the application of Yamane (1967) sample size selection formula.

Face to face interviews were conducted in the month of April and May 2021, with farmers using a well-structured questionnaire for each farmer. This captured information on some demographic variables such as age, education, skills and knowledge, Years of farming experience, farmland size, and other factors influencing adoption of agroforestry practices as adaptation strategy to the climate change hazards in Sudan Savanna agro-ecological zones.

The data was analyzed and presented by using descriptive statistics, namely percentages, frequencies tables, means and standard deviation in some cases.

Results and discussion

The data collected during the field survey involved socio-economic characteristics of small land farmers. The data was presented through the use of frequency distribution tables and quantitatively and qualitatively discussed in different major categories such as demographic characteristics of farmers, agro-based characteristics of farmers, economic factors and how distance from farm to forest reserve, market and urban centers influence the adoption of agroforestry in Sudan Savanna agro-ecological zones of Kaduna state.

Demographic Characteristics Influencing the Adoption of Agroforestry

The active ages of this study are considered to be between 31 and 60 years, while below 30 years are expected to be in schools or be under their parents, and above 60 years are expected to have retired and taken care by their children, these two age groups are considered to be dependent age groups. The distribution of the ages as shown in the Table 1 showed the bulk of the sampled population in Kubua (sudan savanna) 76% were in the active ages of 31 to 60 years and 24% were in dependent age groups, the mean age is 39 years. This implied that most of the respondents were in their active years and as such could participate effectively in agroforestry activities.

Age is one of the factors that influences the adoption of agroforestry. Older farmers may not have preferential access to new information or technologies through extension services or development projects that operate in the study area. Also, in the age factor, active age group farmers gather more personal financial capital, and may lead to higher investment in innovations (Nkamleu and Coulibaly, 2000). Active age farmers also have access to new technologies and were regarded to be early adopters (Alavalapati *et al*. 1995). In agreement with Ogunsumi (2004) age is a significant factor for adoption of technology, because active age groups have more energy to work and have better opportunity to investment in the long-term, these are the strategy to adapt to climate change hazards because they still have capacity and ability to farm for a long time on the same plot of land.

Table 1: Demographic Characteristics of Farmers

Variables		Frequency	%	Mean Value
Age:	21 – 30 Years	61	24	
	31 – 40 Years	83	33	
	41 – 50 Years	68	27	
	51 – 60 Years	40	16	
	Above 60 Years	0	0	
	Total	**252**	**100**	**39 Years**
Gender:	Male	243	96	
	Female	9	4	
	Total	**252**	**100**	
Marital Status:	Single	11	4	
	Married	237	94	
	Widowed Divorced	1	0.4	
	Total	3	1.6	
		252	**100**	
Education Level:	Primary Ed	55	22	
	Secondary Ed	48	19	
	Tertiary Ed	20	8	
	Adult Ed	105	41	
	No Formal Ed	24	10	
	Total	**252**	**100**	
Household Size:	< 3	24	10	
	3 – 5	47	19	
	6 – 10	84	33	
	> 10	97	38	
	Total	**252**	**100**	**10 Persons**
Sec Occupation:	Civil Servant	39	15	
	Artisan	28	11	
	Self Empl	43	17	
	Trading	37	15	
	None	97	38	
	Others	8	4	
	Total	**252**	**100**	

Sources: Author's Field Survey, 2021

From Table 1, 96% of the sampled farmers in sudan savanna were male and 4% were female. The low number of females reflects the predominance of Islamic culture which allows the practice of Puddah (women are restricted inside houses). Thus accessibility to interview female farmers in large number was not possible. The few interviewed were either widow or came from other region to reside Kubau Local Governmengt. Generally, the cultural practice does not allow women to engage in the work like farming. This implies that there is participation of male gender in farming activities and also in the adoption of agroforestry practices. Alfred (2001) and Adedotun (2010) stated that male farmers usually out-number female farmers in many communities in Nigeria.

Information relating to the marital status of the respondents is also presented on Table 1. Majority of the farmers sampled 94% were married, 4% were single, 0.4% were widows, 1.6% were divorced.

The distribution of respondents according to educational level as presented in Table 1. It was significant to note that majority of the respondents in the zone had one form of education or another, 41% had adult education, 22% had primary education, 19% had secondary education, 10% had no formal education and only 8% had tertiary education. This was expected to have significant impact on ability of farmers to effectively adopt agroforestry as better strategy to adapt to climate change hazards in the study area. This result was in agreement with the findings of Abdulazeez *et al*, (2014) that, education influences the adoption of agroforestry practices positively. A popular belief was that highly educated farmers were early adopters of new technologies (Kebede *et al*. 2015). It was also hypothesized that education was positively related to the adoption of agroforestry as a strategy to adapt to climate change hazards.

Information relating to the household size of respondents is presented on Table1. Majority of farmers had above 6 persons per house, in sudan savanna, 71% were more than 6 persons per household and 29% were less than 6 persons, with a mean size of 10 persons per household. Secondary occupations of respondents were also considered in Table1. The result showed that 38% were not into any other occupation apart from farming, 17% were self-employed, 15% were civil servant and traders, 11% were artisans, and 4% were into other occupations that were not mentioned.

Agro-Based Characteristics Influencing the Adoption of Agroforestry

Years of farming experience is another major factor that contributed to the effectiveness and influenced the adoption of a new strategy in this type of occupation. From Table 2, the result showed that, 33% had farming experience of 16 – 20 years, 28% had spent 6 – 10 years, 13% had more than 20 years, 13% also had 11 – 15 years and less the 5 years of farming knowledge, with the mean of 13.2 years.
Majority of the respondents 62% had farm sizes ranging between 2 and 7 hectares per farmer, 28% had less than 2 hectares while 5% each had 8 to 10 and more than 10 hectares, with the mean value of 3.8 hectares. Table 2 showed the type of land ownership system among the respondents. In sudan savanna, 76% purchased the land, 11% hired the land, 6% inherited it, 4% rented the land and only 3% leased the land.
From Table 2 the sources of labor for majority 47% of farmers in the study area were either family or hired labour, 33% depended only on family, 18% only on hired labour, while only 2% engaged cooperative for labour on their farm, while 1% depended on cooperative society to do labour for them. However, 30% people depended solely on family labour.
Some villages that were difficult access faced several constraints as result limited their access to new innovations like agroforestry, this was also considered in Table 2. The result showed that 54% had un-tarred road leading to their farms, and 27% had easy access of tarred road to their farms, while only 19% found it difficult to gain access to their farms. Free Access to farm refers to a situation where the farmers had access to good road network from home to farm and from farms to the market as the case may be to sell their farm produce.

Membership of farmer's association could enhance access to credit facility and other agricultural technological innovations hence influenced the adoption of agroforestry as adaptation strategy to climate change hazards. Iwasaki *et al*., (2009) noted that lack of social cohesion and community ties and disaster awareness can lead to loss and damage of material assets. Parry *et al.*, (2007) observed that investing in social relationships and communities for support during difficult times, and building social relations and network to increase cooperation, and the sharing of ideas and technological innovations can increase the adaptive capacity of the farmers. From the result, 91% are in one farmers' association or the other, while only 9% are not in any association. (See Table 2). This implies that majority of the respondents were members of one farmers' association or the other, which might have given them access to credit facilities, and other agricultural technological innovations hence influenced them to adopt agroforestry practice as adaptation strategy to climate change hazards.Agricultural research often produces technologies that have high potential for benefiting large segments of the population, particularly farmers in the rural areas. The influence of agriculture oriented institutions is very crucial and necessary for agricultural technology adoption. Heidi (2005) argued that technology like agroforestry that can improve the performance of African agriculture exist and new innovations that can be adopted to adapt to climate change hazards were developed but the problem is that the learning of these new technologies to farmers were slow, incomplete and many times not accessible to the farmers. This is the case in the sampled farmers in the study area, 74% had no agroforestry training, while only 26% had access to agroforestry training. Results from this study showed access to information on tree planting positively associated with adoption of agroforestry. Result showed that 83% had access to information about benefits of agroforestry, while only 17% had no access to information about agroforestry. (See Table 2). This corroborated with Chija (2013), who found out that farmer's awareness and access to information were some of the most critical factors that influenced farmers' adoption of agroforestry to adapt to climate change hazards in sudan savanna agro-ecological zones of Kaduna state.

Access to the input in agricultural activities is also one of the important factors that determine the choice or the adoption of some innovations. Likewise access to input like tree seedlings by the farmers will strongly influence their decision to adopt agroforestry. The result in Table 2 showed that 91% had access to major agroforestry input which is tree seedlings, while only 9% had no access to tree seedlings. This attested to some studies that access to cash incentives, subsidies and other agroforestry inputs promote adoption of agroforestry practices as a strategy to adapt to climate change hazards. (Jhariya *et al*, 2015). While low levels of incentives, self-financing and difficult to access tree seedlings may lead to a slower pace of adoption or lack of interest to adopt agroforestry (Okunade and Yekini, 2007).
Contrary to the assertion that farmers' access to information from extension officers on tree planting aid the decision to adopt agroforestry. The result in Table 2 showed that 88% had no access to extension officer's information and their services, while only 12% had access to extension officers. The frequent visits of extension officers to the farm increase the level of awareness and information about certain agricultural technology innovations. The result from Table 2 showed that the visitation of extension officers to render service to the farmers is very low. 58% had access to extension officers on quarterly basis while 32% had access to them once in a year, and only 10% had access to them monthly, and none of the farmer had access to them on weekly basis.

Table 2: Agro-Based Characteristics of Farmers

Variables		Frequency	%	Mean Value
Farming Exp:	Less than 5 Years	34	13	
	6 – 10 Years	70	28	
	11 – 15 Years	34	13	
	16 – 20 Years	80	33	
	More than 20 Years	34	13	
	Total	**252**	**100**	**13.2 Years**
Farm Size:	< 2 Hectare	71	28	
	2 – 4 Hectare	102	40	
	5 – 7 Hectare	55	22	
	8 – 10 Hectare	12	5	
	> 10 Hectare	12	5	
	Total	**252**	**100**	**3.8 Hectare**
Land Acquisition:	Rent	9	4	
	Lease	8	3	
	Hired	27	11	
	Inheritance	14	6	
	Purchase	194	76	
	Others	0	0	
	Total	**252**	**100**	
Sources of Labour:	Family	83	33	
	Hired	47	18	
	Family & Hired	117	47	
	Cooperative	5	2	
	Others	0	0	
	Total	**252**	**100**	
Accessibility:	Tarred Rd	69	27	
	Un-tarred Rd	137	54	
	Difficult Access	46	19	
	Total	**252**	**100**	
Farmers" Association:	Yes	229	91	
	No	23	9	
	Total	**252**	**100**	
Formal AGF Training:	Yes	66	26	
	No	186	74	
	Total	**252**	**100**	
Information About AGF:	Yes	208	83	
	No	44	17	
	Total	**252**	**100**	
Access to Input:	Yes	229	91	
	No	23	9	
	Total	**252**	**100**	
Access to Ext Officers:	Yes	31	12	
	No	221	88	
	Total	**252**	**100**	
Visit of Ext Officers:	Weekly	0	0	
	Monthly	3	10	
	Quarterly	18	58	
	Yearly	10	32	
	Total	**31**	**100**	

Sources: Author's Field Survey, 2021

Economic Factors Influencing the Adoption of Agroforestry

The income earned from farming activities was also examine in Table.3, The result showed that, 38% realized between #50,000 and #100,000 per month, 26% realized between #101,000 and #150,000 per month, 19% realized less than #50,000 and 15%

realized between #151,000 and #200,000 per month while only 2% realized above #200,000 per month, the mean value was #96,000 which is the highest value of the three agro-ecological zones.

Table 3 also shows percentage distribution of respondents according to non-farm income per month. The respondents had varied monthly income based on their secondary occupations. In Sudan Savanna 37% had monthly income of between #50,000 - #100,000, 24% earned between #101,000 - #150,000, 15% earned less than #50,000 per month, 13% earned #151,000 - #200,000 per month and only 11% earned more than #200,000 per month, with mean value of #110,000. This amount is far above the national minimum wage of #30,000 per month, implying that majority may have more money to practice agroforestry to adapt to climate change hazards in their respective farms. This was in line with Ozor (2009) who observed that with high income, farmers will adopt different innovative strategies to improve the soil so as to increase the farm productivities.

Another important factor examined in the Table 3 is famer's source of capital to finance their farm, the result revealed that 46% received grants from federal and state government, 27% received loans from their cooperative societies. 11% re-invested their last year profit to finance the farming activities, 10% got capital through the bank loans, while only 6% got their capital from friend or members of their family. This finding indicated that majority of farmers embarked on one loan or the other, this was possible because they were sure of paying back with ease since there was adaptation strategy in place which had been adopted to reduce climate change hazards in the farm.

Access to the credit facility is another important determinant economic factor influencing the choice of various technological innovations on the farm. This finding is line with Yamo (2007), who observed that most people affected by climate change are unable to have access to formal bank loans due to lack of collateral. Table 3 also showed that, 71% had access to credit facility while only 29% had no access to credit facility. Accessibility to formal or informal credit facilities is important in agricultural occupation and may influence adoption of agroforestry practice.

Table 3: Economic Factors Influencing the Adoption of Agroforestry

Variable		Frequency	%	Mean Value
Farm Income:	< #50,000	49	19	
	#50,000 - #100,000	96	38	
	#101,000 -#150,000	65	26	
	#151,000 -#200,000	38	15	
	> #200,000	4	2	
	Total	**252**	**100**	**#96,000**
Non- Farm Income:	< #50,000	37	15	
	#50,000 - #100,000	92	37	
	#101,000 -#150,000	61	24	
	#151,000 -#200,000	34	13	
	> #200,000	28	11	
	Total	**252**	**100**	**#110,000**
Sources of Capital:	Bank	25	10	
	Relative/Friend	14	6	
	Govt Grant	117	46	
	Coop Society	68	27	
	Re-Inv Profit	28	11	
	Total	**252**	**100**	
Access to Credit Fac.:	Yes	178	71	
	No	74	29	
	Total	**252**	**100**	

Sources: Author's Field Survey, 2021

Location Factors Influencing the Adoption of Agroforestry

Farmers in communities in more proximity to forest reserves were likely to adopt agroforestry. Involvement of the Ministry Agriculture and Rural Development, Ministry of Environment and Forestry Research Institution of Nigeria in these reserve areas provides much extension services and supervision mostly through the governmental tree planting programmes (Taungya programme). Farmers in these areas are therefore more informed by tree planting and agricultural technology innovations such as agroforestry. The result in Table 4 showed that 71% had their farm at distance farther than 10km to the forest reserves, while only 29% had their farm at distance less than 10km. Farmers' preferences for on-farm trees are expected to influence their decision to adopt agroforestry.

The result of proximity of farm to the market place showed that 82% had their farm at distance less than 10km to the market, while only 18% had their farm at distance farther than 10km to the market place.

Land availability may permit farmers to practice longer fallows. The result from Table 4, showed that 68% had their farms farther than 10km while only 32% had their farms less than 10km to the main town. This is contrary to the popular belief that the further the village from the urban area, the lower the probability of the adoption of agroforestry (Nkamleu and Manyong, 2005). This result

is contrary to expectation. This implies that the farther the farm is from the town, the higher the farmer to adopt of agroforestry practice as result agroforestry practices are more common in villages far from urban areas.

Table 4: Location Factors Influencing the Adoption of Agroforestry

Variables	Frequency	%
Forest Res.: < 5km	28	11
6km – 10km	45	18
> 10km	179	71
Total	**252**	**100**
Market: < 5km	91	36
6km – 10km	115	46
> 10km	46	18
Total	**252**	**100**
Urban Center: < 5km	29	12
6km – 10km	51	20
> 10km	172	68
Total	**252**	**100**

Sources: Author's Field Survey, 2021

Conclusion and recommendations

The adoption of agroforestry technologies is important because it offers the prospect of increasing production and hence increase farmers' income. Sustainable development through agroforestry practice can be achieved through a jointed effort to actively and continuously encourage farmers' involvement in agroforestry activities. Recognizing and tackling main factors that determine involvement of farmers in agroforestry practices predisposes an agroforestry project to successful local farmers' participation. This study is relevant to the adoption of agroforestry technologies involving economic as well as sociological considerations.

The result in this study has demonstrated that some factors influencing farmers' adoption of agroforestry practices in different agro-ecological zones are not necessarily the same, therefore generalization should be avoided. The results have a number of implications for strategies to promote agroforestry among farmers in different agro-ecological zones. Government agencies, policy makers, environmental managers and planners need reliable information on the effects of various socio-economic variables on the adoption or rejection of a technology for a sustainable development.

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