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ASSESSMENT OF AGROFORESTRY SYSTEM FOR RESTORING ECOSYSTEM SERVICES IN JERE LOCAL GOVERNMENT AREA, BORNO STATE, NIGERIA

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ABSTRACT

The research assessed agroforestry systems as a tool for restoring ecosystem services in Jere local Government Area of Borno State. Four out of 12 district were purposively selected based on the practice of Agroforestry in the area which includes Alau, Gonglung, Old Maiduguri and Zabarmari. Three villages were randomly selected from each district and 15 respondents were selected from each village randomly, given a total of 180 respondents. Data were collected through the use of structured questionnaire. The data obtained were analyzed using descriptive statistics. Results showed that most of the farmers were within 31-40 years. Majority (82.8%) of the respondents were male and married (64.4%). Most (36.1%) has attained Quranic education with 6.1% without any form of education. Majority (80.6%) of the farmers had no contact with extension agents. Result further shows that 38.3% got idea on agroforestry system through their parents and 34.4% practiced dispersed tree on cropland. Majority (69.4%) used tree in their farm for the provision of fruits and food. Majority (51.7%) of the respondents stated the use of agroforestry practice helped in restoration through enrichment planting. It also helped for biodiversity management through provision of fauna and flora. Awareness campaign was suggested by the respondents as an effective action to be taken for restoration strategy. It was concluded that agroforestry helped in restoration and biodiversity management. It is therefore recommended that awareness should be emphasized more by government, NGOs and extension agencies.

Keywords: Agroforestry; Biodiversity; Restoration; Strategy.

INTRODUCTION

Effort to define Agroforestry started since the mid-1970s and evolved rapidly as studies began on the diversity and scope of Agroforestry practices. In the late 1970s and early 1980s, the fate of agroforestry suffered from a surfeit of definitions and a general lack of common understanding caused by a paucity of information (Babalola, 2009). These earlier struggles to define a broad new area of study have resulted in a conceptual understanding from which to examine complex systems and practices. Agroforestry is thus characterized by a high diversity and variable scope of practice that leads to many definitions. Lundgren (1982) gave a broadly applicable definition, which is also the

definition used by the "World Agroforestry Centre" (ICRAF, 2009) as a collective name for land-use systems where woody perennials (trees, shrubs, palms, and bamboos) are deliberately used on the same land management unit as agricultural crops and or animals, either in some form of spatial arrangement or temporal sequence. Agroforestry is one of farming systems that is practiced in subsistence agriculture throughout the tropics. According to Muhammad and Bello (2014) Agroforestry is classified as Agri-Silviculture, silviculture, agrosilvipasture, apiculture and entomoforestry. However, many practices are carried out under this systems ranging from home garden, alley cropping, living fencing, taungya, disperse tree on cropland. Farmers can benefit from agroforestry systems that address the issues of soil productivity, environmental stability, product diversification, and economic development (Franzel *et al.,* 2002). The IUCN defined restoration as a process that aims to regain ecological integrity and enhance human wellbeing in a landscape that is dominated by forests and woodlands which continue to yield forest related goods and services (Reitbergen-McCracken *et al.,* 2007).

One of the greatest challenges facing Nigerians and the inhabitants of Sudano-Sahelian regions is deforestation, vegetation loss and forested landscape degradation (Chukwujekwu, 2010). Nigerian forests have been undergoing rapid depletion because of human influence. According to Jose (2011) the rapid degradation of forestland has not only severely hampered agricultural production, but also has serious effect on the ecological balance. In most places of the world, including the area of present study, many farmers practice agroforestry systems but still remain unaware of the contribution it makes to their ecological well- being, socio-economic development, especially in relation restoration (Ajayi *et al*., 2006). The main focus of agroforestry is on the sustainability of the environment with emphasis on the desirable ways in which farmers can utilize the land to prevent it from degrading. Apart from ensuring maximum utilization of land resources for adequate provision of food, shelter and capital for restoration, agroforestry also checks environmental hazards like erosion, desertification, global warming, and ozone depletion among others (Onumadu *et al.,* 2001). Finding alternative options to increase the supply of forest products and services to support rural livelihoods have become a fundamental concern for policy makers and planners. The main objective of this study is to assess Agroforestry systems as a tool for restoration in Jere Local Government area of Borno State and specifically to describe the socio-economic characteristics of the respondents, examine the type of Agroforestry practice in the area and the restoration strategy.

METERIALS AND METHODS

Study Area

The study was carried out in Jere Local Government Area of Borno State. It lies within latitude $11^{0}40^{1}$ and $12^{0}05^{1}$N and longitude $13^{0}50^{1}$ and $12^{0}20^{1}$E (Tijjani *et al.,* 2010). The climate is characterized by dry and hot seasons, with minimum temperature ranging from 15 to 20°C the maximum temperature ranges from 37 to 43°C. Mean annual rainfall ranges from 300 to 500 mm per annum (NMA, 2012). The vegetation falls within the Sahel savanna agro-ecological zone and it covers an area of 868 km^2 with its headquarters in Khaddamari (MLS, 2012). Jere has an estimated population of 247,860 (NPC, 2011). The major ethnic groups are Kanuri and Shuwa-Arab, others include Marghi, Hausa, many immigrant settlers from within and outside Nigeria.

Sampling Technique and Sample Size

A reconnaissance survey was carried out with a view to get acquainted with the terrain of the study area and locates areas with dominant of Agroforestry systems. Purposive sampling was used to select four out of 12 districts present in the local government because of the agroforestry practice in the area and three villages were randomly selected from each district. A total of 15 respondents were selected from each village equally due to absence of exact population of agroforestry farmers in each village given a sample size of 180 respondents.

Data Collection and Analysis

Primary data and secondary information were used for the study. One hundred and eighty structured questionnaires were used as an instrument for collecting data before retrieved and analyzed to achieve the objectives of the research. Data were collected on socio-economic characteristics of the respondents, type of agroforestry practice and restoration strategy in the area. While the secondary information was obtained from relevant literature, journals, internet, etc. The data obtained were analyzed using descriptive statistics. The statistical tool used includes percentages and frequency distribution.

RESULTS AND DISCUSSION

Result on respondent's socio-economic characteristics include age, sex, marital status, level of education, extension visits and the usefulness and type of Agroforestry practiced for restoration as presented in Table 1.

Socio-economic Characteristics of Farmers

The largest age group of the respondents was between 31-40 years. This shows that the respondents were young and energetic and could actively participate in agroforestry. This age group gives the potential for practice of agroforestry in the study area. Findings from Adesina *et al*. (2000) affirmed that young farmers are more likely to practice agroforestry systems. Out of the 180 respondents selected for the research, majority of them were male with only few females (Table 1). The female respondents constituted a smaller percentage, thus, male headed households engage in agroforestry more than female headed households. This could be due to the socio-cultural milieu of the area which gives males the access to production resources like land where agroforestry is practiced more than females. This is in line with the findings of Ango *et al*. (2011) who reported that majority of the rural populace in the northern part of the country engage in farming, while the female folk partake only in rearing of children, domestic and other house chores and processing of agricultural produce. It is also noted that majority of the respondents (64.4%) were married with 16.1% single (Table 1). This implies that greater proportion of farmers in the area were married individuals. Consequently, it increases access to production variables such as land and labor which are traditionally owned and provided by husbands. Obasi *et al*. (2012) and Orisakwe, & Agomuo (2011) professed in their separate studies that majority of agroforestry farmers in Nigeria were married. This shows that married people dominates agricultural production in the most study area. Majority of respondents (36.1%) has attained

Quranic education with only 6.1% having no formal education. This level of education could affect the practice of agroforestry system in the area. According to Adesina *et al*. (2000) farmers with a higher education level are more likely to adopt new technologies compared to less or low educated farmers. Greater proportion (80.6%) of the farmers affirmed to have had no contact with extension agent while the remaining (19.4%) have had contact with extension agents. Extension visit encourages the development of receptive attitude in the farmers to accept technological changes in their farming practices, and also equip them with managerial skill, through informal education and demonstrations, to be able to sustain accepted technologies. Orisakwe & Agomuo (2011) noted that regular contact with extension agents motivates and exposes the farmers to innovations and gives them information on how to use modern system. The mean number of extension visits was approximately yearly and was considered very low.

Table 1: Distribution of respondents according to their socio-economic characteristics

Variables	Frequency	Percent (%)
Age (years)		
10-20	8	4.4
21-30	31	17.2
31-40	89	49.4
41-50	45	25.0
51 and above	7	3.9
Total	180	100.0
Male	149	82.8
Female	31	17.2
Total	180	100.0
Marital status		
Single	29	16.1
Married	116	64.4
Widow	25	13.9
Separated	10	5.6
Total	180	100.0
Educational qualification		
Quranic	65	36.1
Primary	46	25.6
Secondary	42	23.3
Tertiary	16	8.9
No formal education	11	6.1
Total	180	100.0
Visit by extension workers		
Yearly	35	19.4
Not at all	145	80.6
Total	180	100.0

Idea on Agroforestry System

The result showed in Table 2, that most of the respondents had information of agroforestry through their parents, friends and family, media and schools. This finding was supported by the view of Benine *et al*. (2003) that access to information (through parents, family and friends, media) is an important variable that shape farmer's information on agroforestry system. The farmers who had a radio (who often listen to) got information on the benefits of agroforestry than those who did not.

Table 2: Idea on agroforestry in the study area

Variables	Frequency	Percent (%)
Media	51	28.3
Friend and family	55	30.6
Inherited	69	38.3
School	5	2.8
Total	180	100.0

Agroforestry Practices in the Area

Results in Table 3 shows the distribution of respondents according to types of agroforestry they practiced. Majority (34.4%) stated dispersed tree on cropland. It is practiced in agriculturally less productive sites or on sites susceptible to high erosion. It is observed that the main tree species incorporated in this system of agroforestry in the study area were *Citrus sinensis*, *Mangifera indica*, *Anacardium occidentale*, *Acacia spp*, *Azadirachta indica* etc.

Table 3: Distribution of respondents according to agroforestry practices in the area

Variables	Frequency	Percent (%)
Alley cropping	37	20.6
Living fence	12	6.7
Home garden	36	20.0
Shelterbelt	33	18.3
Dispersed tree on cropland	62	34.4
Total	180	100.0

The use of multipurpose trees and integrated approaches can enhance the profitability of agroforestry. According to Aladi and Olagunju (2014) multipurpose trees on crop land can supply people's diets in almost all rural areas by adding diversity and flavoring as well as providing essential minerals to human diet. Neupane and Thapa (2001); Assogbadjo, *et al*. (2012) in their separate studies averted that multipurpose trees can be sources of fodder, edible fruits, and non-timber products that serve as alternative food during periods of deficit and primary sources of income for many rural communities. A total number of 36 (20.0%) respondents practiced home garden. This could be possible because it is a prominent feature of traditional farming systems, especially in region of high population density and decreasing availability of crop and lands. This is in line with the findings of Fernandes and Nair (2006) who stated that food production is the primary function of most home gardens and much of what is produced is consumed by the

household. This indicates that, it is practiced for the purpose of satisfying the farmers' basic needs because it has the ability to produce food throughout the year. About 6.7% practice living fence in the area. This implies that, farmers practiced live fence and appreciated in the rural areas where the concrete fencing is not affordable. The result is affirmed by Kelly (2010) that live fence provides permanent boundary demarcation which gives security to the homestead.

Importance of Tree Species on Farmland

Result in Table 4 shows that, the major importance of trees in agroforestry practices as expressed by the farmers was increasing soil fertility (14.4%), protecting soil against wind (5.6%), provision of shade (5.0%), provision of fuel wood (5.6%) and 69.4% provision of fruits and food. Trees in the farm have potential to increase soil fertility. This implies that the presence of trees in the farm could help the soil to regain its fertility without the use of inorganic fertilizers. According to World Agroforestry Centre (2013) Nitrogen fixing trees increase soil fertility and by incorporating more biomass into soils, enables more efficient use of inorganic fertilizers. Incorporating trees with crops helps in protecting soil from damaging impact of rain and wind. Trees are able to prevent wind and water erosion by acting as wind break and by intercepting the raindrop impact on the soil. Akpan (2000) affirmed that some forest tree crown cover reduces the intensity of rain water on the soil which invariably reduces the impact of washing away of the organic matter in the soil. Therefore, farmers leave trees in their farm because it helps to minimize the impact of rain on the crops, prevent erosion and improve crop yield.

Table 4: Distribution of respondents according to importance of tree species on farm

Variables	Frequency	Percent (%)
Increase soil fertility	26	14.4
Provision of shade	9	5.0
Provision of fruits and food	125	69.4
Protection against wind	10	5.6
Provision of fuelwood	10	5.6
Total	180	100.0

Use of Agroforestry System for Restoration

Findings of the study (Table 5) revealed that 51.7% of the farmers stated the use of agroforestry system helped in restoration through enrichment planting, though, others mentioned fast growing trees on terraces (32.2%), 8.9% mentioned use of native species and 7.2% reforestation. This could imply that, restoration at the landscape level may involve a variety of ecosystems and land uses. Restoration activities may go well beyond planting trees, or establishment of forests. Nevertheless, the trees are key components because of the often central role they play in the provision of benefits for both people and biodiversity. This finding is in line with FAO (2015) that agroforestry helped in restoration through planting due to the fact that the canopies of trees, and the aerial parts of smaller plant species, reduce the negative impacts on the soil thereby reducing erosion and helped restoration of degraded land.

Table 5: Distribution of respondents according to use of agroforestry for restoration

Variables	Frequency	Percent (%)
Fast growing trees on terraces	58	32.2
Enrichment planting	93	51.7
Use of native species	16	8.9
Reforestation	13	7.2
Total	180	100.0

Use of Agroforestry Systems for Biodiversity Management

Majority (57.2%) of the respondents revealed that practice of agroforestry system provide habitat for fauna and flora and 42.8% mentioned reduction in frequency and intensity of fires and 21.1% reduction of pest and disease as the service function of agroforestry system. This implies that the presence of tree in a field provide home for avian, mammals, and other species of plants. The presence of green plants helped reduce the frequency and intensity of fire at the same time conserving environmental goods and services which could help in restoration. The result is similar with the finding of Brandle *et al*., (2004) in multi strata cacao (*Theobroma cacao*) agroforestry systems that include timber, fruit tree, and native forest species who professed that, it contributes to biodiversity conservation by providing habitat for avian, mammalian, and other species, enhancing landscape connectivity, reduction of pest and disease and reducing edge effects between forest and agricultural land.

Table 6: Agroforestry for biodiversity management

Variables	Frequency	Percent (%)
Provision of habitat for fauna and flora	103	57.2
Reduction in frequency and intensity of fires	39	21.7
Reduction of pest and disease	38	21.1
Total	180	100.0

Strategy to be use for Restoration

Awareness campaign was found to be the best actions to be use for restoration (Table 7). This means that the farmers need extension or forestry agencies to enlighten the people in the rural area as some of them are unaware of the knowledge on restoration.

Table 7: Distribution of respondents according to strategy to be use for restoration

Variables	Frequency	Percent (%)
Provision of financial incentives	50	27.8
Awareness campaign	59	32.8
Continuous Monitoring and learning	2	1.1
Multiple use of land	53	29.4
Restriction of tree cutting	16	8.9
Total	180	100.0

Similar finding was reported by FAO (2015) that awareness campaign was the best actions to be taken for rural populace. It is also noted by the respondents that provision of financial incentives, multiple use of land, and restriction of tree cutting as part of restoration**.**

CONCLUSION

Generally, the level of awareness on agroforestry practices in the area for restoration is low. However, farmers maintain trees in their farmland in form of agroforestry practices and derived the benefits from it for their sustenance. The major source of information on agroforestry was through parents, family and friends. It was found that agroforestry helped in restoration of landscape as well as biodiversity management. However, some actions to be taken for restoration require government and NGOs intervention. As a recommendation, policy makers need to be informed about the benefits of agroforestry for restoration so that they can support rural development and provide environmental services.

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