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CONTRIBUTION OF AGROFORESTRY PRACTICE TO ARTIFICIAL FOREST REGENERATION IN EDO STATE OF NIGERIA

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ABSTRACT

The aim of the study was to evaluate the contribution of agroforestry practice to regeneration of forest estates in Edo state. A well structured questionnaire was administered to 230 randomly-selected respondents in eight Local Government Areas practising agroforestry in government reserved forests, based on sampling intensities of 5, 20 and 30% to elicit information for the study. Secondary data were obtained from the Forestry Department and Area Offices on land rate, size of plots allocated to farmer, and areas covered by timber species. Data were analyzed with the use of descriptive statistics of frequency and proportion and inferential statistics using t-test and ANOVA. Results showed that there were significant differences ($P<0.05$) between the location of farms within and outside reserves. About 97% of the respondents were practising the traditional taungya farming system. The results also revealed that 81.7% of the farmers were given free seedlings by the government, while 13.8 and 4.5% sourced their planting materials from wildings and market, respectively. Twenty-nine percent of the respondents affirmed that the major problem of agroforestry practice in the study area was absence of field staff while 27.7% of them believed that the problem was inadequate incentive for the farmers. It is expedient to have sustainable artificial forest regeneration practice in place, given the steady decline of the forest estate.

Key words: Artificial regeneration; Taungya; Agroforestry; Forest reserve

INTRODUCTION

The problem of too much pressure on the fixed land for the production of food and wood to meet demand of the increasing population has made it imperative to consider appropriate and sustainable land use options in various parts of the world (Adegbehin and Igboanugo, 1990). This will help to improve the economy of the nation. In fact, the system of shifting cultivation, which has been practised since time immemorial hardly meets the need of the farmers for food and wood production. As a result of this, various agroforestry practices have received increased attention namely; homestead gardens, taungya, alley-farming and agri-sivilculture. Experiences of most successful agroforestry experiments in the tropics were observed in Nigeria (FORMECU, 1999). One of the advantages of agroforestry land system is that it encourages the intensive use of land as well as forest

expansion without impinging upon the land needed for other purposes. The system has added benefits in terms of more crop yield, improved soil and reduced nutrient loss (Vanluawe, 2004). The ever increasing demand for land further contributes to competition and possible conflicts between land uses. Thus most of the land has been impoverished by poor land management which depresses its productivity. However, the system allows deliberate integration, in space or time, of woody perennials with herbaceous crops and / or animals on the same land management unit (Steppler and Nair, 1987; Lowe, 1986; Ogundari and Ojo, 2007). There is no direct plantation establishment effort or visible means of forest restoration in Edo state in recent time other than agroforestry practice. Biologically-enriched fallow practices using *Acioa barteri, Anthenotha macrophylla, Alchornea cordifolia, Gliricidia seepiun,* and *Leucaena leucocephala* have been reported by Okigbo and Lal (1979), Getahun *et al.* (1982), and Agboola *et al*. (1982). Some of the fruit and food tree species for agroforestry system are *Treculia africana, Irvingia gabonensis, Dacryodes edulis, Gambaya albidium, Cola acuminata, Elaeis guineensis, Spondia mombin, Garcinia kola, Pentaclethera macrophyllia, Myrianthus arboreus, Dialium guineense, Blighia sapidia* and *Raphia* spp. While non-food trees are *Melicia excelsa, Berlinia grandiflora, Acioa barteri, Newbouldia leavis* and *Alchornea cordifolia* (Nair, 1980). These trees are multipurpose in nature due to their various products like edible fruits, fodder for animals (Adegbehin and Omijeh, 1993) and cultural implications especially *Newbouldia leavis*, which ascribes a status of a home when planted in a piece of land. Hellermann (2007) reported that farmers from villages in the nearby town of Udo and even Benin City as well as workers in the plantations partake in taungya farms in Okomu Reserve. Teak and Gmelina are planted at 4.8m by 4.8m while other species like Terminalia are planted at 5.4m by 5.4m espacement in most of the plantations in the state. The loss of natural forest imposes social-economic and ecological costs on the forest stakeholders, especially the rural populace (Otorokpo *et al.,* 2010). Forest contributes immensely to the livelihood and survival of the rural populace (Kalu and Okojie, 2009). Ultimately, the challenge is to find ways to sustain forest goods and services in ways that meet the need of the present without depriving future generations from same benefits. The study highlights the type of agroforetry systems, and survival rates of tree crops. Areas covered by various timber species in agroforesty system and the problems affecting agroforestry practices are also given considerable attention.

METHODOLOGY

Study Area

The study was conducted in eight Local Government Areas namely; Ovia North East, Orhionmwon, Uhunmwonde, Oredo, Ovia South West, Etsako West, Esan South East and Ikpoba-Okha where agroforestry is practised in Edo State (Fig. 1). Edo State is in the South-south of Nigeria located between latitudes 6^0 and $7^020'$ N and longitudes 05^o 44'E and 06^0 45'E. The state is bounded to the East by Anambra State, to the North by Kogi State, to the West by Ondo State and to the South by Delta State (FORMECU, 1999). The relief in the state is generally flat to gently undulating with elevation increasing northwards from approximately 50 to 300m. The landscape is interrupted by an east sandstone scarp found in some portion of the state. It extends from Benin city to Uromi with elevation exceeding 300m in the eastern part of the state (FORMECU, 1999).

The soil classes consist of Benin series (Enwezor *et al.*, 1990; Agboola and Ogunkule, 1993). The Rainforest soils are very deep and moderately deep, well drained and composed of sands, sandy loam and loamy sand. There are two major seasons in a year comprising the rainy (March-November) and dry (November-February) seasons. The state has a tropical climate characterized by two distinct conditions of wet and dry seasons which receive an average of annual rainfall of 2500mm in the long period of rain and 1375mm in the short period of dry season. It is mostly covered by the moist tropical forest with lowland rainforest accounting for 76.5% of the total land area of the state (FORMECU, 1999). The distribution of rainfall is markedly bimodal, with a lower peak in July and August (Adefolalu, 1986). The mean temperature varies between 25^0C in the South and 34^0C in the North while the relative humidity ranges from 79 to 90%. The temperature across the state is relatively high with very narrow variations; that is, in season and diurnal ranges 22-36 ^{0}C (Adegbehin and Omijeh, 1993).

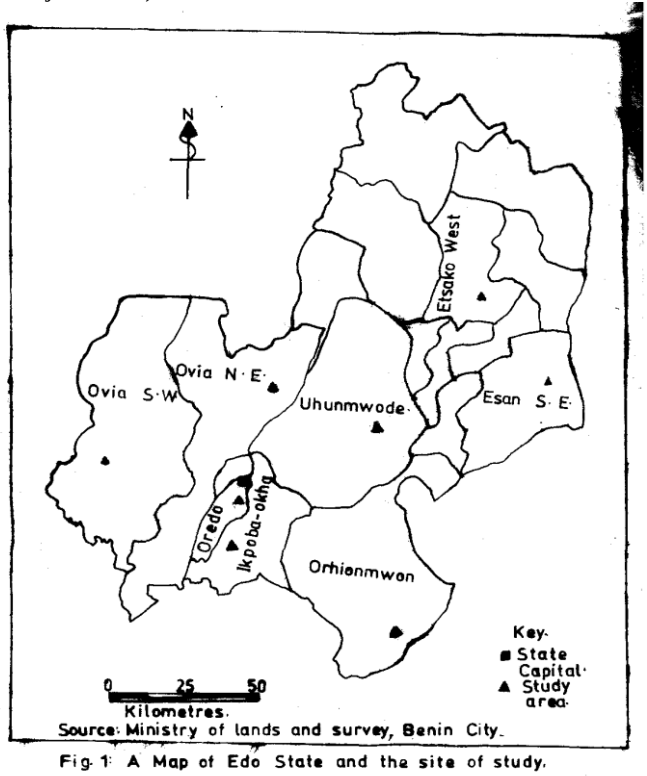

Fig. 1: A Map of Edo State and the site of study.

A reconnaissance visit was made to the Forestry Department and Area Forest Offices of Edo State Ministry of Environment. Subsequently, random sampling was conducted to obtain information concerning Local Government Area practising agroforestry in the state. Data on the actual number of farmers involved in agroforestry practice in reserved land in each Local Government Area were obtained from the Forestry Departments. The respondents were composed of farmers practising agroforestry in government-reserved forests, based on 5, 20 and 30% sampling intensities for population of above 200, 100-200 and less than 100, respectively (Table 1). These accounted for

variations in the values among the locations. A total of 230 respondents [in these areas] were randomly selected accordingly.

Table 1: Location and sampling intensity of agroforestry farmers in each location

Local Government Area	Total Population	Sampled Population
Ovia North East	320	16
Orhionmwon	829	41
Uhunmwonde	1,178	59
Ovia South East	456	23
Etsako West	169	34
Esan South East	119	24
Ikpoba-Okha	90	27
Oredo	21	6
Total	3,182	230

Data Collection and Analysis

The primary data were obtained with the use of a well structured questionnaire. The questionnaire was used to elicit information during the period under review. Personal interviews were carried out using field assistants who understand the local languages such as Bini and Ishan. The secondary sources of data were Edo state ministerial documents, Journals, Text books and internet. Data collected were analyzed using descriptive statistics of frequency and proportion summarized in tables, and inferential statistics using t-test and analysis of variance (ANOVA) to test whether there are differences among the sub-classes of the variables considered in the study. A total of 230 questionnaires were distributed in all the locations considered in this study, while 224 questionnaires were retrieved from the respondents.

RESULTS AND DISCUSSION

Table 2 shows that the result of the t-test analysis on the number of taungya farms within the forest reserves and outside the reserves. There were significant differences ($P<0.05$) among the mean values considered in the study. The average land holding for individual farmer was one hectare; however, few farmers did acquire more than one hectare during allocation of taungya farms. There were more agroforestry farms within forest reserves than outside the forest reserves.

The findings agree with the view of Idusuyi (1997), who noted that most agroforestry farmers in Edo State have their farms within the forest reserve which were created between 1960s and 1970s. The reason cannot be far from the fact that soils in the reserves are more fertile than outside the reserve. The appropriate use of agroforestry farm in the forest reserve is believed to be able to alleviate some constraints to crop production as well as establishment of desired timber species. The principle of the technology, especially taungya is that the farmer crops in a piece of land for three years at most, before the canopy closes in order to avoid unhealthy competition between arable crops and tree

components. The system's arable crop output is generally high, because leucaena alley system increases crop yield at 4t ha^{-1} in most of year (Mugwe *et al.*, 2004).

Table 2: Location of agroforestry farms

Local Government Area	Location		
	Within the reserve		Outside the reserve
Ovia North East	14		2
Orhionmwon	35		5
Uhunmwonde	45		11
Ovia South West	16		7
Etsako West	30		2
Esan South East	15		9
Ikpoba-Okha	13		14
Ordeo	2		4
Total	170		54
XA	21.25	XB	6.75

Note: XA= mean of farms within the reserve, XB= mean of farms outside the reserve, ta df = 2.76

The results of the t-test analysis on the two types of agroforestry systems; taungya farms and alley farming indicated that there were significant differences among the mean values considered in the study (Table 3). Taungya dominated alley farming in the agroforestry practices adopted by farmers.

Table 3: Agroforestry systems in the study area

Local Gov't Area	Agrisilviculture (Taungya)		Alley farming
Ovia North East	15		1
Orhionmwon	40		0
Uhunmwonde	54		2
Ovia South West	23		0
Etsako West	31		1
Esan South East	24		0
Ikpoba-Okha	24		3
Ordeo	5		1
Total	216		8
XA	27.0	XB	1.0

Note: XA=mean of taungya farms, XB=mean of alley farms, ta df = 4.87

The findings agree with the views expressed by Ehiagbonare (2006), that plots are allocated to the farmers to grow arable crops along with the use of seedlings of economic trees which are supplied by the Forestry Department.

Table 4 shows that 81.7% of the respondents were given free seedlings by the government, while 13.8 and 4.5% of the respondents sourced their planting materials from wildlings and market, respectively. The average farm size was one hectare allocated

between one and three years, because three years was the maximum period a farmer was expected to remain on the piece of land.

Table 4: Sources of planting materials

Source of planting materials	Frequency	Proportion (%)
Donation	183	81.7
Wildlings	31	13.8
Purchase	10	4.5
Total	224	100

The findings revealed that government donates tree seedlings to the farmers to plant in their various farms. These results agree with Hellermann (2007), who noted that Teak and Gmelina seedlings were provided to farmers by the government and incentive (monetary) was given to them to maintain the planted seedlings such that the survival rate attained would be between 95 and 100%. However, the amount of money paid as incentive is not emphasized at the present time, because it is apparently non-existent due to the fact that equivalent of 50 kobo was paid several decades ago; between 1929 and 1960. The idea of any form is to encourage the farmers to pay adequate attention to the tree crops along side with arable crops. However, the findings contrast the view expressed by Idusuyi (1997), that farmers buy their tree seedlings from the ministry; the government no longer supplies the farmers' free seedlings.

The results highlighted the survival rates of the tree crops planted in the previous planting season by agroforestry farmers. Between 62 and 120 respondents affirmed that survival of timber seedlings was 52-7%, while 121-180 and less than 62 respondents were of the opinion that the survival rates for timber seedlings accounted for 32.1 and 8.0%, respectively (Table 5).

Table 5: First Year survival rate of tree crops

No. of respondents	Frequency	Proportion (%)
No option	4	1.8
<62	1.8	8.0
62-120	118	52.7
121-180	72	32.1
181-240	12	5.4
Total	244	100

The findings contradict the report by Idusuyi (1997) that the survival rate of the tree crops planted by the agroforestry farmers was about 75%. The results revealed that 54.0% of the respondents received incentive from the government for 100% survival of planted tree crops while 19.2% of the respondents affirmed that there was no incentive from the government. About 26.8% of respondents lacked of knowledge about the existence of any incentive for 100% survival of the seedlings in the farm (Table 6).

Table 6: Distribution of respondents based of incentive administered for 100% survival of seedlings

Incentive	Frequency	Proportion (%)
Available incentive	121	54.0
No incentive for farmers	43	19.2
Don't know	60	26.8
Total	244	100

These findings agree with the report made by Hellermann (2007), that taungya farmers received payment for seedling maintenance. This is the device introduced by the colonial masters during early plantation establishment programmes. It seems that emphasis has somewhat relaxed in the survival of planted seedlings for establishment of forest plantation, since allocation of agroforestry plots is regarded as one of the sources of forestry revenues in the state.

The results showed the total areas covered by various timber species in agroforestry system between 1990 and 2009 (Table 7). It was revealed that there was significant difference ($P < 0.05$) in area covered by various species. *Tectona grandis* dominated the areas occupied by other species as revealed by application of Fisher's least significant difference. These variations in areas covered by various species cannot be unconnected to the fact the planting materials are not always available in enough quantity and interest on the part of government to grow some timber species changes at various periods, In addition, Edo state is favourably disposed to growing of Teak, because there was a boom in Teak exploitation between 1980s and 1990s (Kalu and Adeyoju, 2011).

Table 7: Areas covered by timber species (ha)

Year (s)	*Tectona grandis*	*Gmelina arborea*	*Terminalia Ivorensis*	*Nauclea Dederiichi.*	*Pinus Ocapa.*	*Eucalyptus Spp*
1990 - 1993	61	105	45	73	32	15
1994 - 1997	70	46	37	10	29	-
1998 - 2001	-	55	15	40	-	37
2002 - 2005	103	30	-	10	-	-
2006 - 2009	147	21	-	-	-	-
Total	381	257	97	133	61	52
Mean	95.25^{a}	51.40^{b}	32.33^{b}	33.25^{b}	30.50^{b}	26.00^{b}

Teak is the most commonly used species in taungya system in the study area. This finding corroborates the report made by Agyeman *et al.* (2003) that *Tectona grandis* is the most commonly planted tree species in taungya farming system, obviously, because of its growth rate and its great economic benefits as poles, fence posts and construction timber. The leaves are also used by local people for wrapping food ingredients. It can attain its peak within 20 years of plantation establishment (Adegbehin *et al.*, 1992; Adeyoju, 1975; Barbour-Bhat and Okma, 2004).

The results highlighted the various problems of agroforestry in the study area (Table 8). It was revealed that short duration of planting (>3 years) accounted for 4.5%, inadequate incentive had 27.7%, while absence of planting materials, inadequate monitoring, and absence of field staff accounted for 12.5, 26.3 and 29.0%, respectively.

Table 8: Problems affecting agroforestry practice

Problems	Frequency	Proportion (%)
>3years farming period	10	4.5
Inadequate incentive	62	27.7
Absence of planting material	28	12.5
Inadequate monitoring	59	26.3
Absence of field staff	65	29.0
Total	244	100

From the results, it was indicated that the reason why the practice may not succeed in the study area was the absence of field staff, and the attendant inadequate monitoring. The incentives given by the government were not very encouraging and in most cases were not available. These findings agree with the report made by Hellermann (2007) that one of the major problems of taungya farming in Edo State is absence of field staff. For several decades field assistants, forest labourers and lower cadres of uniform personnel were not employed to replace retiring staff or at demise of some staff (Kalu *et al*., 2009). The situation has adversely affected artificial forest regeneration in the production of enough tree seedlings for the taungya farmers and created fewer field staff to effectively monitor all the taungya farms in the state. However, other categories of forest personnel like technical and professional cadres monitor the taungya farms occasionally, In fact, the seedlings are supplied free of charge to taungya farmers; the supply is still problematic if the seedlings are not raised and are not available after allocations of taungya farms are made, which are done annually on continuous basis.

CONCLUSION

The fixed natures of land and continuous high demand for fertile land in the forest estates have prompted the recommendation and adoption of agroforestry. The practice of agroforestry has resulted in the stablishment of forest plantations of *Gmelina arborea, Tectona grandis, and Terminalia ivorensi*s. The results revealed that the two common types of agroforestry practice in Edo state are alley farming and taungya. It was also revealed that 52.7% was the prevalent rate of survival of tree crops in agroforestry system during the first. This could be probably linked with the fact that only 54% of the respondents affirmed the existence of encouragement (payment of bonus) for 100% survival of tree crops. Agroforestry farmers were faced with numerous problems on the production of food and wood namely; length of time (time line), inadequate incentive, absence of planting material, inadequate monitoring and absence of field staff. The findings revealed that absence of field staff dominated other problems considered in the study. Undoubtedly, the introduction, sustenance and widespread adoption of agroforestry technologies will play immense roles in artificial forest regeneration, conservation of wood land and environment and consequently, reduce hunger for fertile land, deforestation, and total decline of forest estates.

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