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An assessment of the forest regeneration potential of the taungya system of farming in Oyo State, south-western Nigeria§

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Balancing forest regeneration and meeting food and fibre needs of Nigeria's ever-increasing population challenges is imperative to her sustainable development. Two methods of artificial forest regeneration practiced in Oyo State, Nigeria to meet these challenges are direct planting and taungya systems. This paper reports the performance of the taungya system of forest regeneration in Osho Forest Reserve, Oyo State, Nigeria with a view to harnessing information for informed and effective policy decision on sustainable forestry development. Four out of seven taungya centres within and around the reserve were purposively studied using questionnaire administration, oral interviews and direct field measurement. Direct field measurement was undertaken in 10 temporary sampling plots, each measuring 25 m × 25 m. The data collected were analysed using descriptive and inferential statistics at $P = 0.05$. The taungya farmers in the study area were male and a majority (76.0%) had no formal education. More than half of the farmers (56.0%) had knowledge about taungya and silvicultural operations, while 82.0% of them had no other farm outside the taungya farm. The observed survival of trees planted on the farms was high. Significant variation was observed in the circumference at breast height (Cbh) of species under the direct planting and taungya systems with *Gmelina arborea* contributing to most of the variation and the differences in stand age. The survival percentage of tree species under taungya was higher (52.0% ha^{-1}) than that under direct planting system (41.0% ha^{-1}). The study identified lack of credit facilities, inadequate funding and ignorance of the advantage of tree crops on tropical farmland as well as inadequate technical support as the major constraints of the taungya system. The taungya system is effective for forest regeneration albeit taking care of farmers' interest beyond the tree canopy closure age is recommended, if more trees are expected to survive.

Keywords: direct planting, forest regeneration, taungya farming

Introduction

The world's forest area has been declining for centuries but the process has accelerated to alarming proportions in the last half of the twentieth century (Carpenter et al. 2004). In 2005, the estimated forest area for Africa was 635 million ha; net annual forest loss was about 4 million ha for the period 2000–2005, which amounts to almost 55% of the global reduction in forest area (FAO 2007). A significant share of net forest loss was reported from countries with the greatest extent of forest, with Nigeria accounting for most of the loss in West Africa (FAO 2007). Adedoyin (2001) put forest depletion in Nigeria at about 3.5% per annum, which translates to the loss of 350 000–400 000 ha per annum. FAO (2015) reposed Nigeria with an annual loss of 410 000 ha between 2010 and 2015 as one of the countries with the greatest annual forest reduction.

Tropical rainforests provide a vast array of products, which are relevant to the livelihood of the inhabitants of the tropical environment (Faleyimu 2000). FAO (1999) reported that around 80% of the population in developing countries uses non-wood forest products from tropical forests to meet nutrition and health needs. In Nigeria, forests provide a wide range of wood and non-wood products as well as social and environmental services. However, the growing demands for these forest goods and services are putting serious pressure on the resource base, leading to over-exploitation and subsequent forest degradation (Onuoha 1999; Oyebo 2003).

In Nigeria both natural and plantation forests could only meet 100 million m^3 of the 180 million m^3 wood demand in 2000 (Aruofor 2000). At present, one of the most challenging problems facing the country is the production of sufficient food and fibre to meet the needs of the ever-increasing population (Peters 2005). This outlook was earlier presented by Akinsanmi (1982) who observed existing pressure to destroy the forests through logging, agriculture, urbanisation and indiscriminate dereservation for different purposes.

In most developing countries, agriculture, forestry and urban development land uses are unplanned resulting in wanton land use. With a fixed landmass and population

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growth at a geometric rate, integrating land uses with emphasis on sustainable economic development and ecological balance is imperative. Integration of agriculture and forestry results in various agroforestry practices incorporating various inter- and intrasectoral components in the system. However, in as much as the two interests must be integrated, the fact remains that forests cannot be substituted (Jarvis 1991).

Unlike Scandinavian countries, forest management in Nigeria is mainly a government concern. Earlier attempts made by the Colonial Administration to manage the Nigerian forest reserves using the tropical shelterwood system (TSS) and other enrichment planting recorded little success (Nwoboshi 1982). The need to meet the increasing demand for wood products and the accompanying slow growth rate of most forest tree species shifted emphasis from natural to artificial regeneration (Oguntala 1978; Evans 1992). Two methods of artificial regeneration practiced in Oyo State, south-western Nigeria, to develop plantations were the direct planting system and the taungya system (Oyo State Forestry 2008).

According to the United Nations Environment Programme (Kurukulasuriya and Robinson 2006), encouraging participation by local communities and forest dwellers in forest conservation will engender sustainable management of forests. Apart from this, appropriation of funds to meet budgetary needs in Oyo State does not favour her Forestry Department (Agbeja 1999), thus foreclosing forest regeneration through direct planting in the state (Oyo State Forestry 2008). Furthermore, studies regarded as 'successful' by natural scientists are often impracticable by users because, as observed by Chambers and Leach (1989), objectives and methods of natural scientists, extension and other agencies do not often match those of the end-users, particularly the resource-poor farmers. Therefore, in order to reduce the social impact of plantation projects and enhance adoption, natural scientists must use methods not greatly different from the practices already familiar to the local people. A good example of such practices is the taungya system because the habit of the shifting cultivators does not need drastic reforming (FAO 2002; Udofia 2005).

Direct planting includes all reforestation plantings carried out using forestry staff (Nwoboshi 1982). Taungya, on the other hand, is an agroforestry subsystem, which Nair (1993) and Nielsen (1996) defined as the practice of growing annual agricultural crops temporarily with forestry species during the early phase of plantation establishment. The taungya system has been widely used in India, Belize (British Honduras), Trinidad and Tobago, Nigeria and other West African countries (Evans 1992). Spears (1980) stated that most of Kenya's afforestation programme has been carried out using the taungya system. The present study examined the background of taungya farmers, evaluated the area of land regenerated through the taungya system, identified the problems associated with taungya practice and assessed the sustainability of the practice among farmers. This is with a view to comparing taungya and direct planting systems of forest regeneration in Osho Forest Reserve, Oyo State, south-western Nigeria.

Methods

Study area

The study was carried out in the Osho Forest Reserve in Ido Local Government Area of Oyo State, south-western Nigeria (Figure 1). The reserve is situated in the derived savanna ecological zone between 6°50′ N and 4°30′ E at about 152 m above sea level. Osho Forest Reserve was initially constituted as Ibadan Native Administration Forest Reserve on 6 January 1932 under the seal of W Buchanan-South, the Lieutenant-Governor for Southern Provinces. It was reclassified as Ibadan District Native Authority Forest Reserve through a 1951 Amendment Order (Vide W. R. Republic Notice No. 12 of 1952 in WR Gazette No. 13 of 21 February 1952) under the seals of AJ Phillips (Ag. Resident, Ibadan Province) and TM Shankland (Ag. Civil Secretary, Western Region). The reserve had an original land area of about 51.8 km^2 but was reduced to about 35 km^2 through the 1951 Amendment Order. The forest reserve contains an abundance of valuable tree and other flora and fauna species.

The climate of Osho Forest Reserve is mainly tropical, characterised by two seasons, namely dry and wet seasons. Two distinct wet seasons occur in the reserve, May to July and September to November, apart from the break in August. The major dry season occurs between December and March and is usually accompanied by north-east trade winds. The average annual rainfall is about 1 257 mm, while the relative humidity ranges from 84.5% in June–September to 78.8% in December–January. The mean annual maximum and minimum temperatures are about 31.3 °C and 21.0 °C, respectively.

The main drainage feature of the reserve is the Osho River from which its name was derived. The reserve accommodates seven taungya farms named after the villages in which they are sited (Figure 1). These villages consist of Adedapo, Gbagba, Agbetu, Onifufu, Mabole (Bolorunpelu), Abokede and Onikanga. Farmers within the reserve practice a mixed cropping system, and varieties of arable crops such as maize, cassava, yam, melon and plantain are cultivated. Tree species planted under taungya and direct planting systems are *Tectona grandis*, *Gmelina arborea* and *Pinus caribea*.

Study population

The targeted study populations were the taungya farmers from the villages within and outside Osho Forest Reserve as well as the management staff of the reserve in the Oyo State Ministry of Agriculture and Natural Resources (Forestry Department). There were 80 registered taungya famers in the reserve, of which 68 were sampled based on information garnered on farmers' level of involvement in taungya activities during a reconnaissance survey.

Reconnaissance survey

A reconnaissance survey of villages within and outside the reserve was carried out to determine villages that will be sampled as true representatives of the population of the taungya farmers and plots. This partly lends credence to the data generated for this study.

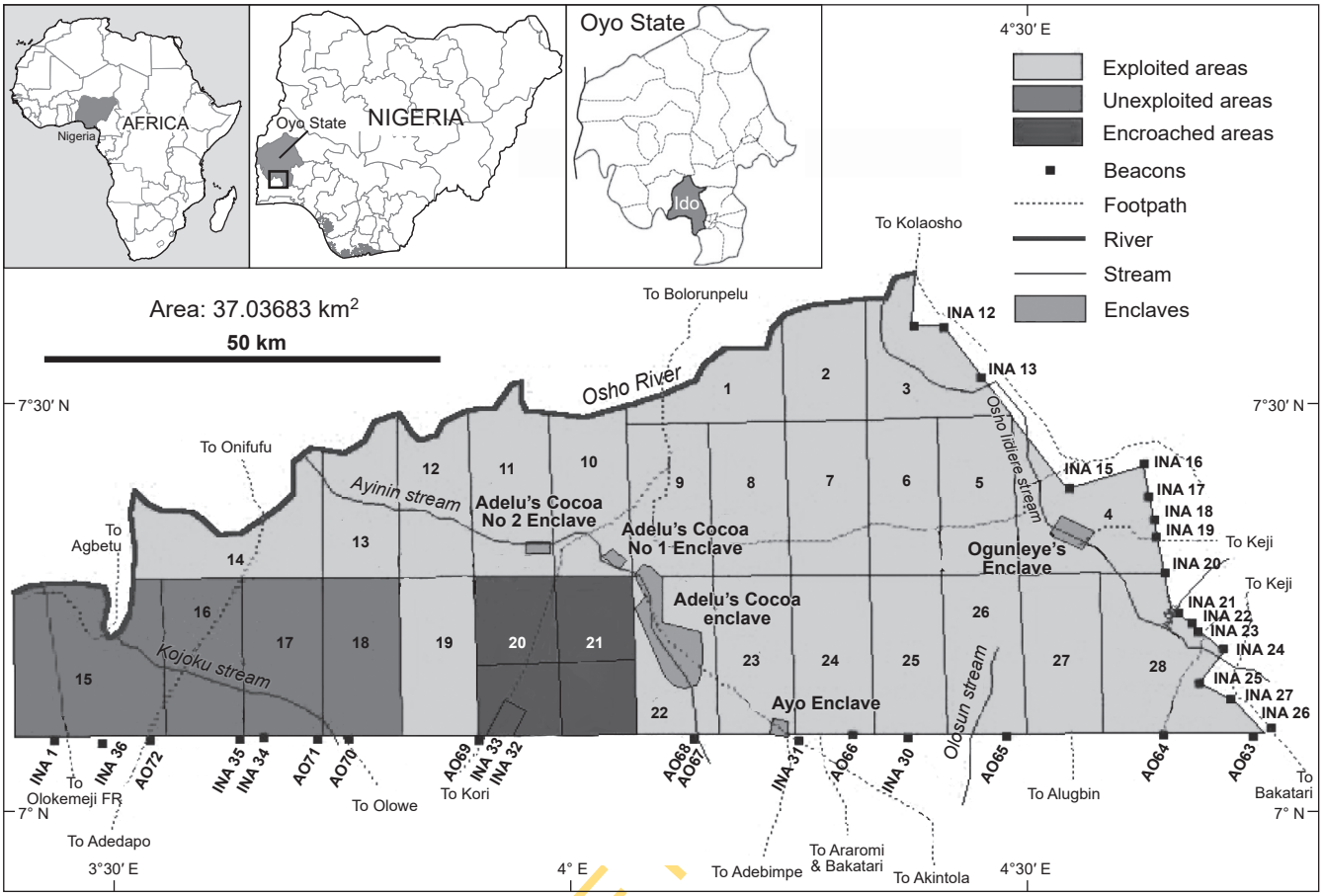

Figure 1: Location and map of Osho Forest Reserve in the Ido Local Government Area, Oyo State, Nigeria, showing taungya centres

Data collection

A set of structured and open-ended questionnaire was developed and administered on taungya farmers in the selected villages and used to gather information on the social status of the respondents, importance of the system to their livelihood, their impression about the present management system and willingness to participate in the system. Secondary data were extracted from records of the Oyo State Forestry Department and the internet on forestry and rural development activities in the study area. Oral interviews involving forestry staff and taungya head farmers were also conducted. Finally, field assessments of trees planted using taungya and direct planting systems were carried out.

Sampling procedure

Through a reconnaissance survey of villages within and outside the Reserve, four (Abokede, Onifufu, Gbagba and Agbetu) of the seven settlements, which were identified as representative of the population of the taungya farmers and plots were purposively selected for the study. Not only was the number representative of the number of taungya centres, the villages also had the highest number of taungya farmers and were located south-west, south-east, north-east and north-west of the Osho River. A set of questionnaire was then administered on 85% of farmers in each of the settlements selected through reconnaissance.

Plant assessment

There was an assessment of the survival of planted stock in both the taungya and direct planting centres. In each of the systems, five temporary sample plots (25 m × 25 m) were randomly located in each stand. The trees were assessed for the following two parameters.

Number of surviving trees per plot

Number of surviving trees was counted in each plot (25 m × 25 m) and multiplied by 16 to give the number of surviving trees per hectare (N ha^{-1}).

Circumference over bark at 1.3 m from the ground per plot

The circumference over bark at 1.3 m from the ground (Cbh) was measured. Trees that forked below 1.3 m were regarded as two trees, whereas trees that forked above 1.3 m were regarded as single trees. The number of surviving trees per plot was obtained through observation and counting.

Data analysis

Data collected were subjected to descriptive analyses using frequency counts, percentages and arithmetic modal distribution. The impacts of respondents' demographic and socio-economic background on the sustainability of the taungya system were also analysed using cross-tabulation (crosstab) and chi-square inferential test statistics. Here, consent

of respondents on interest in planting trees with arable crops and the impact of the study site on the practice of the taungya system (type of trees preferred by respondent, their views on growing trees with arable crops, and interest in mixing trees with arable crops), which were taken as a measure of sustainability of the system, were the dependent variables. Selected respondent background (marital status, educational status, scale of farming and consent to farming outside Osho Forest Reserve) and sampled sites in the study area were the independent variables. In addition, Student's *t*-test statistical analyses and bar graphs were used to compare forest regeneration under direct planting and the taungya system in the study area.

Results

Socio-economic survey

Of the 80 sets of questionnaire designed for the socio-economic survey, to be administered on the taungya farmers, sixty-eight (68) sets were eventually administered at the Abokede (22), Onifufu (12), Gbagba (20) and Agbetu (14) taungya settlements. Analyses of data generated from the questionnaire were as follows.

Demographic and socio-economic background of respondents

A high percentage of the respondents were observed to be aged between 30 and 35 years (23.5%) (Table 1). This was followed by those aged 25–30 years (17.6%), whereas 2.9% of the respondents wre between ages 70 and 75 years. Most of the taungya famers (76.5%) had no formal education (Table 1). Only 17.7% of respondents had primary education, whereas 2.9% had secondary school leaving certificates. With regard to marital status, 85.2% of respondents were married while 12.0% were single. Most (82.0%) of the respondents produced more than their subsistence needs; only 18.0% farmed at subsistence level. Enquiry on labour sources among respondents revealed that hired labour was more often used, as indicated by 41.2% of the respondents, compared with self (26.5%) and labour sourcing among peers (29.4%).

Farmers' perceptions of the taungya farming system

Table 2 reveals that 76.0% of the respondents consented to taungya farming being advantageous to them while 29.0% held a contrary opinion. This is also in line with the fact that more respondents (52.9%) practiced mixed farming involving trees and arable crops compared with 41.2% of respondents that do not (Table 2). About 56.0% of the respondents preferred combining timber species with arable crops compared with 29.0% that opted for the combination of fruit trees with other arable crops (Table 2). Of concern, however, is that most of the farmers (58.8%) claimed not to have received seedlings/wildlings even once from the Forestry Department. Only 11.8% of respondents had received planting stock once, whereas a paltry 2.9% had received planting stock twice (Table 2).

Farmers experience and taungya farming

Examining respondents experience (Table 3) showed that

Table 1: Frequency distribution of respondents' socio-economic background

Socio-economic background	Frequency	Percentage	Mode
Age (y)			
25–30	12	17.6	<30–35
>30–35	16	23.5	
>35–40	8	11.8	
>40–45	8	11.8	
>45–50	6	8.8	
>50–55	6	8.8	
>55–60	0	0	
>60–65	6	8.8	
>65–70	4	5.9	
>70	2	2.8	
Marital status			
Single	8	12.0	Married
Married	58	85.2	
No response	2	2.8	
Educational background			
None	52	76.4	None
First school leaving certificate	12	17.7	
Secondary school certificate	2	2.8	
No response	2	2.8	
Scale of farming			
Subsistence	12	18.0	Commercial and subsistence
Commercial and subsistence	56	82.0	
Labour source			
Self	18	26.5	Hired labour
Peers	20	29.4	
Hired	28	41.2	
No response	2	2.8	

about 56.0% of them had previous or formal knowledge of silvicultural and tree tending operations, whereas 44.0% had none. The knowledge of silvicultural practice notwithstanding, 41.2% of the farmers were identified as capable of coping with simultaneous tending of trees with arable crops. No correlation could be established between those with knowledge of silviculture and those that can cope with tending trees alongside arable crops (Table 3). The dependence of a majority of the respondents on the reserve for farmlands was confirmed by 82.0% of them having no other farm outside the reserve (Table 3). About 92.0% of the farmers did not respond to comparing yield from a taungya farm with ordinary arable crop farms. This may also be adduced to most respondents not having a farm outside the reserve. Furthermore, 11.7% of respondents were of the view that yield from taungya farms was not higher. Examining the relationship between forestry staff and respondents (Table 3), half of the respondents did not react, although almost all those who responded (48.5%) viewed the relationship as cordial. However, in spite of the below-average response on the relationship between actors, 94.0% of the respondents

Table 2: Frequency distribution of respondents' perception of the taungya system

Perception statement	Frequency	Percentage	Mode
Respondents' views on growing trees with arable crops			
Advantageous	52	76.0	Advantageous
Not advantageous	16	24.0	
Preference of respondents for growing trees with arable crops			
Like trees with crops	36	52.9	Like trees with crops
Dislike trees with crops	28	41.2	
No response	4	5.9	
Preferred tree types on taungya farms			
Leguminous trees	–	–	Timber species
Fruit trees	20	29.4	
Timber species	38	55.9	
Timber and fruit trees	2	2.9	
Any type of tree	4	5.9	
No response	4	5.9	
Frequency of supply of planting stock			
Never	40	58.8	Never
Once	8	11.8	
Twice	2	2.9	
Regularly	4	5.9	
Occasionally	8	11.8	
Many times	2	2.9	
No response	4	5.9	

Table 3: Frequency distribution of respondents' knowledge of the taungya system

Knowledge of taungya system	Frequency	Percentage	Mode
Consent of respondents' about having knowledge of silviculture			
Yes	38	55.9	Yes
No	30	44.1	
Respondents consent on difficulty coping with tree tending on arable farm			
Yes	28	41.2	No
No	40	58.8	
Consent of respondents' on having other farm(s) outside the reserve			
Yes	12	17.7	No
No	56	82.3	
Consent of respondents on harvest from taungya farm being higher than other farms			
Yes	4	12.0	No response
No	8	6.0	
No response	56	82.0	
Respondents' perception of their relationship with forestry staff			
Cordial	33	48.5	No response
Not cordial	1	1.5	
No response	34	50.0	
Consent of respondents' on preference for taungya practice continuity			
Yes	64	94.12	Yes
No	2	2.94	
No response	2	2.94	

want the practice of taungya farming system to continue in Osho Forest Reserve.

Impact of respondents' background on the practice of the taungya system

None of the selected variables to test the impact of respondents' background on their participation in taungya farming was found to impact on the practice in the study area. For example, the test on marital status revealed an asymptotic chi-square (χ^2) value of 1.65, $\alpha_{0.199}$ and df of 1. Crosstab analysis also revealed that 54 of the respondents were married (the modal group) and only 28 (barely 50.0%) liked planting trees with crops (Table 4). Similarly, most of the respondents (48) had no formal education and slightly more than 50.0% of this population (28) had no interest in planting trees with arable crops on their farmland. This informed why the test on the impact of education on interest among respondents to practice taungya was also not significant ($\chi^2 = 2.062$; df = 2; $\alpha_{0.357}$).

Impact of study sites on the practice of the taungya system

Examining the impact of the study site on respondents' interest in taungya practice (Table 5), it was found that where they reside had no impact on their interest in mixing trees with arable crops ($\chi^2 = 0.834$; df = 3; $\alpha_{0.841}$), their views on growing trees with arable crops ($\chi^2 = 3.757$; df = 3; $\alpha_{0.289}$) and the type of trees they prefer on their taungya farm ($\chi^2 = 0.095$; df = 9; $\alpha_{0.730}$).

Field survey

The assessment of both forest regeneration system in the study site by laying five temporary sample plots randomly in each stand also generated data sets, which were analysed as follows.

Comparison of forest regeneration under the direct planting and taungya systems

Field survey (Figure 2) revealed that the girth of trees under the plantation established by direct planting carried out by the Forestry Department using the Forestry Trust

Table 4: Cross-tabulation analyses of respondents background and their interest in the taungya practice. All tests were carried out at the $\alpha_{0.05}$ significance level. Percentages of frequency counts are in parentheses

Respondents' background	Indices of respondents' background	Consent on interest in planting trees with arable crops		Total	Chi-square statistics
		Yes (%)	No (%)		
Marital status	Single	6 (9.7)	2 (3.2)	8 (12.9)	$\chi^2 = 1.651$ df = 1 $\alpha_{0.199}$
	Married	22 (35.5)	32 (51.6)	54 (87.1)	
	Total	28 (45.2)	34 (54.8)	62 (100.0)	
Educational background	None	20 (32.3)	28 (45.2)	48 (77.5)	$\chi^2 = 2.062$ df = 2 $\alpha_{0.357}$
	Primary	8 (12.9)	4 (6.5)	12 (19.4)	
	Secondary	0 (0.0)	2 (3.2)	2 (3.2)	
	Total	28 (45.2)	34 (54.9)	62 (100.0)	
Scale of framing	Subsistence	4 (6.3)	8 (12.5)	12 (18.8)	$\chi^2 = 0.326$ df = 1 $\alpha_{0.568}$
	Subsistence and Commercial	24 (37.5)	28 (43.8)	52 (81.3)	
	Total	28 (43.8)	36 (56.3)	64 (100.0)	
Farming outside the reserve	Yes	6 (9.4)	6 (9.4)	12 (18.8)	$\chi^2 = 0.117$ df = 1 $\alpha_{0.732}$
	No	22 (34.4)	30 (81.3)	52 (81.3)	
	Total	28 (43.8)	36 (56.3)	64 (100.0)	

Table 5: Cross-tabulation analyses of study sites and respondents' interest in the taungya practice. All tests were carried out at the $\alpha_{0.05}$ significance level. Percentages of frequency counts are in parentheses

Interest in taungya system	Study sites				Total (%)	Chi-square statistics
	Onifufu	Abokede	Gbagba	Agbetu		
Like trees mixed with arable crops						
Yes	4 (6.3)	8 (12.5)	8 (12.5)	8 (12.5)	28 (43.8)	$\chi^2 = 0.834$ df = 3 $\alpha_{0.841}$
No	8 (12.5)	12 (18.8)	10 (15.6)	6 (9.4)	36 (56.3)	
Total	12 (18.8)	20 (31.3)	18 (28.1)	14 (21.9)	64 (100.0)	
Respondents' views on growing trees with arable crops						
Advantageous	8 (11.8)	14 (20.6)	12 (17.7)	14 (20.6)	48 (70.6)	$\chi^2 = 3.757$ df = 3 $\alpha_{0.289}$
Not advantageous	4 (5.9)	8 (11.8)	8 (11.8)	0 (0.0)	20 (29.4)	
Total	12 (17.7)	22 (32.4)	20 (29.4)	14 (20.6)	68 (100.0)	
Type of trees preferred by respondent on taungya farm						
Fruit trees	4 (6.3)	6 (9.4)	8 (12.5)	2 (3.1)	20 (31.3)	$\chi^2 = 0.095$ df = 9 $\alpha_{0.730}$
Timber species	8 (12.5)	10 (15.6)	8 (12.5)	12 (18.8)	38 (59.4)	
Fruit and timber	0 (0.0)	2 (3.1)	0 (0.0)	0 (0.0)	2 (3.1)	
Any type	0 (0.0)	2 (3.1)	2 (3.1)	0 (0.0)	4 (6.3)	
Total	12 (18.8)	20 (31.3)	18 (28.1)	14 (21.9)	64 (100.0)	

Fund (FTF) was greater than that of trees established under taungya farming. The mean girth was higher for direct planting (62.44 cm) because *Gmelina arborea*, which grows faster than teak, constituted at least 60.0% of the trees in the plantation established using direct planting. In addition, the plantation established by direct planting was older than the taungya established plantation.

The mean number of stumps or trees per hectare that survived under taungya was 52, whereas 41 were in the plantation established using the direct regeneration system (Figure 3). It must, however, be pointed out that age difference coupled with encroachment might also be adduced for this difference.

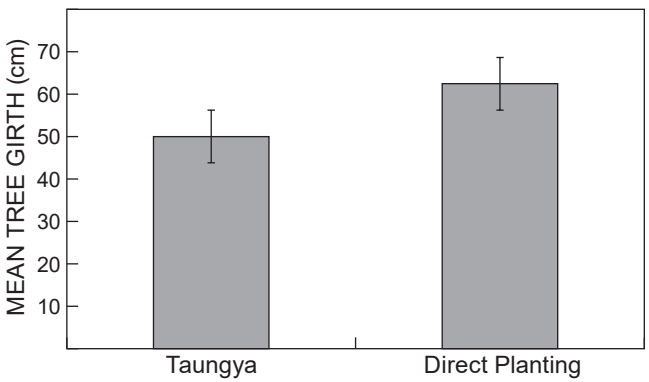

Figure 2: Mean tree girth under plantations established through direct planting and the taungya system of forest regeneration in Osho Forest Reserve

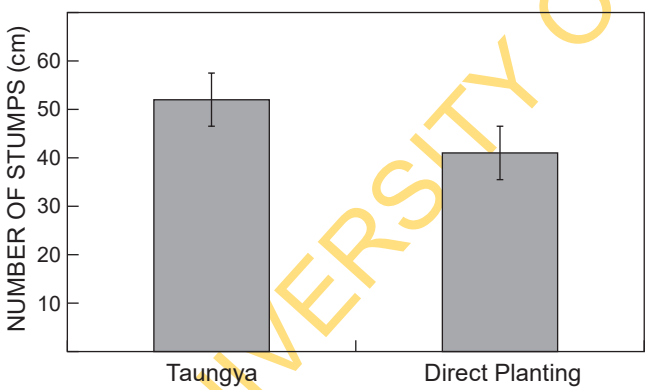

Figure 3: Mean number of stumps under plantations established through direct planting and the taungya system of forest regeneration in Osho Forest Reserve

Student's *t*-test was used to confirm if the variation in tree girth between plantations established using the direct planting and taungya farming systems was significant (Table 6). The *t*-test was significant and hence showed that there was a significant difference between the Cbh of species in the two systems. In contrast, comparison between the mean number of stumps per plot under the direct planting and taungya systems revealed that the difference was not significant, which indicated that the rate of tree survival in the two systems was not significantly different despite the competition of trees in the latter with arable crops.

Discussion

All of the taungya farmers at Osho Forest Reserve were male probably because males are mostly responsible for the procurement of family needs due to culture. Though an appreciable percentage were within ages 25 and 35, the finding that 46.9% were ≥40 years suggested that most of the farmers were old and with declining capability for farm operation. This implies that age might affect farmer's interest to plant trees and also hinder farmers' continual stay in the system (Azeez et. al. 2010). A majority of the farmers were married and had a family size of between four and seven members. Given that most of the farmers operated at both subsistence and commercial levels, the trend encouraged the use of hired labour. However, an appreciable percentage still employs the use of peers especially during pre-planting operations.

Most of the farmers had no formal education and a majority did not have previous knowledge of silviculture and tree tending operations. This implies that their level of education might affect the silviculture practices. The result also showed that information dissemination by forest extension agents through leaflets, pamphlets and other print media may not be appropriate. Land allocation is fixed because a majority of the farmers have never relocated to new toning sites, which could have resulted into same yield harvest within and outside the Forest Reserve, as the land would have lost its fertility after several cropping seasons (Akinsanmi 1982).

Farmers admitted that the taungya system had advantages. This may be connected to the system's provision of solution to their problem of land hunger and tenure rights as most of the farmers were non-indigenes. Enabor et. al. (1982) made the submission that non-indigenes do not get land outside the reserve. Interviews with the taungya head farmers revealed that for

Table 6: Summary of *t*-tests comparing tree girth and number of survived stumps in plantations established under direct planting and the taungya system

Variation	No. of cases	Mean	*t*-test statistics
Variation in tree girth			
Taungya	234	49.99	*t*-value = 5.69; df = 415; $\alpha_{0.00}$
Direct planting	183	62.44	
Variation in number of stumps per plot			
Taungya	5	52.80	*t*-value = 1.46; df = 8; $\alpha_{0.07}$
Direct planting	5	41.20	

fear of leaving the plot, farmers may deliberately destroy trees planted on farms. The same observation was earlier reported by Herrera and Passano (2006). To curb this, they suggested that plots for planting trees be different from where they plant their arable crops, which will invariably be ceding forestry land for agriculture entirely. The interview also showed that a long distance from a farmer's residence to taungya plots or farms was a limitation to taungya practice and as a result taungya farmers were allocated tree planting sites in their respective villages, thereby easing taungya practice. This explains the cordial relationship between the farmers and the forestry staff. However, incentives that would have encouraged farmers to plant more trees (King 1968; Nwoboshi 1982; Hoekstra 1994) were not given to them. Taungya farmers identified some of the challenges limiting the practice of taungya as the bad road network as well as the lack of basic amenities such as hospitals and schools. In addition, the long distance trekked by farmers surely has an effect on productivity (Feder et. al. 1988.).

A majority of the farmers preferred planting timber species, and others fruit trees, while few had no choice of tree types. However, most farmers did not like mixing trees with arable crops because at the closure of tree canopy farmers are sent out of the reserve. Some farmers were of the opinion that planting trees with crops is breeding competition for the arable crops. This result suggests that creation of awareness on the importance of planting trees with crops could motivate farmers' interest in planting trees with crops and thus improve their yield.

Furthermore, the reserve has experienced irregular or no supply of planting stocks. This was due to inadequate funding by the state government, which had affected the raising of seedlings at the appropriate time. In the course of the interview with the forestry officials in charge of the reserve, it was gathered that lack of a functional central nursery, adequate labour and transport means to distribute planting stocks to the farmers contributed to the anomaly. An average of 88.9% survival of trees planted was reported by farmers. The result revealed that planting and post-planting operations of trees must have been handled by taungya head farmers with strict supervision from the forestry staff as earlier submitted by Nwoboshi (1982).

The rates of tree survival observed in teak and *Gmelina* plantations were virtually the same but their circumferences and diameters at breast height (Dbh) varied because of the fast growth rate of *Gmelina* (Onyekwelu 2001). Comparatively, however, the Dbh of trees under direct planting were higher because *Gmelina* constituted at least 60.0% of the trees in the plantation established using direct planting coupled with the fact that the direct plantation was about 2–3 years older than the taungya plantation. However, survival percentages under both systems were not significantly different: >70.0% for the taungya system and about 60.0% under the direct plantation system. The low survival percentage recorded under direct planting could be due to a low level of post-planting care, which could be attributed to inadequate forestry labour. This limitation, as observed by Soerianegara and Lemmeus (1993), encourages weed competition and strangling by climbers, which would cause mortality and growth retardation among younger trees. Trees on taungya farms used for the study suffer similar rigours as they were abandoned immediately farmers leave their plots. However, in the new taungya practice, the trees planted are properly supervised by farmers throughout the planting and post-planting operations. Further, taungya farmers wanted the practice of taungya in Osho Forest Reserve to continue because they lack land to farm on. This was the primary reason for their involvement in taungya farming as previously pointed out by Akinsanmi (1982), MacDonald (1982), Lowe (1987) and British Columbia Ministry of Forests (2003).

Conclusion and recommendations

The taungya system of farming as presently practiced is a little different from the general definition of taungya practice elsewhere. It is, however, the only system of regeneration practiced at Osho Forest Reserve presently. The study affirms the positive role of the taungya system in the promotion of forest conservation and regeneration. It was observed that the prospects for the practice of taungya in Osho Forest Reserve hinges on continuous protection of the farmers and Oyo State Forestry Department interests as stakeholders. The predominance of subsistence farming in the study area could limit the forest regeneration potential of the practice, most especially where the farmers have little or no access to infrastructural facilities, which could also negatively impact the forestry department's delivery of the taungya system incentives. In spite of the identified constraints, the taungya system holds much promise, although it has not been a complete success.

Based on the results of this study, the following recommendations will suffice for improved policy decisions on use of the taungya system in forest regenerations:

- A learning environment is advocated among stakeholders, which will allow the taungya farmers to take an active role in the planning and implementation of taungya operation as well as the drawing of benefit-sharing contracts between the government and the communities concerned.
- To enhance the productivity of the system, more forest areas should be gradually opened to facilitate continuous meeting of farmers' subsistence food needs.
- To encourage continuity of the system, the living conditions of the famers should be improved by providing social benefits and other incentives.
- Forestry extension officers should be employed to facilitate learning with farmers on forest regeneration/conservation and the advantages of trees on farmland.
- There is also the need for government to provide adequately for taungya incentives and subsequent maintenance of established forest stands.

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