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The Role of Forest Trees in Indigenous Farming Systems as a Catalyst for Forest Resources Management in the Rural Villages of Cross River State, Nigeria

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The Role of Forest Trees in Indigenous Farming Systems as a Catalyst for Forest Resources Management in the Rural Villages of Cross River State, Nigeria

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Abstract - The concern of humanity is the need to tackle the increasing challenges of severe degradation of the forest ecosystem and its resources. The study examined the critical role of forest tree species in indigenous farming systems on the management of forest resources in the rainforest villages of Cross River State, Nigeria. The participatory Rural Appraisal (PRA) method, household questionnaire survey, field inventory and measurement were used to generate the required data. The data were analyzed using statistics such as simple percentage, mean, standard deviation, tables, graphs, charts and one-way analysis of variance (ANOVA). The study result indicated that the practice of tree felling during land preparation for farming is a minority attribute of the study population. 69.91 percent of the people allow trees on farmlands during land clearance, while 31.09% are found in tree-felling. Although, this practice of tree retention and cultivation varies significantly across the study villages, it was found that significant number of household heads preferred some forest tree species on farmlands such as mahogany (entandrophragma spp), Bush Mango (Irvingia gabonensis), mimosup (Baillonellia toxisperma), Iroko (melicia excelsa) and Native pear (Dacryodes edullis). These species attracted 64%, 90%, 56%, 76% and 56% of the study population respectively. The study further discovered the most common indigenous farming practices, where forest trees are planted and retained as mixed food crop and mono-food which attracted a mean population of 45.06 and 48.42 household heads. Farm sizes of more than five hectares engaged a few number of households but has the highest population of tree species cultivated and retained on farmlands. Also, the analysis shows a considerable variation in the planting and retention of forest trees in indigenous farming systems. The result indicates that forest tree retention is common with mixed food crop and mono-food. This accounts for 60% and 55.1% respectively while tree cultivation was more associated mixed /food crop (56.28%), mono tree crop (55.5%) and mixed tree (54%). Similarly, the result revealed that 42.56 mean population of the people sampled owned between 1-5 plots of farmlands, while a few number of households (2.18) under study limited themselves to eleven to fifteen farm plots. This implies that households with several number of farm plots are significantly involved in planting of forest trees than those with a few a number of farm plots. The analysis equally shows such number of plots may increase deforestation. Therefore, the study suggest that indigenous people should be encouraged to utilize few number of farm plots through the integration of valuable tree species, than acquiring more lands for farming. In addition, since forest trees are the basis of rural people's sustenance, the study analysis concluded that the higher the population of tree species on indigenous farming systems the more benefits for the rural population. These practices directly reduce pressure from the primary forest and ensure sustainable forest resources management. Based on these findings the study recommended forest and agricultural education for indigenous people and intensification tree retention and cultivation in indigenous farming systems among the forest villages of Cross River State, Nigeria.

Keywords : forest management, farming systems, inventory, resources, tree retention, sustainability.

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I. Introduction

Trees are the essential component of the indigenous agricultural systems. When people clear land for farming, they leave a wide selection of species on farmlands. Most of these species are preserved or managed to meet the immediate needs of the population such as food, medicines, income, agricultural materials and ecological needs.

According to Raintree (1998), the changes in forestry practice that emphasized forestry for local community especially in developing countries together with parallel development such as farming systems approach in agriculture are part of the response to a broad-based societal demand for greater participation of local people in their own development. Various scholars (Hough, 1990; Warner, 1991; Bisong, 1993) have identified trees in farming system as a strategy for restoring degraded areas, increasing people's access to valued forest products and conserving existing forest ecosystem. The role of trees and forestry in maintaining stability in ecosystem has come to the forefront in the search for solution to environmental degradation.

Although farmers have always incorporated trees in their farming systems; but since the onset of technological advancement trees became a neglected factor in agriculture (Park, 1992). Mono-cropping, combined with widespread use of artificial fertilizers and

pesticides seem to have been the only means of increasing productivity, thus, undermining natural fertilizers from trees (Clunies-Ross and Hildyard, 1992). To some extent, Brills, Ende, Leede, Paap and Wallace (1996) reported that many tropical areas who adopted these innovations in agricultural landscapes ended with disastrous results such as wild spread soil erosion and degradation, chemical pollution of water, soil and air. Recent studies on traditional farming systems in many areas of the world suggest that complex poly-cultures with trees have many advantages for the local economy over modern systems of extensive annual and monoculture (Ajake 2008, Akorn, 1990). Mixed tree system however, shows that local farmers can and do manage agro-ecosystem on sustainable basis. The integration of trees into farming system remains relevant in the on-farm biodiversity conservation strategy and the expansion of the production of many fruits, vegetables, medicinal plant and bush meat. Biodiversity support programme (1993) reported that forest farming has been practiced for at least 1,000 years, and the distinction between "natural" forest and those altered by human activities is often difficult to discern. Indeed, many agricultural technologies evolved from the practices of forest dwellers that depended on trees and other forest plants for their needs. Brills et al, (1996) revealed that trees are important for their ecological and economic functions in a farming system. When trees and crops are grown together on the same piece of land, they would be interactions between the two components, which may have positive or negative effects. But Gregersen, Synder and Dieter (1989) earlier in their study indicated that tree allowed during forest clearance or introduced into farming systems can help improve the productivity of farmlands by fixing nitrogen, providing green manure and reducing wind erosion and soil moisture loss especially when they are used in shelter belts or windbreaks.

The importance of leaving tree species of good phenotypic quality during forest clearance for timber and farming, particularly during regeneration sampling has revealed low levels of established seedlings and advanced growth of desirable species is a further instance of close coincidence of interest between the objectives of production and those of genetic resource conservation (Kemp, Namkoong and Wadsworth, 1993). However, this practice has been commonly overlooked by the pressure for maximum harvest yield and profit. Although, success in silvicultural practices has been defined in terms of bringing timber to maturity and producing natural regeneration on farmlands where the soils show no signs of deterioration (Dawkins, 1988), the impacts on the genetic resources, especially on the total range of biological diversity on plant and animals in the forest, particularly the use or arboricides, can have far more persistent and disseminating influences than crop manipulation or logging. The success of the sulvicultural treatments has sometime been due to their accidental encouragement of the regeneration of species which were not at the time considered desirable, but which are now in substantial demand. The essential question regarding the conservation of genetic resources is the extent to which harvesting practices and sulvicultural system allow for the retention of a wide spectrum of potentially valuable genetic diversity which provide resources for the rural population. This is most likely to be achieved if different farming systems and different systems within the same production forestry are subjected to assessment and analysis based on the ecological principles to favour the regeneration and bringing to maturity the different elements of the main "guilds" including the climax species.

Several studies have identified the utility of trees in increasing the overall farm productivity (Raintree, 1998), fuel wood and construction materials (Brills et al, 1996) erosion control and soil conservation (Iboanugo, 1993); socio-economic improvement of rural communities (Ajake, 2008) among others. However, tree species are recognized for their various functions. In some parts of the world, farmers have planted trees as hedgerows at intervals along the contour to transform a permanent cropping with increased yields. In Sikko District, Flores, Indonesia, Prussner (1981) reported that the planting of "*Leucaena*" tree has been successfully implemented on more than 20,000 hectares of highly erodible, steep soils since 1973. "*Leucaena*" was planted as hedgerows on the contour to control erosion and provide feed, fixed nitrogen, fertilizer and fuel wood. Nair (1993) recommended the establishment of multipurpose trees for land reclamation of several eroded and degraded grazing areas. Although, encouraging reports of their application are however scanty, success has been accomplished by tree planting and subsequent soil amelioration in the salt-affected soils of north western India where species such as *Acacia nilotica;A tortilis; prosopis juliflora; Butea Monosperma* and *encalyptus spp* were adopted (Ahmed, 1991). Similar studies in Yurimagua, Peru (Szott, et al, 1991), parts of Amazonian (Unruh, 1990), Kalimantan, Indonesia (Inoue and Iahjie 1990); and Togo (Dreshsel, et al, 1991), have investigated fallow improvement strategies in shifting cultivation areas. In Bangladeshi, Gregesen, Synder and Dieter (1989) report that farmers were using mangrove trees to stabilize tidal mudbank; Indian farmers used *Terminalia spp* to reclaim salinized areas, whereas Indonesia farmers used *Gliricida* species to suppress pericious weed growth. In Enugu, Nigeria, Ojukwu (1998) identified anti-erosion species for multipurpose such as *Irvingia gabonensis, Dacrayodes edulis, Canarium Schewenfuthic, Crythrophleum suuaeons, Treculia africana etc* and farm

tree species as *Parkia biglobosa*, *pietum guineensis, Afzelia Africana* etc. These species were planted to prevent shallow landslides in hilly areas and erosion along slopes. All these studies as presented have not focused on the use of indigenous tree species to reduce pressure from the forest.

Even though trees are having inevitable role in the farming systems such as environmental management and socio-economic livelihood of most people across the world, conflicts do exist between cultivating trees and raising agriculture which emphasized the use of machines and fertilizers have dominated crop production. These practices have adverse effect especially on forest ecosystem and the environment in general. The retention of trees on farming systems has been recognized in the rainforest communities of Cross River State, South Eastern Nigeria as an inevitable priority among the rural farmers. Bisong (1993) and Ajake (2008) have recognized the function of forest trees in the study area in term of income generation, good medicare, employment generation, raw materials, provision of food among others. Dunn, et al (1994) note that farmers in Cross River State are aware of some tree species, which if left on the farm will improve crop yield. But Bisong (1994) estimated the proportion of cash income from agriculture, forest products and other sources and notes that income from farming is greater than that from forest products. However, Balogun (1994) observes that the above analysis is not complete because it ignores value of food and non-timber forest products (NTFPS) consumed within the household. Trees in farming systems therefore have significant role in the socio-economic activities of the people and constitute the basis of forest resources management in the study area.

Although, forest resources are rapidly decreasing, their value and utility of the forest is increasing daily. Agricultural systems that meet human requirements for livelihood sustenance but exert minimal damage to biotic or forest resources are at the core of the search for sustainable land-use system. This study explored trees in indigenous farming systems and their role in forest resource management in the rainforest communities of Cross River State, South Eastern Nigeria. Emphasis is basically on indices such as size of farm holdings, cropping pattern and practices, number of trees integrated into rural farming systems, types and number of farm plots per household and their impact on forest resources management in the study area.

II. Study Area

The study was conducted in the rainforest villages of Cross River State, South Eastern Nigeria. The area is located between longitudes' $7^0$40'' and $9^0$50" east and $4^0$40'' and $7^0$00" North and cover a landmass of approximately 23,074.43km^2 (fig. 1). The study area lies within the tropical rainforest ecological zone of Nigeria, which is climatically disposed to the growth of forest plants. The forest is characterized by dense primary and secondary forests, made up of the disturbed, open forests and presumably forest fallows, rich in flora and fauna species and occupying the largest area in Nigeria of about 7610.00km^2 representing 35.2 percent of the total land area of the state (CRSFC, 2011). The forests are stocked with timber and non-timber forest products, which are increasingly being exploited or harvested for the daily sustenance of the people. These products determine the rural economy of the state.

The population in 2006 was 2,888,966 people spread over eighteen local government areas of Abi, Akamkpa, Akpabuyo, Bakassi, Bekwerra, Biase, Boki Calabar municipality, Calabar south, Etung, Ikom, Obanliku, Obubra, Obudu, Odukpani, Ogoja, Yala and Yakurr (Figure 1). The high forest areas are found in Akamkpa, Biase, Obubra, Yakurr, Etun, Ikom, Boki, Obudu and Obanliku (CRSFC, 2011).

III. Method of Study

Data collection was largely through the household questionnaire survey, forest inventory of tree species, field measurement and participatory Rural Appraisal (PRA) method. The PRA method was adopted to provide background information of the people concerning the harvesting of timber and non-timber forest products, farming processes, cropping pattern and practices and the type of forest tree species retained and planted in rural farming systems. The open-ended questionnaire allowed the household heads used for the study to express themselves and indicate their feelings and perception about the effects of forest trees retention and planting in the rural farming systems on the management of forest resources in the study area. Forest field inventory and measurement were carried out to determine plant frequencies and density on farmlands, farm types and sizes. Other materials such as, a metric tape, a string and pegs for measurement of farm sizes were equally used to complement the field survey.

The study sampled eighteen rural forest communities across the Local Government Areas having forest ecosystem. A purposive sampling was adopted for the choice of the rural communities, while the household heads were systematically selected for the questionnaire administration. The number of household heads selected was based on the household population sizes of each village. Fifty percent sampling proportion was used in the selection of the household heads from each village. A total number of 1,457 household heads were sampled from overall household number of 2,906 with the population size of 42,826 for the whole area under study. The administration of the questionnaire

was carried out on the 1,457 household heads systematically selected for the study. The communities under study include Agbokim, Ajassor, Okuni, Akparabong, Abo, Orumenkpang, Odonget, Iyametet, Ibogo, Agoi Ekpo, Ibami, Idoma, Iko Ekperem, Iwuru central, Bayatong, Okorshie, Bendi & Busi.

The data from the field studies and questionnaire administration were analyzed using appropriate quantitative and qualitative statistics such as graphs, maps, charts, parentages, means, standard deviation and One-way Analysis of Variance (ANOVA). The One-way Analysis of Variance was basically used to test the hypothesis which was meant to determine which farm size that can encourage tree integration in the area.

IV. Result and Discussions

The results and discussion of findings was based on the objective and focus of study and was presented under sub-sections.

a) Farming Processes and Forest Management

Evidence in the study area, shows that bush fallow system is a solution to the agricultural limitation and sustainable forest resources management. There is *in-situ* conservation of forest trees which is a characteristic feature of clearing and cropping practices. In all the study areas, it is apparent that forest trees are retained on farmlands during forest clearing. There is a strong tendency among the rural people to selectively keep trees alive and integrate them into farming systems. Trees are not only left on farmlands during land preparation stages, they are consciously cultivated by farmers as an integral part of the farming system (Figure 2).

The result of the household survey shows that the practice of tree felling during forest clearing is a minority attribute of the study population. Many people retain tree species on farmlands for diverse reasons during clearing of forest ecosystems for farming. The result shows that 69.91 percent retain trees on farmlands during clearing of forest, while 31.09% are involved in tree felling due to their cropping pattern. Variations exist in the household responses to tree retention and clearance during land preparation for farming across the sampled villages (Figure 3).

The result shows that trees retention practices after land clearance is greater in Ajassor, Akparabong, Abo, Orumenkpang, Ibogo and Idoma. This sampled villages account for more than 70 percent of the population responses. For those farmers who claimed to clear all trees the overwhelming reason given was that there is danger of shading the crops. Clear-felling of trees during land preparation for fanning is more in Odonget, Bendi, Iwuru Central, Agoi Ekpo and Ibami study settlements. This attracts 40% to 55% of the study population in the area. The PRA study identified over a hundred forest plant species in the rural farming system. These species may be retained during forest clearance or cultivated in order to increase output of forest resources and farm produce. Inventory of forest trees on farmlands conducted during this study identified nineteen forest species frequently retained or planted by the people. These species were also indicated during the household questionnaire survey. Because of the utility of the forest species on farmlands, the study population response varies accordingly (Figure 4).

It is apparent that numerous species of forest plants are left in the farmlands of indigenous people. The forest species most favoured by majority of the households are Mahogany *(Entandrophragma spp),* Bush mango *(Irvingia gaboneensis),* Mimosup *(Baillonellia toxisperma),* Iroko *(Melicia excelsa),* Native pear *(Dacryodes edullis).* These species are retained or planted by 64%, 90%, 56%, 76% and 58% respectively of the study population. Other significant species of over 22% population response are Camwood (*Pterocarpus osun),* Cotton tree *(Ceiba pantadra),* Opepe *(Nauclea diderrichii),* small leaf *(Piptadenistrum africanum),* Black afara *(Terminalia ivorensis),* Achi *(Brachystegia Spp),* Oil palm *(Elaeis guineensis),* Afang *(Gnetum africanum),* Native kola *(Cola accummata).* Cedar *(Lovoa trichiloides),* Bitter kola *(Garcina cola).* Native mango *(Magnifera indica),* and Ebony *(Diospyros spp).*

There are numerous tree species which did not significantly show up on aggregate on farmlands, but do occur in the farming systems of the people. These species are indicative of numerous forest resources integrated into the farming systems of the study rainforest villages of Cross River State. The study observes that the nineteen common plant species are indigenous to the people and are valued for numerous reasons.

b) Cropping pattern and practices in the study area

The study observed that intercropping is carried out under a careful spatial and temporal sequence of crop arrangements on farm plots. Several crops were identified in the study area. The most common and widely cultivated crops are cassava *(Manihot esculenta),* Yam *(Dioscerea Spp),* cocoyam *(Xanthosama sagittifolia, Culocasia esculenta),* flutted pumpkin *(Teifairia occidentalis),* Cucumber *(Cucumis Sativis),* pepper *(Capsicum Spp),*okro *(Abelmoschus esclentus),* Maize *(Zeamays),* Garden eggs *(Solanum melongena),* mellon (*Cucumis melo),* Pineapple *(Ananas sativus),* plantain (*Musa paradisiaca),* oil palm *(Elaeis guineensis),* cocoa (*Theeobroma Cacao*), banana, sugar cane, vegetables and rice (*Oriza Sativa*). The intercropping depended on the vegetation conditions (high forest, secondary forest and fallows), soil and climatic conditions.

The household survey and PRA interviews identified five main cropping patterns (crop

combinations). The result is presented in Table 1. The mean scores of population responses to mono food tend to be the highest with 48.42, while the mean score for mixed food crop is 45.6. The high mean scores for the two farming systems indicate that mono food crop and mixed food crop are widely adopted by the people as their farming practices. The crops adopted for mono food crop production are cassava, rice, yam, cocoyam, sugar cane, maize, melon, pineapple etc, while mixed food crop production across the villages, are yam, cassava, cocoyam, melon, pepper, cucumber, garden eggs, maize, okro and sugar cane. These are all intercropped together in a farming system, and sometime two or more of the crops are cultivated together. The practice of mono-food crop production was attributed to the soil conditions, cheap cost of labour, ease of maintenance, increase in output and economic value. Apart from pineapple that is intensively grown in Orumenkpang, other mono crops are widely cultivated across villages. These crops were grown mostly in red soils, clay soil, as well as sandy loamy soil or white soils.

The study discovers that most rural households are involved in mixed crop farming. This was attributed to scarcity of land, ease of production, availability of household labour, soil condition and vegetation status. For instance, the above crops are considered suitable for virgin forest lands or old fallow re-growth. Early maize, pepper and garden eggs are planted together in well burnt farm plots. They are particularly around the stumps of well burnt trees. Maize, fluted pumpkin, cocoyam, yam and green vegetable can also be grown together at the same time. If cassava is desirable to be included in this arrangement, it is introduced three months or four months later. Most of these crops are suitable for soils referred to as red soil and white soil by the indigenous people. But because of the texture and colour of the soil, such as light brown with loose grains, they may also be referred to as sandy loamy soils. While the red soils are mostly clay derived from the basement complex basalt.

The next higher mean of 34.83 is for mixed trees and food crops production. This combination involves growing the crops such as cocoa, plantain, kolanut, cashew, with food crops such as cocoyam, pepper, cassava and vegetables. The PRA study investigation shows that, food crops are integrated especially when the tree crops are still growing. For instance, planting of cocoa is considered in the same farmland with cocoyam, cassava and vegetables. But when the tree crops are grown to mature stage, food crops are introduced mostly in the gaps within the farmlands or are eliminated. The tree crops were considered as products with high economic value but their cultivation is capital intensive and requires enough labour. Other farm types of significance are mono tree crops and mixed tree crops, which attract the mean of 19.82 and 27 respectively. The monotree crops involve the cultivation of oil palm, cocoa, orange, banana, plantain and cashew, while mixed tree crops requires the combination of cocoa, plantain, banana, etc. Although the latter is capital and labour intensive but attracts more income to the people than other systems of production.

In addition, the high standard deviation of 42.50 for mixed tree production and 43.07 for mixed tree and food crop indicate that the level of disparity of the distribution of the respondents to these farm types, across the various communities is very high. This means that, while some farm types may record very low distribution (2 or 3), others have extremely high distribution (182 or 174) (Table 1). The study concluded that mixed food crop, mixed tree and food crops are the main farming practices or crop combinations across the villages. These farm types encourage the integration of forest tree species into the rural farming system. The integration of forest trees into rural farmlands was confirmed by the study population as a new technology that has improved the productivity of farm crops and forest product vis-a-vis reducing pressure on the remaining forest ecosystem in Cross River State - South eastern Nigeria.

c) Farm sizes and forest management

The size of farm holding determines the extent to which the land is utilized and to which trees are interspersed with farm crops. The participant observation and field measurement conducted show that farm sizes vary significantly according to the household. The farm sizes of the study population are categorized into three groups. The findings in Table 2 show that the farm sizes of most households were less than (<) one hectare, representing a population mean score of 42.78 and standard deviation of 24.88, while those between 1-5 hectares attract population mean score of 32.72 and standard deviation of 28.0. A few people have farm sizes greater than five hectares representing a mean score of 5.56. It was observed that the more forest trees are on farmlands, the higher the quantity of forest resources harvested, and the increase in income generation and food supply. This reduces the frequency of the people visit to the high forest for harvesting of forest products. The high standard deviations indicated for farm sizes less than one hectare and 1-5 hectares shows high level of disparity of distribution of population responses to these farm sizes across the constituents' part of the state. The study observed that farm sizes determine the number of forest tree species on farmlands. Further investigation through tree survey inventory on farmlands and household questionnaire survey was carried out in the eighteen sampled villages. The result is presented in table 3. The

sizes of farm holdings determine the population of forest trees. The result shows that the mean number of trees in farm sizes greater than five hectare is higher than other farm sizes. For instance, the mean number of trees in farm sizes greater than five hectares is 250.56 with standard deviation of 33.74. This is closely followed by farm sizes of one to five hectares with 141.72 mean numbers of trees, and 24.65 as standard deviation. The least mean value of trees is 48.17 for less than one hectare farms. This analysis implies that smaller farm sizes have fewer number of trees retained or planted. It was observed that farm sizes of less than one hectare are mainly associated with mono food crops and mixed crop farm types, with crop combination of cassava, yams, rice, sugar cane, cocoyam, vegetable, pepper etc. Apart from rice farms, forest trees are found dispersed or scattered on mono food and mixed food crop farms in the study area. Most common forest tree species on rural farming systems are Bush mango *(Irvingia gaboneensis),* Mahogany *(Etandrophragra spp)* Mimosup *(Baillonelia toxisperma),* Iroko *(Melicia excelsa),* small leaf *(Piptadenistrum africanum),* Achi (*Brachystegia spp),* Native mango *(Mangifena indica),* silk cotton tree *(Ciba pentandra),* Umbrella tree *(Musanga cecropoides),* locust bean *(Parkia spp),* Sheanut *(Poga oleosa),* Wild palms (*Elacis guineensis).* These farms are common in Iyametet, Idonget, Agoi Ekpo, Ibami, Ibogo, Orumenkpang, Okuni, Idoma and Iwuru Central.

The mono tree crop and mixed tree farm types are developed in large plantation of six hectares and above. These plantations are mainly cocoa, plantain, banana, oil palm cashew etc. Because of their sizes, high population of forest plants or tree species are retained or planted than other farms. Although oil palm plantation may not require many trees for their growth, cocoa, plantain and banana plantations are dominated by several forest tree species which were considered very critical by most of the farmers. Forest trees and plants associated with these farm types are Bush mango *(Irvingia gabonensis),* Native Kola (*Cola acuminata*), Bitter Kola (*Cola nitida*), Native pear (*Dacryodes edullis*), Afang (*Gnetum afriamum*), Editan *(Lasianthera africanum),* Star apple or Udara *(Chrysophyllum albidum)* Hot leaf/seed (*Piper guineensis),* Pawpaw *(Carica papaya).* Groundnut tree *(Ricinodendron leudetii),* White afara *(Teminalia superba*), Mahogany *(Etandrophragma spp),* Mimosup *(Baillonellia toxisperma),* Iroko (*Melicia excelsa)* Achi *(Brachystegia spp).* Bread fruit *(Triculia africanum),* Atama (*Heinsia crinata),* Ceda *(Lovoa trichiloides),* Cane wood *(Pterocarpus osun),* Small leaf *(Piptadenistrum africanum)* etc. In addition to the ecological functions of these forest trees species on plantation farms, the study discovered that most of these species were of high economic, medicinal, and social value to the people. The mixed trees and food crop farming systems are within the farm sizes of two to five hectares. These farm types are dominated by the production of food and tree crops such as cocoa, cocoyam, pepper, plantain, banana, cassava, vegetables, garden eggs, pineapples etc. The participant observation in the study villages reveals that bitter kola, native kola and bush mango are now developed into agricultural plantations having the forest tree species earlier mentioned. To determine the degree of variation of forest trees across the various farm sizes across the villages, a null hypothesis was formulated and tested.

d) Test of hypothesis

Ho: There is no significant difference in the population of forest trees integrated per farm size in rural farming system.

The tree survey inventory and household questionnaire survey were adopted to generate the required data (Table 3) for testing the hypothesis. Forest trees population across the sampled villages were summed up and categorized into three main farm sizes identified in the study area. The one way analysis of variance was applied to determine which farm size that can encourage tree integration in the area. The results are presented in Table 4.

The analysis produced a calculated F-ratio of 287.88 which was higher than the tabulated F-ratio of 3.15. This was statistically significant at 0.05 level, thus rejecting the hypothesis. This result reveals that there is statistically significant difference between the three sets of data with respect to the number of forest trees on farm sizes in the study area. The result further implies that, the population of tree species is higher in farm sizes greater than five hectares. Therefore, the study conclude that as farm size increases there is a corresponding increase of forest tree species integrated into farmlands. If this trend of tree integration into farmlands continues, it may reduce pressure from the primary forest and ensure sustainable management of forest resources in the study area. The household survey and forest trees inventory further investigated the population responses to forest trees based on the farming systems. The result is presented in Table 5. The result shows that there is no considerable variation in planting and retention of forest tree species in traditional farming systems. This may be a function of the relative importance of forest trees on farmlands. The result further shows that forest tree retention is common with mono food crop and mixed food crop farm types. This accounts for 55.1% and 60% respectively. Trees cultivation is more common in mono tree crops, mixed tree crops, and mixed tree and food farm types. This attracts a higher population of 55.5%, 54% and 56.28% respectively. This was attributed to the increasing forest

trees on farmlands. The study also discovered the propagation of non-timber forest products within farmlands. For instance hot alligator pepper, afang, editan, hot leaf/seeds etc are grown in Iwuru central, Ibogo, Iko Ekperem, Ibami and Agoi Ekpo. Therefore, the conversion of forest to agricultural lands by the indigenous people does not lead to the loss of many important forest species. These are normally conserved during forest clearance or planted to improve productivity of farmlands.

Furthermore, the study observes that most households have several plots of farmland for the purpose of land acquisition, forest and farm productivity in the study area. The Participatory Rural Appraisal study reveals that one household can have different farms of cassava, yam, cocoa, plantain etc. With this, it was difficult to determine the sizes of farmland for a particular household. To determine the number of farm plots, a survey of the study population was carried out in the eighteen sampled villages. The findings in the Table 6 indicated that a significant number of the households own about five plots. This accounts for a mean score of 42.56 and standard deviation of 28.02. The high population of people having one to five plots was attributed to the difficulty involved presently in most communities to acquire new plots from the virgin forest. While 24.06 of the study population confirmed that they have six to ten plots, whereas an insignificant number of people representing a population mean score of 2.18 and standard deviation of 1.67 indicated for about sixteen plots of farmlands. The result implies that household with several number of farm plots are significantly involved in planting of forest trees than those with a few number of farm plots. Therefore, it was observed that even though several number of farm plots can promote forest tree species integration in farming systems; it *was* an indirect way of increasing deforestation. This is because the quest for more farm plots requires the clearing of the virgin forest. The high standard deviation for people having one to five plots indicates a high level of disparity of the population distribution across the sampled communities. This means that while some communities may record very low distribution, others have high population distribution of household heads.

In conclusion, the study suggest that indigenous people should be encouraged to utilize few number of farm plots through the integration of valuable forest trees species into the farming systems, instead of acquiring more farm lands from the virgin forest which increase deforestation in the study area.

V. Conclusion/Recommendations

Trees left on farmlands during land preparation process, and consciously cultivated by indigenous farmers as integral part of the rural farming systems have great impacts on forest management. Evidence in the study area are glaring that the utilization of forest tree species at the indigenous farmlands has drastically reduced the number of trips and pressure which human population is mounting on the primary forest especially in the remaining natural forest ecosystem of Cross River State, Nigeria" The tendency among the rural people to selectively keep trees of significance alive and integrate them into farming systems should be promoted as the only alternative in managing forest resources. These practices tend to increase output of forest resources and farm produce which constitute the rural economy. In addition, since the acquisition of several farmlands increases deforestation, indigenous people should encourage to utilize few number of farm plots through integration of valuable tree species which can improve output and income.

Although, the indigenous people are knowledgeable about tree crop interaction, but it is necessary that adequate forestry and agricultural education through extension services be encouraged and intensified in order to sustain the consciousness of managing the remaining forest for ecological and other benefits to rural people and the state at large. The increment of forest area through tree planting for the purpose of carbon sequestration (carbon credit) and climate change moderation has been the recent interest of Cross River State and Nigeria as a whole, this can only be achieved when the indigenous farmers are integrated into the programmes and the intensification of tree retention and cultivation in rural farming systems is encouraged among the indigenous people. Finally, trees and indigenous farming systems and practices is basis of sustainable forest management in the rainforest of Cross River State, Nigeria.

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Table 1 : Cropping pattern and practices in the study area.

Farm types	Total responses	Min.	Max	Mean	Standard Deviation
Mixed food crop	811	12	126	45.06	31.35
Mixed trees crop	486	2	182	27.00	1 42.50
Mono food crop	872	10	96	48.42	25.67
Mono tree crops	357	2	82	19.82	24.87
Mixed tree/food crop	627	3	174	34.83	43.07
Total	3181	2	182	35.34	36.32

Source : Field work, 2010/ 2011

From Table 1, the mean scores of population responses to mono food tend to be the highest with 48.42, while the mean score for mixed food crop is 45.6. The high mean scores for the two farming systems indicate that mono food crop and mixed food crop are widely adopted by the people as their farming practices.

Table 2 : Farm sizes per household

Farm size in hectares	Total response	Min.	Max.	Mean	Standard deviation
Less than 1 hectare	770	16	109	42.78	24.89
1-5 hectares	589	3	130	32.72	28.03
Greater than 5 hectares and above(>5ha)	100	00	18	5.56	4.78
Total	1459	00	130	27.04	26.64

Source : Fieldwork, 2010/2011

The findings in Table 2 show that the farm sizes of most households were less than (<) one hectare, representing a population mean score of 42.78 and standard deviation of 24.88, while those between 1-5 hectares attract population mean score of 32.72 and standard deviation of 28.0. A few people have farm sizes greater than five hectares representing a mean score of 5.56.

Table 3 : Number of forest tree species per farm size.

Sampled village	<1hectare	1-5	➢ 5 hectares	Total
Agbokim	62	142	281	485
Ajassor	68	136	278	482
Akparabong	70	185	298	553
Okuni	48	134	232	414
Abo	56	129	269	454
Orumenkpang	42	131	249	422
Odonget	38	128	236	402
Iyametet	36	143	291	470
Agoi Ekpo	69	182	280	531
Ibanni	58	146	261	465
Ibogo	37	128	234	399
Idoma	48	142	201	391
Iko Ekperem	52	171	285	508
Iwuru central	34	121	206	361
Bayatong	26	84	192	302
Okorshie	49	49	161	271
Bendi	36	168	241	445
Busi	38	140	205	383
Total	867	2551	4510	7928
Mean	48.17	141.72	250.56	146.81
Std Deviation	13.14	24.65	33.74	87.10
Minimum	26	84	192	26
Maximum	70	185	298	298

Source : Fieldwork 2010/2011

The sizes of farm holdings determine the population of forest trees. The result shows that the mean number of trees in farm sizes greater than five hectare is higher than other farm sizes. For instance, the mean number of trees in farm sizes greater than five hectares is 250.56 with standard deviation of 33.74. This is closely followed by farm sizes of one to five hectares with 141.72 mean numbers of trees, and 24.65 as standard deviation. The least mean value of trees is 48.17 for less than one hectare farms.

Table 4

Source of variance	Sum of square	Df	Mean square	Cal. F-ratio	Tab. F-ratio
Between Group	369351.60	2	184675,80	287.88	3.15
Within Groups	32716.56	51	641.501		
Total	402,068.10	53			

Source : Fieldwork 2010/2011

From Table 4, the analysis produced a calculated F-ratio of 287.88 which was higher than the tabulated F-ratio of 3.15. This was statistically significant at 0.05 level, thus rejecting the hypothesis.

Table 5 : Number of trees planted or retained on farmlands.

Farm types	Trees planted	Tree retained	Total
Mono food crop	70(44.9%)	86(55.1%)	156 (100%)
Mono tree crop	122(55.5%)	98(44.5%)	200 (100%)
Mixed food crop	64(40%)	96(60%)	160 (100%)
Mixed tree crop	142(54%)	121(46%)	263 (100%)
Mixed tree/food crop	139(56.28%)	108(43.72%)	247(100%)
Total	537(52.34%)	509(47.66%)	102 (100%)

Source : Fieldwork, 2005/2006.

In Table 5, the result shows that there is no considerable variation in planting and retention of forest tree species in traditional farming systems. This may be a function of the relative importance of forest trees on farmlands. The result further shows that forest tree retention is common with mono food crop and mixed food crop farm types.

This accounts for 55.1% and 60% respectively. Trees cultivation is more common in mono tree crops, mixed tree crops, and mixed tree and food farm types. This attracts a higher population of 55.5%, 54% and 56.28% respectively.

Table 6 : Average number of farm plots per household.

Sampled villages	1-5 Plots	6-10 Plots	11-15 Plots	15 Plots and above
Agbokim	12	14	21	6
Ajassor	16	32	25	4
Akparabong	41	10S	62	5
Okuni	78	58	41	4
Aboibam	28	12	2	1
Orumenkpang	10	29	4	2
Odonget	51	11	5	2
Iyametet	116	20	4	9
Agoi Ekpo	82	21	6	2
Ibami	65	6	8	4
Ibogo	42	14	7	2
Idoma	24	16	4	4
Iko Ekperem	51	14	7	1
Iwuru central	43	20	14	2
Bayatong	14	18	2	1
Okorshie	43	12	7	0
Bendi	31	0	*4*	0
Busi	28	12	4	1
Total	766	433	221	39
Mean	42.56	24.06	12.26	2.18
Std Deviation	28.02	23.93	15.50	1.67
Minimum	10	6	2	0
Maximum	116	108	62	5

Source : Field work 2010/2011

The findings in the Table 6 indicated that a significant number of the households own about five plots. This accounts for a mean score of 42.56 and standard deviation of 28.02. The high population of people having one to five plots was attributed to the difficulty involved presently in most communities to acquire new plots from the virgin forest. While 24.06 of the study population confirmed that they have six to ten plots, whereas an insignificant number of people representing a population mean score of 2.18 and standard deviation of 1.67 indicated for about sixteen plots of farmlands.

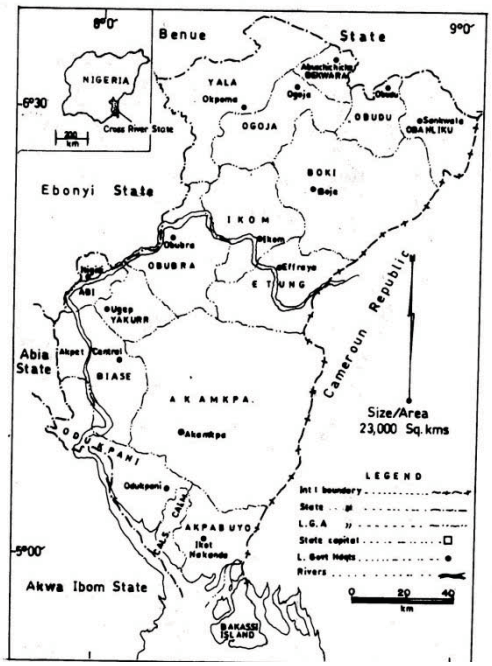

Figure 1 : Location of Cross River State, Nigeria.

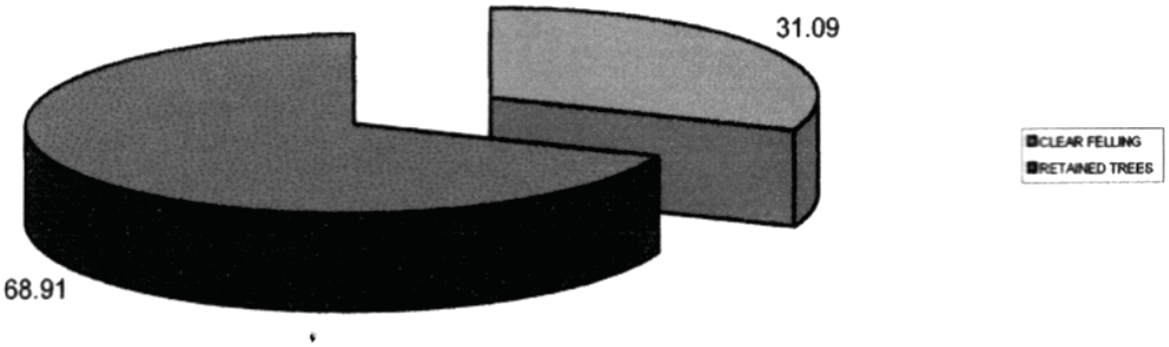

Figure 2 : Trees and land clearance in the study area.

Fig. 2 shows that 69.91 percent of the population retained trees on farmlands during forest clearance while 31.09% are involved in tree felling due to their cropping pattern.

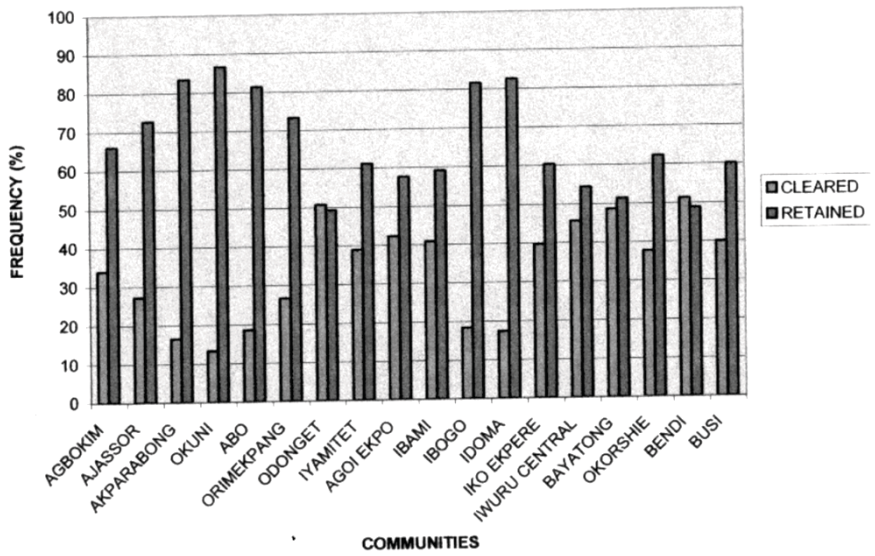

Figure 3 : Spatial distribution of trees and land clearance.

Fig. 3 show that there exist significant variations in the household responses to tree retention and clearance during land preparation for farming across the sampled villages. The findings revealed that over 70 percent of the respondents across the villages indicated tree retention during forest clearance for farming while clear felling of trees attracted between 40- 55 percent of the study population especially in Odonget, Bendi, Iwuru central, Agoi Ekpo and Ibami.

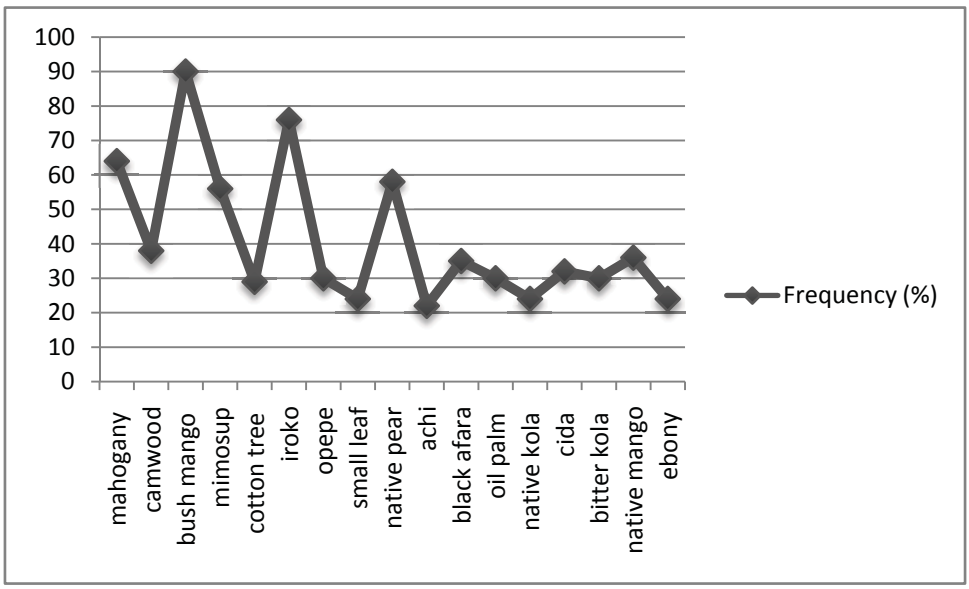

Figure 4 : Population response to management of selected tree species in rural farming systems.

It is apparent that numerous species of forest plants are left in the farmlands of indigenous people. The forest species most favoured by majority of the households are Mahogany *(Entandrophragma spp),* Bush mango *(Irvingia gaboneensis),* Mimosup *(Baillonellia toxisperma),* Iroko *(Melicia excelsa),* Native pear *(Dacryodes edullis).* These species are retained or planted by 64%, 90%, 56%, 76% and 58% respectively of the study population.