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Evaluation of Agroforestry Practices among Farmers of Kano State, Nigeria

Noah Alabi Oyebamiji*[1] Emmanuel Ada Ojoko[2] Abubakar Yakasai Ali[1]
1.Department of Forestry and Wildlife Management, Federal University Dutsin-Ma, Katsina State, Nigeria
2.Department of Agricultural Economics, Federal University Dutsin-Ma, Katsina State, Nigeria
*Corresponding author: Noah Alabi Oyebamiji E-mail: noahoye06@gmail.com, 08064694878

Abstract
Introduction: Integration of trees in agricultural land can certainly be complex and might be difficult to implement in various situations, and there is no one model that works for every region, but the benefits are significant. Trees are components of agroforestry system that contribute to food security, nutrition, medicine, income and environmental services. **Aim:** the study aimed to evaluate agroforestry practices among farmers of Kano State, Nigeria. **Methodology:** The study was conducted using multistage sampling procedure in which the state was characterized into three strata were selected from the three senatorial zone of the state making a selection of three (3) Local Government areas from each stratum and a total of thirty six (36) villages. In each village, ten (10) interviewees were randomly selected for the structured questionnaire. **Results:** A total of three hundred and sixty (360) respondents were recruited in the study, of which, 137 majority (38 %) were between the ages of 30-39 years. 360 (100 %) males were the dominant sex, 271 (75 %) were married having at least the family size of 1-10 persons per household. 107, 97 and 45 had formal education (69 %) (primary 30 %, secondary 27 % and tertiary education 12 %). 234 (65 %) mainly engaged in farming, 176 (49 %) acquired their land through inheritance. Majority, 233 (65 %) of the farms size were between < 1-2 hectares. However, 143 (40 %) had average of 21-31 years of farming experience. The commonest predominant agroforestry practices are boundary markings 153 (43 %) and scattered trees on farmland 144 (40 %). **Conclusion:** the study shows that agroforestry practices are practiced among the farmers, though, more awareness will assist the farmers to enjoy all its benefits.
Keywords: Agroforestry; Practices; Trees; Farmers; Kano State; Nigeria.
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1. Introduction

Agroforestry has been defined in many ways over the last three decades; it started gaining more attention by researchers. Gold and Garrett (2009) looked at agroforestry being an intensive land management practice in which trees and/or shrubs are deliberately incorporated with crops in an agricultural setting. ICRAF (2004) defined agroforestry as a "collective term for a land use systems and practices whereby woody perennials are intentionally integrated with crops and/or animals on the same land management unit.

The intensive land-use management which combines woody perennials (trees or shrubs) with agricultural crops and/or livestock is called Agroforestry (Gold and Garrett, 2009). It is important to emphasize that such combination of agricultural components (e.g., trees, livestock) existing in agroforestry systems is created intentionally (Erdmann, 2005). The biological interactions occurring in agroforestry systems optimizes the abundance of eco-physical, economic, and social benefits for farmers, local communities and overall society (Gold and Garrett, 2009; Lassoie *et al.,* 2009).

Trees are components of agroforestry system that contribute to food security, nutrition, medicine, income and environmental services. Trees in crop fields work as insurance in case of sudden crop failure or to support crops against environmental hazards and also to provide extra income from trees. These trees have been either purposely planted or naturally grown on farmlands and left to stand to support agriculture by reducing nutrient losses from erosion and leaching, increasing nutrient inputs through nitrogen fixation, and increasing biological activities by providing biomass and suitable microclimate (Aladi and John, 2014).

The enormous importance of savanna trees and grasses prompt many researchers to intensively study them. The importance of trees in daily lives cannot be over emphasized hence, they are vital to our existence because of many ecological and economic functions they perform (World Wildlife Foundation, 2016). Trees are known to provide diverse benefits which ranges from ecological (soil erosion control, watershed management, windbreak and shelterbelt, desertification control, climate change mitigation) socio-economic (source of income from the sales of fuel-wood, timber, edible fruits, and other non-timber forest products) and cultural (medical, spiritual, aesthetic, historical). Moreover, trees help in the purification and improvement of air quality; thus, cropland agroforestry is largely evolved with sustainability concerns, resiliency and diversity (Islam *et al.,* 2012; Chakraborty *et al.,* 2015).

There is a range of practices that can be used for agroforestry, some of which have been employed for

thousands of years. Such methods include, alley cropping (planting single rows of trees and growing crops in the alley ways in between), silvo-pasture (combining trees with pasture or livestock grazing areas), forest farming (the cultivation of shade tolerant crops under the protection of a managed forest), and others (Enete and Amusa, 2010; Turgut, 2019).

Agroforestry as a land use system has been in practice for many years and in most continents of the world. In the past century, there had been efforts to develop the concept of agroforestry as science in order to appropriately quantify improvement in productivity of various crops and the soil as well as the cash flow in terms of profit to the farmer. However, agroforestry as a land management system combines forest trees and food crops production with or without livestock in such a way that they are technically and financially feasible and will enable the small holder farmer to obtain high income and living standards while ensuring improvement of soil and the environment.

However, integrating trees in agricultural land can certainly be complex and might be difficult to implement in various situations, and there is no one model that works for every region, but the benefits are significant. And this in turn, has been shown to increase the crop productivity, improve nutrient cycling, create and change microclimate (Turgut, 2019). Some countries have heeded the call and are employing agroforestry technology as a strategy to rehabilitate degraded forestlands, avoiding "slash and-burn" farming, reducing soil erosion, improving soil quality, enhancing vegetation cover, and improving the living standards of forest-dependent communities (Glover *et al.,* 2013).

Agroforestry can help to improve the livelihoods of the rural poor by producing food (e.g., fruit, nuts, edible leaf, sap and honey), fodder, timber, wood fuel, fibers and medicines. The adoption of agroforestry can save time in the harvesting of fodder and wood fuel, a particularly important benefit for humans (Hillbrand, 2017). Through better understanding of agroforestry practices, the use of appropriate trees and shrubs would assist rural dwellers in tackling their social and environmental problems.

Classification of Agroforestry System

Nair (2008) classified agroforestry systems according to the following sets of criteria:

Structural basis: The structural of a system can be defined in terms of its components and the expected role or function of each. In this system the type of component and their arrangement are important. Hence, on the basis of structure, agroforestry systems can be grouped into two categories: nature of components (agrisilvicultural systems, silvopastoral systems, agro-silvopastoral systems and other systems) and arrangement of components (spatial and temporal)

Functional basis: This is based on the major function or role of the different components of the system, mainly of the woody components (these can be product, e.g., production of food, fodder, fuel wood and so on or protective, e.g., windbreak, shelter-belts, soil conservation and so on).

Socioeconomic basis: Considers the level of inputs of management (low input, high input) or intensity or scale of management and commercial goals (subsistence, commercial, intermediate).

Ecological basis: Takes into account the environmental conditions on the assumption that certain types of systems can be more appropriate for certain ecological conditions. There may be a set of systems for arid and semi-arid lands etc.

2. Materials and Methods

2.1 Study Area

This study was carried out across nine (9) Local Governments in Kano State (Bebeji, Dawakin Kudu, Gwarzo, Karaye, Kiru, Kura, Madobi, Rogo, and Shanono). Kano State lies between latitude 13^0 N in the North and 11^0 N in the South and longitude 8^0 W in the West and 10^0 E in the East. Kano State is made up of the following forty four Local Government Areas. The total land area of Kano State is 20,760 square kilometers with a population of 9,383,682 (2006 provisional result) (Figure 1). The dominant religious affiliation in Kano is Islam while the Hausa and Fulfulde languages are widely spoken in the area. It has annual rainfall between 63.3 mm $\pm$ 48.2 mm in May and 133.4 mm $\pm$ 59 mm in August the wettest month and a temperature usually ranges between a maximum of 33^0 C and a minimum of 15.8^0 C although sometimes during the harmattan it falls down to as low as 10^0 C. The vegetation of Kano State is the semi-arid savannah which is rich in fauna and flora resources, it is suitable for both cereal agriculture and livestock rearing, and the environment is relatively easy for movement of natural resources and manufactured goods.

Figure 1: Map of Kano State
Source: Google, 2021.

2.2 Sampling Procedure and Sample Size

Four multistage sampling techniques were used for the study. In the first stage, Kano State was stratified into three (3) groupings based on characterization namely; Kano North, Kano Central and Kano South. In the second stage was randomly selection of three (3) Local Government Areas from each grouping to make a total number of nine (9) Local Government Areas. The third stage was the randomly selection of four (4) villages (farming communities) in each of the 9 Local Government Areas to make a total of 36 villages, while, the fourth stage was the randomly selection of ten (10) respondents from each of the 36 villages to make a total number of 360 respondents selected for the study. Data collection were collected using structured questionnaire. The respondents were interviewed using their local language (Hausa).

2.3 Data Analysis Techniques

The data were analyzed using descriptive statistics which was used to summarise the demographic characteristics of the respondents and these were presented in frequency counts, percentages and bar charts with the software IBM SPSS Statistics V21 x 86 version. Significant associations between various demographic perception variables and agroforestry practices subscales were evaluated using 5-points likert scale rating.

3. Results and Discussion

3.1 Demographic Characteristics of the Respondents

Majority of respondents (64 %) were 30-49 years old. This revealed that middle aged farmers were the active human resource in the practices of agroforestry in the study areas. Ajayi *et al.,* (2007) reported that middle aged people are more likely to be better agents for new skills adoption and transfer as they may have higher aspiration

to accept new technologies compared to older farmers who are skeptical and critical of innovations (Table 1a).

100 % of the respondents were Hausa/Fulani and their dominant languages was Hausa. Also, (100 %) of the respondents sex were male. This implies that the male gender is more involved in agroforestry practices and other farming activities compared to their female counterparts. However, farming involve different sections and the respondents claimed that female are more involve in the harvesting, processing and sometimes marketing aspect of farming. 75 % of the respondents across the study areas were married with majority (45 %) having a family size containing 1-10 persons/ household. This was in agreement with Obasi *et al.* (2012) and Oyebamiji *et al.* (2014) who reported in their separate studies that majority of farmers who practice agroforestry in Nigeria were married and inferred that large household is advantageous in farming as labour may be derived from the household members. (100 %) of the respondents across the study areas claimed to have acquired Islamic education (Quran). However, 31 % claimed to have no Western education while majority (69 %) had 30 % primary education (Table 1a).

Framers in the study areas had indigenous/traditional knowledge about farming systems, tree species, shrubs and agroforestry practices. This indigenous knowledge affects their perception and willingness to participate in agroforestry practices. This is supported by Dogondaji and Baba (2010) who observed that high literacy level could have positive impact on the adoption of agricultural practices. (66 %) of the respondents major occupation is farming, as the people in the study areas are predominantly agrarians that rely on farm products and tree products as their major source of food and income. This study is in line with Vihi *et al.* (2019) in their research on adaptation of agroforestry practices among farmers in Gwaram Local Government Area of Jigawa State. (38 %) of the farmers across all zones in the study areas claimed not to have any subsidiary occupation, while, (35 %) of the respondents claimed farming as their subsidiary occupation (Table 1b).

Majority (49 %) of the respondents acquired their farm through inheritance, and this usually affects their farm size as majority (65 %) of the respondents had a farm size of between < 1 to 2 hectares. This implies that majority of farmers in the study areas are operating on little portions of farmland. In a study carried out by Adekunle and Bakare (2004), they reported that (87 %) of Nigeria farmers usually have a small farm size of between 1 and 2 hectares. Years of farming experience refers to the duration at which a farmer has been into farming system, and this study showed that majority (40 %) of the respondents had an experience of between 21 to 30 years. Although, farmers tend to be more efficient and gain more experience in farming through learning as noted by Jamala *et al.* (2013) (Table 1b).

Table 1a: Demographic characteristics of the respondents in the study areas

Variables	**Kano north**		**Kano central**		**Kano south**		**Total**		**Mode**
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
Age (years)									
<20- 29	22	18	17	14	28	23	67	19	
30- 39	42	35	46	38	49	41	137	38	30- 39
40- 49	32	27	30	25	33	28	95	26	
50-Above	24	20	27	23	10	08	61	17	
Language									
Hausa	120	100	120	100	120	100	360	100	Hausa
Sex									
Male	120	100	120	100	120	100	360	100	Male
Female	0	0	0	0	0	0	0	0	
Marital status									
Single	20	17	41	34	28	33	89	25	
Married	100	83	79	66	92	77	271	75	Married
Number of persons per household									
1-10	41	41	43	55	39	42	123	45	1-10
11- 20	38	38	20	25	35	38	93	34	
21- 30	21	21	16	20	18	20	55	20	
Educational status									
Primary	40	33	30	25	37	31	107	30	Primary
Secondary	26	22	39	32	32	27	97	27	
Tertiary	13	11	21	18	11	09	45	12	
No Western Education	41	41	30	25	40	33	111	31	
Quranic Knowledge	120	100	120	100	120	100	360	100	
Total	120	100	120	100	120	100	360	100	

Table 1b continued: Demographic characteristics of the respondents in the study areas

	Kano north		Variables		Kano south		Total		Mode
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency
Major occupation									
Farming	85	71	62	52	87	73	234	66	Farming
Civil servants	17	14	21	18	14	12	52	14	
Student	08	07	15	12	11	09	34	09	
Trading	10	08	22	18	08	06	30	11	
Subsidiary occupation									
Farming	35	29	58	48	33	28	126	35	
Have subsidiary occupation	28	23	33	28	36	30	97	27	
Don't have subsidiary occupation	57	48	29	24	51	42	137	38	No subsidiary
Land acquisition									
Inheritance	57	48	60	50	59	49	176	49	Inheritance
Purchase	29	24	33	28	40	33	102	28	
Rent	13	11	10	08	09	08	32	09	
Family land	21	17	17	14	12	10	50	14	
Farm size (ha)									
<1-2	78	65	69	58	86	72	233	65	< 1-2 ha
2 – 3	29	24	31	26	19	16	79	22	
3 - 4	13	11	20	16	15	12	48	13	
Years of farming experience									
1 – 10	18	15	17	14	15	13	50	14	
11 – 20	32	27	30	25	33	28	95	26	
21 – 30	40	33	46	38	57	47	143	40	21-30
31 – 40	22	18	20	17	10	08	52	14	
41 – 50 >	08	07	07	06	05	04	20	6	
Total	120	100	120	100	120	100	360	100	

3.2 Predominant Agroforestry Practices in the Selected Villages of the Study Areas

The distribution of the most predominant agroforestry practices found in the study areas based on the selected villages include; scattered trees on farmland, boundary marking, plantation and other crops, shade trees and multispecies tree garden. It was observed that the most commonest agroforestry practices employed in the selected villages were found in these villages namely; Gwarzo, Lakwaya, Bebeji and Zoza respectively. The report showed that the farmers in Gwarzo village practised scattered trees on farmland, boundary markings, shade trees and plantation and other crops, while, farmers in Lakwaya village also practised scattered trees on farmland, boundary markings, shade trees and multispecies tree garden, Bebeji village practised scattered trees on farmland, boundary markings, shade trees and plantation and other crops and Zoza farmers practised scattered trees on farmland, boundary markings, plantation and other crops and multispecies tree garden. Farmers could have also enjoyed more of the benefits agroforestry practices offer had it been they committedly practised the systems as suggested by Roger (2003). The agroforestry practices would have also afford the farmers better livelihood and friendly environment and ecological system balance (Table 2).

3.3 Common Agroforestry Practices in the Study Areas

The distribution of the respondents to the most predominant agroforestry practices revealed that boundary markings had 43 % of farmers practicing it, while, scattered tree on farmland had 34 % of farmers practicing it. Meanwhile, (33 %) of farmers practiced shade trees, however, plantation and other crops experienced only 4 % of farmers practicing it across the study areas (Figure 2). These agroforestry practices enable farmers to benefit from the products and services of the trees as an additional advantage to the crop cultivation. Scattered trees on farmland was reported by Oyebamiji *et al.* (2012) to be the most common practice among farmers in Odeda Local Government of Ogun State. Retaining trees on farmland was also a common practice among farmers in the areas, as farmers were found of deliberate retention of economic trees during land preparation. However, boundary markings will enable the farmers to fence their farmland at minimal cost, serving as protection (against animals and soil degradation) and boundary demarcation between one land and another (Figure 2).

3.4 Identified Constraints of Agroforestry Practices in the Study Areas

Despite the widespread of potentials of agroforestry, many challenges hinder the scaling up of system in the study areas. Majority, (100 %) of the respondents agreed to non-availability of seed/seedlings, long rotation period and non-compliance to forest policy to be the major constraint limiting the expansion of agroforestry practices across the study areas. Other constraints include; lack of incentives (88 %), poor extension service (82 %), small land holdings (78 %), lack of technical know-how (72 %), trees casting shadow on crops (45 %), land tenure system (23 %) shortage of labour (18 %) and theft (11 %) (Figure 3). Long rotation period, non-availability of seed/seedlings and non-compliance to forest policy posed big challenges. 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 (Glover *et al.,* 2013). Lack of incentives and technical know-how were also constraints faced by farmers in the study areas as majority reported no support from the Government. Also, insufficient knowledge and skills on different agroforestry practices affect the adoption of other agroforestry practices by the farmers in the study areas. Keil *et al.* (2005) considered information and knowledge about a given technology as key to the adoption of new agricultural practices, especially when experiments about new technologies and innovations are carried out in the presence of farmers (Figure 3).

Table 2: Distribution of predominant agroforestry practices in the selected villages of the study areas

Agroforestry practices/ Villages	Scattered trees on farmland	Boundary markings	Shade trees	Plantation and other crops	Multispecies tree garden	Predominant practice(s) per villages
Getso	*	*				2
Gwarzo	*	*	*	*		4
Lakwaya	*	*	*		*	4
Mainika	*	*	*			3
Karaye	*					1
Kwanyawa	*	*	*			3
Kafin Dafga	*	*				2
Turawa	*	*				2
Alajawa	*	*	*			3
Faruruwa	*	*		*		3
Kokiya		*			*	2
Leni	*	*	*			3
Dosan	*	*	*			3
Gano	*	*	*			3
Dawakiji	*	*				2
Yankatsari	*	*	*			3
Dukawa	*	*				2
Gundutse		*		*		2
Kosawa	*	*	*			3
Kura	*	*				2
Kafin Agur	*	*				2
Magobi	*	*	*			3
Kaura Mata		*		*	*	3
Yakun	*	*				2
Baguda	*	*				2
Bebeji	*	*	*	*		4
Gargai	*	*				2
Gwarmai	*	*			*	3
Dashi	*	*				2
Galadimawa		*				1
Kiru	*	*				2
Zuwo	*	*				2
Gwangwan		*	*			2
Rogo Ruma	*	*				2
Rogo S.Gari	*	*				2
Zoza	*	*		*	*	4
Total	31	35	13	6	5	90

Source: field survey, 2021

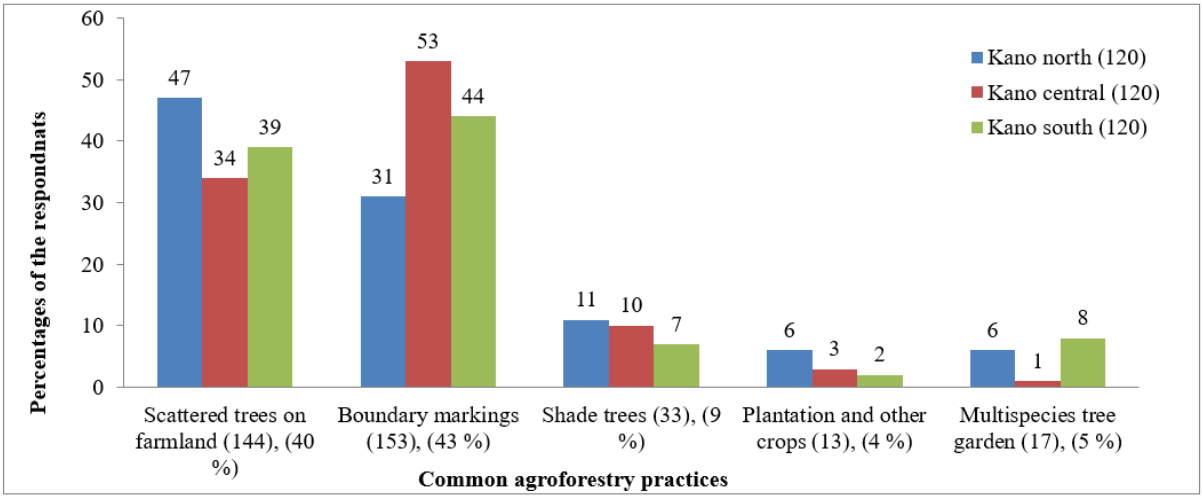

Figure 2: Common agroforestry practices in the study areas

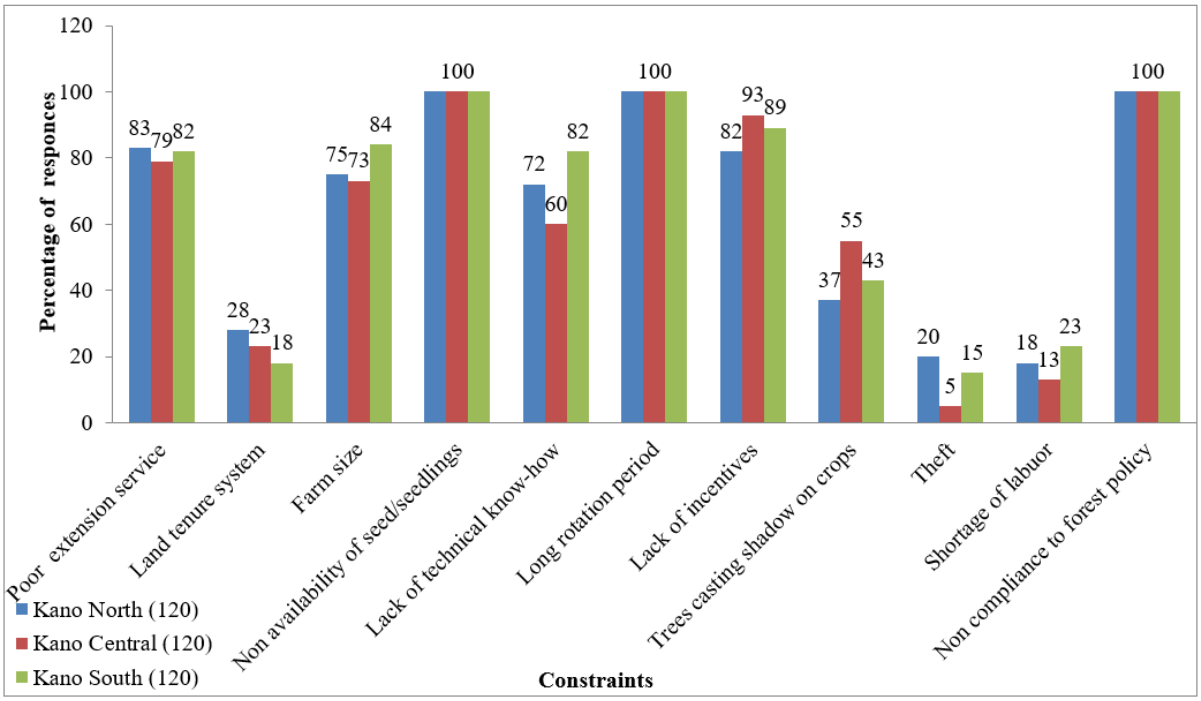

Figure 3: Constraints of agroforestry practices in the study areas

3.5 Farmers' Perception on Agroforestry in the Study Areas

In terms of perception statements of the respondents, the perception variables (Agroforestry practices is too expensive to practice) and (Agroforestry practices as a scientific practice that is difficult to practice) were ranked 1st and 2nd having the highest mean values of 1.14 and 0.72, followed by the statement (Agroforestry practices as a practice that can improve farm productivity) ranked 3rd with a mean value of 0.37. The statement that (Agroforestry practices as a practice not well understood) was ranked 4th with a mean value of 0.07, while, the statement (Agroforestry practices improve the livelihood of farmers) was ranked 5th with a mean value of 0.06 and finally, the statement (Agroforestry practices as a common practice among the local farmers) was ranked 6th with a mean value of 0.04. The implication is that majority of the respondents perceived that the practice of agroforestry is quite expensive and even its scientific practice is also very difficult. It was discovered that indigenous knowledge affect farmers' perception and willingness to participate in agroforestry practices. This is supported by Dogondaji & Baba, (2010) who observed that high literacy level could have adverse effect on the adoption of agroforestry technologies. However, farmers' perception was also noted to be influenced by the demographic characteristics of the respondents (sex, age, marital status and educational status) as equally observed by Adesina & Chianu, (2002) (Table 4)

Table 3: Farmers' perception on agroforestry practices across the study areas

Perception variables	1 F %	2 F %	3 F %	4 F %	5 F %	Mean	Rank
As a common practice among the local farmers	345 (96)	15(04)	00 (00)	00 (00)	00 (00)	0.04	6th
Agroforestry improve the livelihood of farmers	346 (96)	06 (02)	06 (02)	02 (01)	00 (00)	0.06	5th
As a practice that can improve farm productivity	227 (63)	133 (37)	00 (00)	00 (00)	00 (00)	0.37	3rd
As a practice not well understood	336 (93)	22 (06)	02 (01)	00 (00)	00 (00)	0.07	4th
As a scientific practice that is difficult to practice	215 (60)	88 (24)	09 (03)	41 (11)	07 (02)	0.72	2nd
As a scientific practice that is too expensive to practice	172 (48)	97 (27)	02 (01)	49 (14)	40 (11)	1.14	1st

Scale: 1: Strong Agreed 2: Agreed 3: Undecided 4: Disagreed 5: Strong Disagreed

4. Conclusion

Agroforestry is a common practice among local farmers in the study areas. Thus, the introduction of new innovation vis-a-vis agroforestry practices or technologies would not be strange or become new idea since farmers have been practicing it by way of keeping trees together with arable crops in various ways. Also, the retained and/or planted trees contribute several benefits to the farmers such as provision of food, leaf/fodder, medicine, fruits, seeds, oil, and services such as providing shade and controlling erosion. The contribution of tree components to the farmers livelihood was considered to be high in the study areas. However, farmers in the study areas lack current/modern knowledge and skills to efficiently utilize the benefits they derived from those tress. Therefore, there is need for forest extension officers to create awareness and identify other salient forest resources for individual farmers in the study areas to enjoy.

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