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ANALYSIS OF FOREST TREE SPECIES RETENTION AND CULTIVATION IN RURAL FARMING SYSTEMS IN CROSS RIVER STATE, NIGERIA.

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Abstract

The study assessed forest tree species retention and cultivation habits of the people in rural farming systems of Cross River State, Nigeria. The study covers the rainforest zone of Cross River State extending from Biase, Yakurr, Obubra, Etung, Ikom, Boki, Obudu to Obanliku. The Participatory Rural Appraisal (PRA) method, household questionnaire survey techniques and field inventory and measurement were used to collect primary data for analysis. The Principal component Analysis (PCA) was adopted to reduce nine factors of forest trees retention and cultivation habits of rural people such as economic, socio-cultural,, food, ecological, agronomic, shelter, distance reduction and others. These factors were collapse to two main dimensions (socio-economic/ecological and rural development factors), which explain 86.56% of reasons for tree retention and culmination into rural farming systems. The finding further shows that tree retention and cultivation habits of the rural people are influenced by their role in soil protection, climate moderation within farmlands and biodiversity conservation. These three factors attracted a mean population of 67.22, 59.89 and 57.56 respectively. Also, the result reveals that trees in the rural farming systems significantly predict the quantity and income of forest products. But, the student t-test analysis indicated statistical difference between the quantity of forest resources from trees on farmlands and high forest, thus rejecting the hypothesis. And because the mean value of quantity of products from trees in high forest (12,108.60g) was higher than products from trees on farmlands (7,914kg), therefore, trees products from high forest provides greater quantity than farmlands. Although, the quantity of tree products from forest and farmlands predicts 99.6percent of the variance in quantity of rural products in the area, but quantity from forest contribute more than the farmlands. This is indicated by coefficients of 0.77 and 0.499 receptively, thus rejecting the hypothesis and confirming that "because of the retention and cultivation of trees into farming systems the benefits profile of the study population varies significantly according to farms and forests in the study area. The t-test for income of products from trees in the forests and farms show a statistically significant difference. This implies that tree products from the forest with higher income of N705,284.94 per annum and income from farms (N357,288.568) was considered to have predicted the gross income of rural people per annum in the area. Although, a positive relationship between income of products from forest and farms to the gross income of the study population exist but income of products from forest with a higher beta coefficient of 0.67 contributes more significantly to the estimated gross annual income of the people from all sources. Based on the above findings, the study recommended that since trees are critical factors to human population existence, it may be necessary to adopt landuse systems that can encourage tree retention and cultivation habits in the rural areas. Also, tree retention and cultivation practices should be improved in rural farmlands in order to increase benefits vis-à-vis reducing population pressure from the primary forest in the rainforest villages of Cross River State, Nigeria.

Keywords: Tree retention, Tree cultivation, Forest, Farming system, Quantity and Income.

1. Introduction

In most parts of the rural environment, trees are recognized as providing a number of locally important goods and services. The critical role of trees has made farmers to retain and cultivate them in order to obtain the essential benefits to farmlands and socio-economic livelihoods. As natural forests recede, farmers have over time tried to protect, plant and mange trees on their land with the intention of maintaining such sough-after outputs. According to Harlan (1975), managed forest patches may be been one of the first forms of agriculture. Fruits and nut trees were important sources of food for early human consumption. The knowledge of areas with abundant tree species having edible fruits was essential information for survival. Land is the main source of man's primary resources. The pressure on land has led to the degradation of its resources. One of such pressure is the over exploitation of forest trees.

Forest trees in farming systems are recognized as a strategy for restoring degraded ecosystems, increasing people's access to valued forest products and conserving forest (Hough, 1991). The management of forests by early man is considered to be an important evolutionary step. Ethnoeceological, archaeobotanical and paleobotanical studies have indicated that the ancient management practices have influenced the present day abundance and presence of certain species, such as Annona Spp, Quercus spp, Byrosonima spp, Carica spp, Ficus spp, Manikara spp and Spondia spp (Gomez-Pompa, 1987, Posey, 1990 and Roosevelt, 1990). As the dominant species in the natural vegetation in most tropical environment, trees should be considered as necessary to protect the fragile soils of the rural farming systems. In many humid tropical areas, these managed forest systems still play a key role in human subsistence. For instance, studies about the people from Brillo Neuvo, Eastern Peru, subsist largely on various varieties of Manioc interspersed with assortment of trees, usually peach palm (Bactris gasipaes), Uvillia (Pourouma cecropifolia), Star apple (Chrysophyllum albidum), Macambo (Theobroma bicolor), guava (Psidium guajava), barbasco (Lonchocarpus spp) and cocoa (Theobrom cacao) (Denevan, et al, 1984).

The knowledge of the contribution of trees to agriculture is relatively recent (Gregersen, Sydner and Dieter, 1989). Indeed, many agriculture technologies evolved from the practices of forest dwellers that depended on trees and other forest plants for their needs. Brills, et al (1996) reported that trees are important for their ecological and economic function in a farming system. When trees and crops are grown together on the same piece of land, there is interaction between the two components which may have positive or negative results. But Gregersen, et al (1989) indicate that trees allowed during forest clearance or introduced into the farming systems can help improve the productivity of farmland by fixing nitrogen, providing manure and reducing wind erosion and soil moisture loss especially when they are used in shelterbelts or windbreaks. Evidence of tree contributions is provided by Spears (1986); ICRAF (1986); Winterbottom and Hazlewood (1987).

Other studies have identified the pressure on landuse to expanding population and over exploitation of trees and shrubs to satisfy several needs without equivalent efforts at replenishment (Igboanugo, 1993). National Research Council (1993) report that bush fire and intensive exploitation of soil for agricultural production and general construction and development projects has caused much damage to most rural people especially in the developing countries. As plant cover becomes dramatically reduced, the soils are exposed to the destructive forces of rainfall and wind, and in the arid region, high temperature have caused loss of soil moisture. King and Chandler (1978) in their earlier analysis report that 4900 million hectares of land in the tropics or 65 percent of the total land area is classified as "wasted" due to constraints. Such areas include the acid Savanna of South Africa, abandoned shifting cultivation areas of South East Asia and Africa, and extensive stretches of salt-affected soils in Indo-gangetic plants of India.

In Nigeria, several studies have reported that gully erosion sites are 600 in Anambra state (Okorie, 1992), 300 in Imo State (Asiabaka and Boers, 1988), 59 in Akwa Ibom State (Etukudo, 1988) and 130 in Cross River State (Asiabaka, 1990). These figures are conservative estimates as several unknown sites are uncovered and yet to be known especially in Cross River State. Therefore, Igboanugo (1993) suggests that trees in farming systems are one of the feasible methods of controlling erosion and conserving soil and water bodies. Forestry techniques involving planting multi-purpose trees that are tolerant of these adverse soil conditions have been suggested as a management option for reclamation of such areas (FAO, 2007). Trees in farming systems are noted widely as increasing crop yield, land reclamation, stabilization of stream banks, erosion control among other things. The identification and analysis of the appearance of forest tree species on farmlands especially among the indigenous people of the rainforest communities of Cross River State, Nigeria are yet to be given consideration in research.

Although, conflicts do exist between cultivating trees and raising agricultural crops, many systems allow farmers to integrate trees into their farm lands and in some cases the trees increase the overall farm productivity (Raintree, 1998). A vast variety and amount of tree products are needed for on-farm use. Shortage of these products constraints the efficiency of crop production, for instance, adequate supplies of poles for yam cultivation in Nigeria and stakes for yam cultivation in Nigeria and stakes for bean and banana growing in Latin America can increase the productivity of these crops dramatically (Gregersen, et al, 1989). The increase productivity open new market opportunities to the farmers, who harvest the trees for fuel wood and construction materials, and crop for food and income (Brill, et al, 1996).

Adopting trees in farming systems reduce the risk to the security of household's livelihood and can ensure sustainable rural development. It is obvious that local farmers in Nigeria and Cross River State in particular, are yet to fully appropriate and optimize the benefits agro-forestry for poverty amelioration, vis-à-vis reducing pressure from the remaining forest areas. Until recently the long history of agricultural adaptations among indigenous people was neglected as researchers focused on transferring modern crop production models and techniques perfected in the temperate zones. The re-examination and adoption of local farmers' knowledge in tree retention and cultivation as a basis for forest resources management is necessary in the study area.

This study is necessary because large human materials and financial resources have been and presently are committed in sustainable agriculture for food security and forest ecosystem management to ameliorate climate change problems in world and Nigeria in particular, but little or no benefits to the people especially in the rural villages of Cross River State. The empirical analysis and elucidation of indigenous forest trees retention and cultivation will go a long way to ensure food security and reduce pressure from the remaining rainforest areas in the State. According to Park (1992) an alternative means of sustainable use of the rainforest is helping the help people in cultivating trees in farming systems. This study therefore focused on the examination of factors of tree retention and cultivation, impacts of trees in farming system in terms of ecological, quality of forest products and income from forest and farms in the study area.

2. Study Area

The study was conducted in Cross River State, South Eastern Nigeria. The State is located between longitudes 7040" and 9050" east of the Greenwich meridian and longitudes 4040" and 7000" north of the equator. The area covers a total land area of 21,560km2 of which 35 percent (representing 7610km2) is covered by high forest, while 5 percent is swamp and mangrove forest. Together these account for about 50 percent of the remaining rain forest in Nigeria (Cross River State Forestry Commission, 2012). The total forest estate available in Cross River State outside the Cross River National Park is 3960km2 of which 2150km2 (28%) is community forest and 5460km2 (72%) is designated as forest reserves.

The 2006 Nigerian causes puts Cross River State at about 3million people over 620 recognizable human settlements. Majority of these people live in rural areas for whom farming, extraction and utilization of forest resource have traditionally been important sources of income, subsistence and well being. Farming constitute the main occupation of the people, producing several food and cash crops such as cassava, yam, cocoyam, water-yam, cocoa, oil palm produce, rubber, vegetables, maize, okro, pepper, mellon, pineapple, plaintain and banana. Forest and trees provide an appreciable source of edible fruits and foods, fodder, medicine and cash income for many rural people.

3. Materials and Methods

The collection of data was basically through the use of household questionnaire survey, participatory research appraisal (PRA) methods, forest inventory and measurement. The PRA methodology was used during the reconnaissance survey to provide background data on type of farmlands and locations, cropping pattern and forest tree species retained and planted in rural farming systems. The open-ended questionnaire allowed the household heads to express themselves and indicate their perception about the reasons for forest trees retention and cultivation, quantity and income of forest tree species retained and cultivated and quantity and income of forest trees from farms and forest areas. The household questionnaire was supplement by participatory assessment of the benefits of forest trees, forest management practices, watershed protection, and soil conservation among others. Field inventory and measurement were used to the size or farmlands, forest trees density on farmlands volume of trees harvested and quantity of forest products was measured using sizes of basins and weighing balance calibrated in kilograms.

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 were analyzed using appropriate qualitative and qualitative statistics such as percentages, means standard deviation student T- test, Regression Analysis, and principal Component Analysis (PCA). The t-test statistics was adapted to establish statistical difference between benefits of trees from farms and forests. Regression analysis was used to assess the strength of relationship between the gross quantity and income of forest products extracted from trees of natural forest ecosystem and farmlands. The study applied the Principal Component Analysis (PCA) to collapse the reasons or factors responsible for tree retention and cultivation into significant components explaining the underlying reasons for forest tree species in rural farming systems in the areas.

4. Result and Discussions

The analysis of forest tree species retention and cultivation in rural farming system focused on the main issues raised in this study such as factors for integrating trees in rural farming systems, impacts of tree retention and cultivation and spatial analysis of income from forests and farms in the study area.

4.1 Analysis of factors of tree retention and cultivation

Trees in farming system have become apparent in sustainable forest resources management. However, it is clear that the retention and cultivation of forest tree species on farmlands was attributed to a variety of reasons. Altogether nine variables were obtained such as economic, socio-cultural, medicine, agronomic, food, ecological, shelter, reduction in distance and among other as being the main reasons (Table 1) for tree retention and cultivation.

It can be seen that there was no considerable variation in the responses of the study population toward the factors. The result shows that economic, food, agronomic and ecological reasons were considered by the people as the most important factors attracting population means score of 40.33 and above. Economic was ranked first with a means score of 59.67 and standard deviation of 49.09, while agronomic was considered second with mean score of 45.50 and standard deviation of 30.25, food, and ecological followed in that order. The study observes that a significant population sampled highly depends on forest and farm products for their livelihood security. The PRA study identified thirteen main forest occupations of the people such as fruit collection and processing, chewing stick collection and processing, palm oil and kernel processing, traditional medicine, edible leaves collection, logging, hunting, firewood collection and marketing, roofing mat extraction and processing, forest farming, canerope collection, fishing and snail collection. These occupations are the main income generating sources of the rural population in the study area.

Table 1: Reasons for tree retention and cultivation

Reasons	Total responses	Means	Stad. Deviation
Economic	1074	50.67	49.09
Socio-cultural	495	29.50	21.85
Medicine	613	34.06	25.57
Food	726	42.33	27.43
Ecological	752	40.33	29.55
Agronomic	819	45.50	30.25
Shelter	561	31.17	20.80
Distance Reduction	617	34.28	25.94
Others	49	7.28	2.72
Total	1457	80.94	49.52

Source: Fieldwork, (2010/2011)

Apart from using trees as agricultural materials such as yams stakes, basket making, leaves for wrapping, ropes for typing yams etc, forest trees increase organic matter from litter and root residues on farmlands and fixed nitrogen yield. Most of the forest products harvested from farmlands are used as staple foods in the area and beyond. Common products used as food are bush mango, oil palm, native pear, native mango, native kola amongst others. Ecologically, trees in the farming systems provide shade for man and animals, act as wind breakers, control soil erosion and moderate local climatic condition (Brills et al, 1996). From Table 1, the result shows that forest trees in farming systems are used in the treatment of several diseases affecting the study such as kidney diseases, sickle cell anaemia, skin diseases, inflammatory diseases, fever, malaria, jaundice etc. The people believed that forest is their hospital and pharmaceutical industry in which several health problems can be treated without paying huge bills. The socio-cultural life of the people depends on forest trees on farmlands. For instance, people are named after trees (e.g Achi). Some trees in the farming systems provide material used in decorating masquerades, drums, household equipments, cups, cultural costumes and has some mystical qualities such as provision of wealth and protection of life. Materials extracted from trees in the farming system as timber, poles, ropes, mats, bamboo etc are used daily by the people in building their houses. These materials are harvested without much expenditure. This encourages households to build their own houses. The study observed that tree retention and cultivation on farmlands has reduced the distance of the people trekking to high forest to collect forest products for their daily consumption and cash income. Other reasons for tree retention and cultivation are raw material and energy supply.

The study applied Principal Component Analysis (PCA) to determine the underlying dimensions in tree retention and cultivation habits of the people. The Principal Components Analysis was found suitable because of the types of data set, and is a more precise approach in presenting and interpreting geographic data. The technique allows the replacement of an original set of variables by a new set of orthogonal variables called principal components. Nine (9) predictor variables (Table1) were obtained and transformed into a matrix of inter-correlations between the variables to establish the strength of their inter-correlations. The strong correlation coefficients are determined using 0.05 levels of confidence and ± 0.70 correlation coefficients. The results are presented in Table 2.

Table 2: Correlation coefficients matrix of factors of retention and cultivation into rural farming systems

	XI	X2	X3	X4	X5	X6	X7	X8	X9
Economic (x1)	1.00								
Socio-cultural (x2)	0.95	1.00							
Medicine (x3)	0.36	0.39	1.00						
Food (x3)	0.94	0.92	0.38	1.00					
Ecological (x4)	0,88	0.81	030	0.93	1.00				
Agronomic (x5)	0.89	0.89	0.42	0.91	0.92	1.00			
Shelter (x6)	0.91	0.91	0.65	0.90	0.83	0.87	1.00		
Distance reduction (x7)	0.92	090	0.33	0.92	0.91	0.93	0.85	1.00	
Others (Energy supply, raw materials etc) (x9)	0.16	0.01	0.22	0.09	0.06	-0.04	0.17	-0.02	1.00

Significant at 0.05 level of confidence

The correlation matrix shows that some predictor variables are highly correlated with each other while a few show no correlation. For example, economic factor is highly correlated with socio-cultural factors (0.95), food production (0.94), shelter provision (0.91), agronomic (0.89), distance reduction (0.92) and ecological factor (0.88). There is strong positive correlation between food production and ecological reasons (0.93), distance reduction (0.92), shelter provision (0.90) and agronomic (0.91), while there is low correlation between medicine and food (0.38), ecological (0.36), distance reduction (0.33) and others (thunder protection) (0.22). This analysis shows an inverse relationship between distance reduction and others (Energy supply, raw materials) (-0.02). The strong and positive correlations of most variables mean that, they can work together to encourage tree retention and cultivation habits of the rural people in the study area. The negative correlations of some variables indicate an inverse relationship between the variables.

However, these direct associations of some negative, positive, low and high, coefficients of some variables do not give an accurate inference in the explanatory power of such variables. Since the correlation matrix cannot actually exhibits the explanatory dimension and generate variance, we therefore transform our 9-predictor variables (Table 1) into orthogonal values by principal component analysis. This techniques is also applied to remove the effect of strong inter-correlations (resulting to redundancies), and include the contribution of redundant (weak) variables. This requires extracting principal components from the several correlations coefficients to generate component matrix. The main concern is to find out whether a small number of orthogonal components can account for tree retention and cultivation among the rural people in the study area.

To improve interpretation of principal component analysis, varimax rotation was applied to the eigen vectors and 2 components were extracted out of variables for rotated components matrices. These two components had eigen values greater than and equal to unity (≥1.00). The major components were considered on the basis of Kaiser (1959) selection criteria. The significance of the variables that are related to each component was determined by those variables with loadings above 0.70. These variables are considered as being important. The rotated components were extracted for analysis (Table 3). The results of the rotated component matrix shows that significant factors responsible for tree retention and cultivation loaded heavily on only one component. However, rotation in Principal Component Analysis makes output clearer and usually necessary to facilitate interpretation of factors. Rotation was achieved using variable maximization (varimax). From Table 3, the result shows that, the sum of the eigen value was significantly affected by rotation the was observed percentage contribution to the total
variations in factors for tree retention and cultivation in the area is very high.

Table 3: The rotated components matrix of factors of the tree retention and cultivation in the study area

Factors	Components	
	1	II
Economic	0.94	0.19
Socio-cultural	095	0.10
Medicine	0.37	0.70
Food	0.96	0.14
Ecological	0.93	0.10
Agronomic	0.96	0.06
Shelter	0.90 1	0.37
Distance reduction	0.97	0.03
Others (Energy supply, raw materials etc)	-0.09	0.87
Eigen value	6.39	1.40
% contribution	71.04	15.53
Cumulative %	71.04	86.56

Source: Fieldwork, 2010/2011

The rotated components matrix offered variable loadings for two factors in component 11. Component I loaded heavily on variables such as Economic (0.94), Agronomic (0.96), Distance reduction (0.97), Socio-cultural (0.95), Food. (0.96), Ecological (0.93) and Shelter provision 0.90). This component has an Eigen value of 6.39 and account for 71.04% of the variation in tree retention and cultivation habits of the rural population in the study area. The component is describing the socio-economic/ecological factors responsible for forest tree species retention and cultivation by the rural population. This factor determines 71.04% of the tree retention and cultivation habits in the area. Component II, accounts for 1.40 eigen value and 15.53% additional contribution in explaining the factors for tree retention and cultivation in the area (Table 3). The variables that loaded for this component includes; medicine (0.70) and other factors such as energy supply, raw materials extraction etc (0.87). This component explains the dimension that relates to rural development factors in the area. The components promote tree retention and cultivation in rural farming with intention of obtaining health services, and industrial inputs from the farmlands, most medicinal plants, firewood, forest and agricultural raw materials used in craftwork and cottage industries in the study area are extracted from raw farming systems. From the above analyses and interpretation of the principal components, two underlying factors are identified to be responsible for forest tree species retention and cultivation by the rural population in their farming systems. These factors include:

(i) Socio--economic/ecological factors and;
(ii) Rural development factors.

The above two underlying components show a cumulative contribution of 86.56% of the explanations on the factors that are responsible for tree retention and cultivation in the rural farming systems. However, the 13.44% unexplained variation may be caused by external influences from non-governmental organizations creating awareness on the need to manage forest trees in the study area. Tree retention and cultivation in rural farming system was observed to be significance, because it improves crop yields and forest yields vis-a-vis reducing population pressure from the primary forest in the area.

4.2 Impact of tree retention and cultivation on land resources

There are many forces that serve to influence indigenous people decision who constitute the largest producers of food to cultivate trees in addition to the ones left on farm during forest clearance. The foremost of these forces may be that inherent in management of forest and land resources winch, for instance, have impacted positively to ensure sustainability of the natural ecosystem. Thus leaving trees on farm depicts vast potentials which exist and stand to be explored on the relationship between these trees .and agricultural land use stabilization through a rational application of the useful soil improvement properties of trees for sustained crop yield. Although the indigenous population do leave trees on farms for other non-socio-economic related benefits such as watershed protection, climate moderation, biodiversity conservation, tourism and beautification and land reclamation, there is need to sufficiently be aware of the relationship between the benefits. Tree retention and cultivation in rural farming systems was recognized by being important because of the influence on land resources management such as biodiversity conservation, watershed production, climate moderation, soil protection and management, noise abatement. Land reclamation and tourism development.(Table 4).

Table 4: Population response to impacts of tree retention and cultivation on land resources in the area

Impacts	Total response	Mean population response	Std deviation	Percentage
Biodiversity conservation	1036	57.56	32.76	71.11
Watershed protection	706	39.22	19.52	48.45
Soil protection	1210	67.22	44.31	83.04
Land reclamation	651	36.17	22.19	44.68
Tourism	370	20.89	11.50	25.81
Air purification	234	13.00	6.51	16.06
Noise abatement	190	10.56	6.67	13.05
Climate moderation	1078	59.89	43.79	73.99
Shading	354	19.67	14.45	24.30

Source: Fieldwork, (2010/2011)

The result shows that the mean population response to soil protection, climate moderation and biodiversity conservation is higher than others. It attracts a mean population of 67.22, 59.89 and 57.56 respectively. These management features represent population percentage of 83.04%, 73.99% and 91.11% accordingly (Table 4). Noise abatement, air purification and shading for crops attract less population of 10.56, 13.00 and 20.89 respectively. The low population response implies that, these variables were not considered significant in tree retention and cultivation habits of the rural people in the study area. The high standard deviation of soil protection (67.22), biodiversity conservation (57.56) and climate moderation (59.89) indicate high disparity or dispersion in the distribution of the respondents across the sampled communities. This result implies that while some population distribution across the communities is very high (180, 160, 146 etc), others are as low as 26, 29, 31 etc. The study observed that tree retention and cultivation habits of the people are guided by some of the impacts that attracted higher population response in the study area.

Participatory Rural Appraisal study shows that trees are retained and cultivated in rural farming systems for the purpose of conserving biodiversity (plants and animals) thereby-creating a genetic pool for numerous plants and animals. Most trees such as Bush mango (Irvingia gabonecnsis), Wild palms (Elaels guineensis) Native kola (Cola acuminata), Pawpaw (Carica papaya), Mimosup (Baillonelia toxisperma), African bread fruit(Treculia africanum), Star apple (Chrysophyllum albidum), Bamboo (Bambusa vulgari)s, Achi (Brachystegia eurycoma) etc are food resources for wild animals, insects and birds. Protected trees continue to provide people with numerous products such as fuelwood, fruits, poles timbers, honey bushmeat etc.

Watershed protection is critical in the study area due to its importance to the people. Traditional forest laws across the sampled villages restrict farming and timber harvesting along water courses and channels. Destruction of watershed attract penalty in form of payment of certain fine decided by the chief council, such as a goat, kola nut, twenty litres of palm wine and replacement of the trees you destroyed. Migrants are expelled from the community after the payment of stipulated items. The amount of money charged on defaulters varies accordingly. In Okorshie, Ibogo, Iwuru central, Iko Ekperem and Idoma, about N15,000 to N20,000 is collected was fine from both indigenes and non indigenes, while Agoi Ekpo, Ibami and lyametet collects between N20,000 and above. The people believed that the trees along stream bank prevent it from drying up, regulate underground water and provide habitat for numerous plants and animal species.

Indigenous people use green manure from the litter fall to reclaim most lands that are depleted due to over use. Trees are cultivated alongside with crops in such areas for the purpose of improving soil fertility, moisture availability, nutrient retention and general filth. Badly eroded landscapes in the study area are reclaimed through the use of forest trees such as Bush mango (Irvingia gaboneesis), Oil palm (Elaeis guineensis), Bamboo (Bambusa Vulgaries) etc. The study confirmed that soil protection was considered to be the main factor for tree retention and cultivation in the study area. This implies that most tree species in farming systems are meant for soil fertility maintenance. A few farmers interviewed in each sampled community indicated tree species like Pawpaw (Carica papaya). Locust-bean (Parkia spp), Umbrella tree (Musanga cecropoides), Sheanut (Poga oleosa), African bread fruit (Treculia africanum), African nutmeg (Monodora myristica), Groundnut tree (Recinodendron loudetiti), Shea butter (vitellania paradoxa) and African oil bean (Ripterdeniastrum africana) are integrated into rural farm lands for fertility management. Although not all the listed-species seem to feature high on farmlands, evidence indicates that they are indigenous to the region and are valued by the people. The species also are useful in controlling erosion due to their dense foliage. Their extension and deep root systems bind the soils, thus making them suitable for erosion control and regenerating degraded soils. Their shade and manuring properties are not in doubt. The long leafy branches of these trees make them ideal as shade trees for man and animals.

Indigenous trees were also considered by the people as purifiers of the atmosphere by their absorption of carbon dioxide and release of oxygen. Oxygen is vital for every life including man, and is released through a process of photosynthesis. It therefore means that trees must be preserved if the people and the entire mankind are to have an uninterrupted supply of oxygen and energy. Although not much was said about abatement of noise the study observed from the survey that, it was considered by many households. Trees were claimed by a few people across the sampled villages to have been used to cushion or absorb some of the noise from neighbors and natural occurrence resulting from vibrations. According to Odum (1971), plants are efficient absorbers of noise especially those of high frequency.

A few trees were considered as being used for tourism attraction. This is due to their flowing nature, giving out attracting sound especially during a gradually blowing wind, reflecting and shining during a little sunlight. Some trees on farmlands attract colorful birds, which the people confirmed are attracting tourists from western countries. The study observed that most people interviewed in their farmlands sit around bottom or surrounding of large trees. Trees were considered as moderating climatic characteristic such as temperature, wind speed, humidity and light intensity. The provision of shade causes a net effect of complex interaction which extends far beyond mere reduction of heat and light. Shading reduces temperature and temperature fluctuation as well as vapor from streams channels. The study conclude that since trees are critical factors to human population existence, it may be necessary to adopt a land use system that can encourage tree retention and cultivation habits in the areas concerned.

4.3 Analysis of benefits of tree retention and cultivation in indigenous farming system

Tree retention and cultivation has become apparent in determining the socio-economic benefits of the rural population in Cross River State, The household questionnaire survey across the eighteen sampled villages' collected quantity and income data from forest and farms for hypothesis testing. The volume data for timber resources were analyzed separately because a different measurement unit was applied. These data were used to test the hypothesis of this study.

4.3.1 Testing of hypothesis

Ho: Because of the retention and cultivation of trees in rural farming systems the benefits profile of the study population from farms and forest has no significant difference in the area.

The above hypothesis was tested using quantity and income data from forest products across the sampled villages as presented accordingly.

4.3.2 Analysis of quantity of products from forest and farmlands

The study considered the volume data of twenty three forest products harvested from forests and farms based on standardized measurement using weighing balance equipment that was calibrated in kilograms. The weight of the data was obtained for twenty two products (Table 5) harvested from forest and farms across the eighteen communities.

Table *5:* Volume (Kg) of harvested products from forest and farmlands

Forest products	Quantity from forest (Kg)	quantity from farms (kg)	overall quantity of products (kg)
Gnetum africanum(afang)	30610.8	10782.5	41393.3
Bush mango	21264.4	29860.3	57124.7
Chewing stick	42131.4	6862.7	48994.1
Cane rope	34382.6	0	34382.6
Native pear	3119.1	12382.4	13501.5
Bush meat	26730.3	18480.7	45211
Bitter kola	5380.6	14610.5	15191.1
Native kola	7340.7	18142.9	25483.6
Hot leaf/seed	12780.4	5346.8	18127.2
Fish	6890.4	9362.2	16252.6
Palm oil	7610.6	20292.4	27903.0
Palm kernel	6130.8	14180.1	20310.9
Fire wood	3180.3	6304.3	9484.8
Bark/root	11189.7	1326.8	12516.5
Mimosup seed/oil	3020.3	484.3	3504.6
Udara	6130.8	482.7	7613.5
Mushroom	1281.4	2182.2	3463.6
Alligator pepper	2460.3	384.4	2844.7
Editan	5860.1	2389.3	8249.4
Native mange	2706.2	14281.3	16987.5
Olasi	1283.4	367.8	1651.2
Achi leaf/seed	3128.2	1080.6	4208.8
Moi moi leaf	16482.7	0	16482.7

Source: Field work, (2010/2011)

The t-test was used to establish the statistical difference in the quantity of products from the two groups of samples, while the multiple regressions was applied to determine the effects of farmlands and forest on the gross quantity of forest products in the study area. The results of t-test are presented in Table 6.

Table 6: Result of t-test of quantity of forest products from farms and forest

Sample group	Sample size	Mean(kg)	Std. Deviation	Std. Error mean	Mean diff. (kg)	T-value	df
Farm	22	7914.69	8436.17	1798.60	4193.90	0.05	42
Forest	22	12,108.595	122,238.94	2609.35	4193.90	1.323	

Two- Tailed Test 0.05 P.L

The result shows that the calculated F-produced $1.323<1.68$, which was statistically significant at 0.05 level. Thus, the hypothesis was confirmed that there is statistical difference between the quantity of products harvested from forests and farms. This implies that the rural farming systems can not produce the same quantity of forest products harvested from the natural forest ecosystem. The study established that the benefits profile in terms of quantity of products collected by the study population varies significantly according to forest and farm lands due to tree retention and cultivation in the study area. It was also observed that the mean value of quantity of forest products (12,108.595kg) is higher than that of farm lands (7,914.69kg). Therefore, the forest ecosystem provides greater quantity of forest products in the area than farmlands. Further investigation using multiple regression statistics was carried out to determine the strength of the quantity of products from forests and farms (independent variables) to the estimated gross quantity of products from various sources (dependent variable) across the eighteen sampled villages (Table 5). The quantity of data from forest (b1) and farms (b2) and the gross quantity of products (y) were analyzed (Table 7) and a regression equation was obtained.

$Y = 48.71 + 0.77xi + 0.50x2$... (Equation 1) The regression equation shows that, the gross quantity of products (y) was highly dependent on the quantity from forest, and farmlands. This means farms and forests are predictor variables. For instance, a unit change in quantity from forest may affect the gross quantity harvested from the entire area.

Table 7: Regression analysis of quantity of forest products from farms and forest ecosystem

Variables	Variable description		Standard coefficients		t-value
Var.1	Qty from forest		0.77		52.02
Var. 2	Qty from farms		0.50		33.61
Constant	Constant		48.71		0.13
Multiple R	R-squared R^2	Adjusted R^2	SE	Df	F-value
0.998	0.996	0.996	1059.17	2.15	2352.88

Significant at 0.05 level of confidence

The result shows that a combination of quantity from forest and farms predicts the gross quantity of products in the study area. This produced a multiple R of 0.998 and coefficient of determination (R2) of 0.996 (Table 7). The multiple R indicates strong positive inter-correlations among the quantity of forest products from natural forest ecosystem and farmlands in the area. A unit increase in the quantity of forest product of the two independent variables (forest and farms) improves the gross quantity of products harvested by the people. The coefficient of determination (R2) shows that, 99,6% of the variations in the gross quantity is jointly caused by the independent variables (quantity from forest and farms). To test the hypothesis, the analysis of variance was applied to determine the level of significance. The analysis of variance produced F- value of 2352.88>3.52 at 0.05 significant level. The study reject hypothesis and confirms a statistically significant difference in the quantity of forest products harvested from forest and farmlands.

To determine the relative contribution of the quantity of products from forest and farms to the gross quantity from all sources in the area, a test of regression weights was carried out. From equation one and Table 7, the result shows that the Beta coefficient of the quantity of products from forest (x1) is higher than the quantity of products from farm (x2). The coefficient values are 0.772 and 0.499 respectively. These are significant at 0.05 level, implying that the quantity of products from forest contribute more to the estimated gross quantity of products from various sources in the area. The study observed that the rural population is increasingly involved in the daily harvesting of forest products from the natural forest ecosystem and there is improvement in the retention and cultivation of tree species into rural farming systems. This may increase the quantity of forest products on farmlands and reduce pressure from the natural forest ecosystem. The quantity of forest products harvested determines the household consumption patterns, income and other sundry benefits.

4.3.4 Spatial analysis of income from forests and farms in the study area

The income data from natural forest ecosystem and rural farming systems was examined in the study area. The household survey generated income data from forests and farms based on collection of forest products and other insignificant sources. The income was added up according to forests and farms across the sampled villages (Table 8). The t-test was applied to establish the statistical difference of income from the two groups (forest and farms). The result is presented in Table 9.

The result shows that the calculated t-produced 3.407 which is greater than the tabulated t. of 2.04 at 0.05 level of significance. The study rejects the hypothesis and confirms a statistical difference in the income generated from forest and farms across the sampled villages (Table 8). The mean income from forest was N709, 284.94, higher than income from farms which was N357, 288.56 (Table 9). This implies that income from forest was significantly higher than that from farms. The income benefit of the study population from forest product varies significantly according to forest and farms across the villages. The study observed that most of forest products harvested from farms are consumed as food at the household level and therefore cannot generate income as high as the natural forest ecosystem. The study population depends on the products harvested from farms for food, gifts to friends, neighbour and other acquaintances. Further analysis was carried out to determine the effect of income from forest and farms (independent variables) on the gross income of the people from various sources (dependent variable). The regression statistics was applied and the findings (Table 10) and a regression equation was obtained.

$Y = 100035.45 + 0.67xi + 0.48x2$... (Equation two).

This equation indicates that, the gross income of rural population (y) is highly dependent on income from forest (b1) and farms (b2). Further analysis produced the results in Table 10.

Table 8: Forest and farm acres in sampled villages

Sample settlements	Income *(N)* products from forest	Income *(N)* products from farm	Income
Agbokim	984690	890489	2019646
Ajassor	879340	764380	2055200
Akparabong	342680	931890	1467852
Okuni	1226160	387897	2597100
Abo Ebam	1069190	243810	1189682
Orumenkpang	864275	280167	1215500
Odonget	643126	301690	1195680
Lyametet	864375	215633	1431974
Agoi Ekpo	989346	157927	1734670
Agoi Ibami	878960	272380	1292863
Ibogo	789860	264 111	1334163
Idoma	962430	195270	1514470
Iko Ekperem	989483	696027	2325020
Iwuru central	310480	380910	1431349
Bayatong	200430	67620	427030
Okorshie	381490	144980	708990
Bendi II	200680	164613	415202
Busi 1	189936	71400	367691
Total	12,767,129	6,431,194	19,198,323

Source: Field Survey, (2010/2011)

Table 9: Results of t-test on income of forest products from forest and farms in the study area.

Sample Group	N	Mean (N)	Std. Deviation	Std. Error mean	nr	Mean diff. (N)	Cat. t
Forests	18	709.2S4.94	342.868.16	80814.80	34	351.996.39	3,407
Farms	18	357.288.56	273.123.51	64.375.83	32.38	351.996.31	3.407

Significant at 0.05 level of confidence

Table 10: Regression analysis of income from forest and farms in the study area

Variables	Variables Description	Standard Coefficients	t-value
Var. 1	Income from forest	0.67	6.12
Var, 2	Income from farms	0.48	4.36
Constant	Constant	100035.40	0.61

Regression Model Summary

Multiple RI	R-squared (R^2)	Adjusted (R^2)	SE	Df	F-value
0.911	0.830	0.808	27777.34	215	36.67

Significant at 0.05 level of confidence

The result from Table 9, shows that a combination of income from forest and farms produced a multiple correlation coefficient (r) of 0.911 and coefficient of determination (R^2) of 0.830. The multiple R indicates strong positive relationship between the estimated gross income from all sources (Y) and income from forest, and farm. The R" implies that income from forest and farm jointly explains 83% percent of the variance in the estimated gross income of the study population from all sources (y). The analysis of variance was applied to test hypothesis. The result shows that the calculated F-value is 36,671, which was higher than tabulated F of 3.49 and was statistically significant at 0.05 level. The study rejects the hypothesis and confirms that income from forests and farms can significantly predict the gross income of the study population from all sources in the study area. Therefore the benefit profile of the study population in terms of income varies significantly according to forests and farms in the study area.

Further analysis from Table 9 shows that the Beta coefficients of income from forest are higher than income from farms. The coefficient values are 0.670 and 0.478 respectively, which are significant at 0.05 level. This implies that even though the beta coefficients are significant, the contribution of income from forests contribute more significantly to the estimated gross income of the study population from all sources. Therefore, the rural population depends more on income from forests than on income from farms.

This finding is contrary to Bisong's (11994) assertion that income from farming is greater than forest products in Akamkpa, Ikom and Oban forestry charges of the tropical high forest of Cross River State. The study observed that increasing household population and the scarcity of land to expand farmland have reduced the quantity of forest products harvested and income generated from farmlands at the household level in the study area. Further investigations show that farmers consume most of the products harvested from farms and market the products from forestlands for cash income. However, our analysis using the beta coefficient for quantity of products gathered and the income generated excludes the farm crops produce, but are added together to constitute the estimated total income and quantity of products harvested by the people in the area. Income and quantity were considered for indigenous forest species that are retained and cultivated in the rural farming system. The study concludes that improvement in the retention and cultivation of forest trees into rural fanning system may increase output or benefit in terms of quantity of forest products harvested and income generated from farmlands. This may reduce pressure from the remaining tropical high forest in Cross River State.

5. Conclusion

The singular role of trees has become critical in the face of the challenges of food crisis and climate change problems. The study analysis has shown that integration of forest tree species into rural farming system through retention during forest clearance and deliberate cultivation of trees has yielded numerous benefits in terms of increasing crop yield and improves products output of forest, hereby significantly affecting the income earning opportunities of the rural people. Forest trees on farmlands were also considered as positively influencing soil conservation, local climate moderation and biodiversity conservation. These variables represent population response of 83.4%, 77.99%, 91.11% respectively. The study observed that the frequent trips of rural people to high forest in search of forest product is now limited to the farmlands thereby reducing continuous pressure on natural forest ecosystem. The study therefore recommended the following:

1. Since trees are critical factors to human existence it will be necessary to adopt land use systems that can encourage tree retention and cultivation habits of the rural people.
2. Forest tree species retention and cultivation practices should be improved in rural farmlands in order to increase benefits to the people.
3. Intensification of forest trees species through cultivation of indigenous species necessary in rural farm lands. This may increase output or benefits in terms of quantity of forest products harvested and income generated for rural people sustenance.
4. There is need for continuous educational awareness on role of trees on climate moderation and improvement or crop yield on farmlands.
5. The implementation of the above recommendations will improve forest management and increase food production among the rural people of cross River State, Nigeria.

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