APPRAISAL OF TAUNGYA FARMING AS A SUSTAINABLE LAND-USE OPTION IN VANDEIKYA LOCAL GOVERNMENT OF BENUE STATE, NIGERIA

***[1] Agera, S.I.N, [2] Adegeye, A.O., and [2] Jimoh S.O.**

1. Department of Forest Production and Products, University of Agriculture, Makurdi , Nigeria.

2. Department of Forest Resources Management, University of Ibadan, Ibadan, Nigeria

*Corresponding author: E-mail: agerastephen@yahoo.com Phone: 2348058484045.

ABSTRACT

This study appraises taungya farming as a sustainable land -use option in Vandeikya Local Government (VLG) forest estates, Variations in the yield of agricultural crops over time (years), incidences of annual forest fires, forest offences as well as changes in forest area between 1955 and 2000 were assessed. Six out of 12 council wards in VLG were randomly selected for the survey through multi-stage random sampling. A total of 200 farmer respondents were sampled out of a taungya farmer population of 562 in the selected wards. All the 16 members of staff of the VLG forestry service were interviewed. The two categories of respondents were then interviewed using the same type of semi-structured questionnaire. This was to check and corroborate the responses of both groups of respondents. Data collected was subjected to descriptive statistics (like percentages) and inferential statistics [such as analysis of variances (ANOVA)]. The mean yields of yam, cassava, sweet potatoes, rice, maize, groundnuts, soybeans, guinea corn, beans, pepper and melon on taungya plots ranged from 306.67kg/ha for melon to 1698.33kg/ha for cassava. The corresponding yields of melon and cassava on non-taungya plots were 250.00kg/ha and 1372.67kg/ha, respectively. Crop yields were significantly higher on most taungya plots except that of melon ($p>0.05$).The total forest area declined from 312.9ha in1995 to 83.5ha in 2000. Reforestation with indigenous tree species, establishment of seed and clonal banks, adoption of socially and ecologically acceptable taungya practices, review of land tenure laws and sensitization of farmers on sustainable taungya practices are advocated.

Key words: *Appraisal; Taungya; Sustainable land-use; Vandeikya.*

INTRODUCTION

Colonialism -induced , profit -oriented exploitation of tropical forests has led to increased concentration of green house gasses in the atmosphere, erosion, flooding, depletion of underground water and loss of gene pool (IITO/IUCN, 1990). The sustainable utilization of forests as provided by the current plantation forestry service has almost failed to address some socio-economic and ecological considerations (Taylor, 1999). The participation and sensitization of local communities in sustainable forest management and establishment of multi-species forest plantations instead of single species stands for artificially regenerated forests have been advocated (Lamb, 1997).

Sustainable management in forestry means the harnessing and programmed tapping of natural, physical, social, human and financial capital resources available in the forestry enterprises through various structures and processes (laws , rules , regulations , programmes, policies, etc) to increase the wealth and productive capacity of a defined group of people now and in future (Reid, 1995). Sustainable management practices include: tree planting, multiple cropping, zero tillage, alley cropping (Fakoya, 2000), provision of non-timber forest products (Agbeja, 2001), community participation in conserving forest biodiversity and adoption of various agroforestry systems (Onumadu and

Mbakwe, 2001).

Agroforestry is a land- use system in which shrubs or trees are planted in association with crops (pastures and agricultural crops) in a spatial arrangement or rotation and in which there are both ecological and economic interactions between trees and other components of the system (Birma, 1999). Agroforestry is an emerging concept embracing an age-long principle which is directed at resolving conflict resulting from diverse and alternative land uses.

Taungya farming is the fore-runner to agroforestry. It is of Burmese origin and means, "hill" (*Taung*), "cultivation" (*ya*) (Nair, 1993) *Taungya* farming involves the growing of annual or biennial agricultural crops along with the forest species during the early years of establishment of the forest plantation (Jordan *et. al*., 1992). The long-term effect of *taungya* practice on soil fertility will however depend on the management practices adopted at the initial time as well as subsequent re-establishment phases (Jordan *et..al.,*1992). Complimentary, supplementary and competitive interactions exist between tress and crops in agroforestry (Filius, 1982). Higher crop yields have been obtained when some agricultural crops are inter-planted near leguminous trees such as *Faidherbia albida* (Acacia) (FAO , 1994) . Allelopathic interactions between trees and agricultural crops have also been investigated and reported in *taungya* plantations (Susesh and Vinaya 1987). Increased leaching losses have been observed in fertilized plantations (Chang and Chow, 1985).

Vandeikya Local Government (VLG) conceived *taungya* farming as a hybrid farming system (agroforestry) with high potentials for sustaining the productivity of both agricultural crops and forest trees. The broad objective of this study is to assess the practice of *taungya* farming as a sustainable land-use option in Vandeikya Local Government (VIG). The specific objectives are to:

(i) Determine the appropriateness of *taungya* farming practices in relation to sustainable forest management;
(ii) Compare the yields of crops grown on *taungya* farming plots with yields of the same crops grown outside non-*taungya* plots within VLG forest estates;
(iii) Investigate the preparedness of farmers to embrace *taungya* farming and other sustainable farming practices on their personal farmlands.

METHODOLOGY

The Study Area

Vandeikya Local Government (VLG) was created in 1976 from the defunct Gboko Division. It lies between longitude 8 45'-9^0 00' East and latitude 6 30' 7^0 00' North. The Local Government is composed of twelve wards (Figure 1). Its total land area is 183, 939 square kilometers, while its population in 2009 based on projections from the 2006 National Population Census was 256,308.

VLG has a tropical humid climate divided into the wet and dry seasons. The wet season is from April to October while the dry season is between November and March. The annual rainfall is between 1500 - 1750 mm. Temperatures are generally very high (30-35^{0}C) especially between March and April. The vegetation is predominantly Guinea Savanna consisting of fire-resistant trees interspersed with giant grasses. VLG is low-

lying and gently undulating, drained mainly by Rivers Be, Aya, Sambe and Uaghshu.

The people are predominantly farmers involved in the production of arable crops such as yam, cassava, maize, melon, pepper and cocoyam. The various forest estates in the local government were established between 1945 and 1970. The major species of trees planted were *Tectona grandis* (Teak) and *Gmelina arborea.*

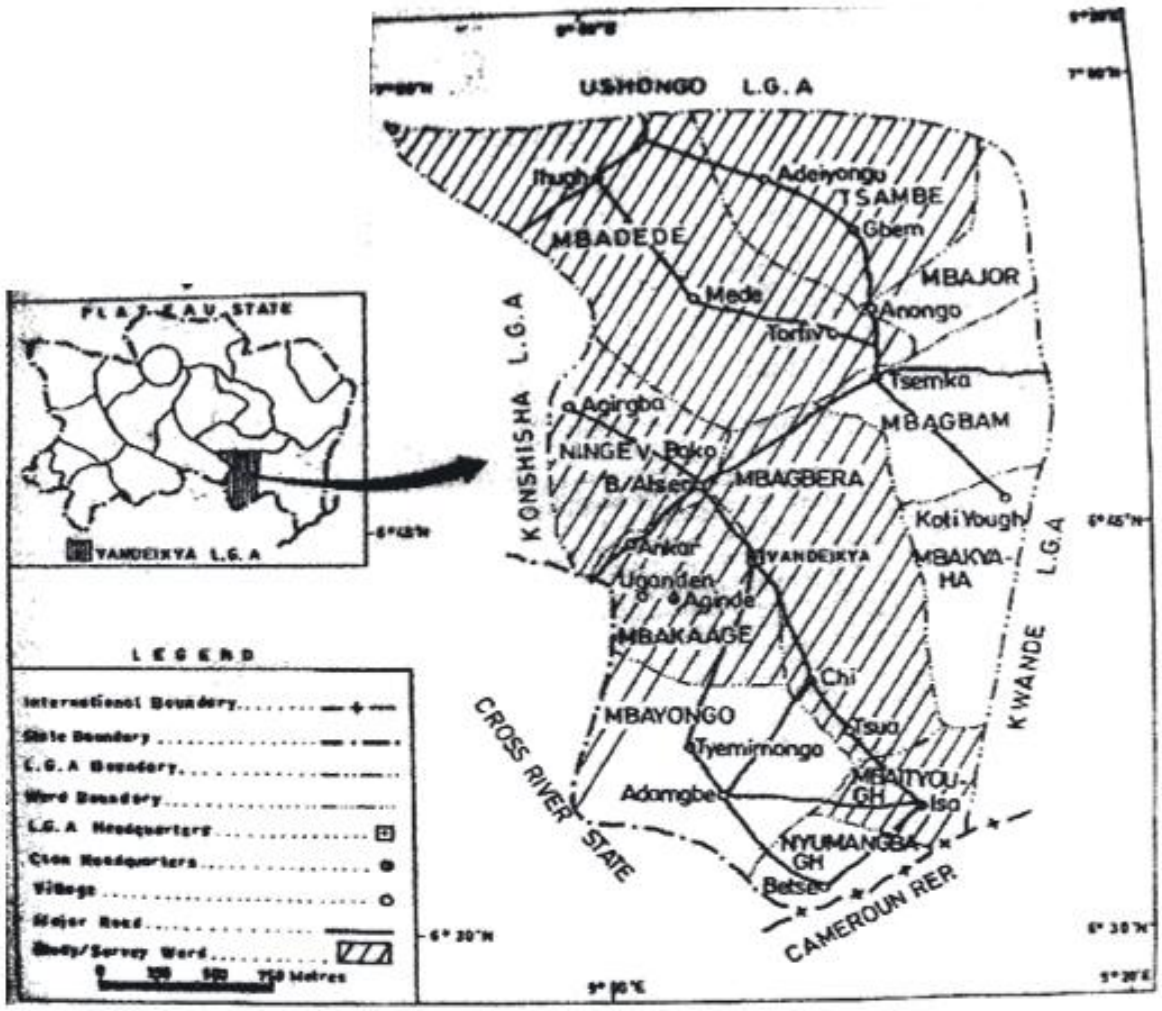

FIGURE 1: MAP OF VANDEIKYA LOCAL GOVERNMENT AREA SHOWING SURVEY WARDS

Sampling procedure

The data utilized in this study were obtained between March and June, 2004. All the 12 wards in VLG were listed in alphabetical order. Six wards were randomly selected for the study. A sample of 200 *taungya* farmer respondents was drawn through random sampling from a population of 562 *taungya* farmers in the selected wards, giving 35.6% sampling intensity. Also, all the 16 members of staff of the VLG forestry service were interviewed, giving 100% sampling intensity. Through personal interviews all the 216 respondents were contacted and 100% retrieval of the questionnaires was achieved. The same type of semi -structured questionnaire was administered on both categories of respondents. This was aimed at corroborating and checking their responses. The questionnaire was designed to solicit

information on the knowledge of the respondents in respect of *taungya* farming. The questionnaire also sought for information on the productivity of 11 agricultural crops under *taungya* and non *taungy*a plots (all within the forest estates), as well as the effect of time on forest area, forest offences and annual fires from 1955-2000. Information collected was subjected to inferential statistical analysis [such as analysis of variance (ANOVA)] and descriptive statistical analysis (like percentages). The socio economic backgrounds of the respondents were also captured in the questionnaires.

Analytical techniques

The data was subjected to descriptive and inferential statistical analyses such as means, percentages and inferential statistics such as student's t-test, and analysis of variance (ANOVA). Post-mortem analysis, using the least significant difference (LSD) was adopted to confirm observed variations.

The Research Model

The randomized complete block design (RCBD) was used to assess possible variations in the forest area, the number of forest offences, and annual fires, from 1955-2000. The general statistical model for the tool used is as follows:

$$Y_j = \mu + b_i + t_i + e_{ij}$$

Where:

Yij = observations on treatments in blocks (Selected wards)

U= Overall mean (population mean common to all treatments).

b = Block effect $_i$

t = Treatment effect (variation in Time (years) $_i$

E_j = Error effect due to treatment in blocks. $_i$

RESULTS AND DISCUSSIONS:

Socio-economic Attributes of Respondents

About a quarter of farmer respondents (27%) were females, while 68% were aged between 31-50 years. Also 86% were married and had family sizes of 7-12. Only 38% of the farmers were literate. Over half of the farmers (55%) earned between N21, 000 and N40, 000 per annum mainly from farming and petty trading (Table 1).

All the members of staff of the VLG forestry service (100%) were aged 31-50 years and 87.50% were married. The educational attainment of the forestry staff was low with 68.75% having primary or secondary education without any professional training. Only 31.5% of the forestry service staff had technical training above ordinary level diploma. About two-thirds (62.50%) of the forestry staff earned salaries between N111, 000 N150, 000 per annum. From the above trend, only few persons fall within the age range of 20 years and below. This agrees with the international labour Organization Legislation (ILO, 1994) excluding children below 18 years from being employed, and this has the potential of constraining labour availability for *taungya* practice. The low participation of women may stem from the incapability of women to pay for the initial high labour costs for land clearing since women make up to 70% of the world's poor (ILO, 1994). The manual nature of *taungya* farming requires large households that can share labour for agricultural production to enhance their expanded farm operations. Households capable of supplying farm labour are most likely to participate more meaningfully in *taungya* farming since there will be division of labour.

Table 1 : Socio -economic attributes of Respondents from the Forestry Service in VLG.

S/No	Parameters	Frequency	Percentages
1	***Level of Education***		
	No formal education	0	0.00
	Primary	6	37.50
	Secondary	5	31.50
	NCE/OND	4	25.00
	HND/Degree	1	6.25
	Others	0	0.00
	Total	**16**	**100.00**
2	***Secondary Occupation***		
	None	0	0.00
	Farming	13	81.25
	Trading	3	18.75
	Total	**16**	**100.00**
3	***Family Size***		
	1-3	2	12.50
	4-5	6	37.50
	7-9	5	31.25
	10-12	2	12.50
	>12	1	6.25
	Total	**16**	**100.00**
4	***Income (₦000)***		
	71-90	0	0.00
	91-110	1	6.25
	111-130	5	31.25
	131-150	5	31.25
	151-170	3	18.75
	171-190	1	6.25
	>190	1	6.25

The low level educational status of the respondents is likely to impair the adoption of *taungya* innovations. This is because an unskilled population has the potential of impairing labour mobility. This is in agreement with ILO report (1994), which states that 'job mobility is more difficult for unskilled, illiterate people'. The low income of the respondents is likely to accentuate deforestation since the poor rural dwellers may resort to exploitation of forest products for survival. The removal of subsidies on

inputs such as fertilizer may further compound the poverty situation. Retired public officers and civil servants engaged in *taungya* have higher incomes and can purchase inputs like fertilizer to expand their farm holdings into commercial ventures (Ngeve, 1998). The low professional educational level of forestry staff in the study area is undesirable for the adoption of *taungya* farming practice as they are ill-equipped for the sophisticated present-day forestry extension work.

Silvicultural Practices in the Forest Estates

Most of the farmers (84.50%) used hoes and cutlasses for land clearing, while 9% set fire on vegetation in a bid to clear their land for *taungya*. Similarly, most of the sampled farmers (88.50%) observed zero fallows on *taungya* plots allocated to them. Few of the farmers interviewed (16%) responded that mainly exotic tree species like *Gmelina arborea* (Roxb), *Tectona grandis* (Linn. F.) and *Acacia* species, existed on their land before they cleared them for *taungya* operations. Soil fertility was regenerated by 84.50% of the farmer respondents through the use of inorganic fertilizers. Not all cleared forest land was reforested as a result of dearth of seedlings and seeds, as well as poor funding.

The minimal use of heavy machinery, like bulldozers and graders is likely to reduce soil disturbance and compaction. Annual fires may be uncontrollable and reduce the economic value of forest and agricultural crops on *taungya* farms, therefore their use is discouraged. Short fallows have very positive contribution to soil organic matter accumulation, nutrient cycling, soil fertility, soil fauna, weed and pest control, feed supply and fuel wood availability. Chemical fertilizers make less positive contribution to the soil compared to short fallows (Ogungbile, 1998).

Ecologists place high premium on multi-species forest plantations instead of the monoculture stand observed in the study areas for the artificially regenerated forests (Lamb 1997). The rate of reforestation was generally low between 1955 and 2000. The modal tree-planting class for the three exotic species of trees earlier mentioned *(Gmelina arborea* (Roxb), *Techtona grandis* (Linn. F.) and *Acacia* species was 41-60 (for the period). The tree-planting classes represent the number of trees planted per farmer for the period each farmer operated in the forest estates of VLG. Little attention was paid to reforestation using indigenous species like *Triplochition scleroxylon ,Prosopis africana*, and *Khaya senegalensis.* This was in agreement with Akinsorotan (2001) who reported that farmers in Sokoto State Afforestation Programme preferred to use more economically versatile tree crops for afforesttion programmes to non-fruit trees. Reforestation using single species is at variance with the principle of ecological diversity (Homberg and Sandbrook, 1994: Lamb, 1997). Crop rotations and deliberate incorporation of nitrogen-fixing leguminous trees on *taungya* plantations were rare in the study area and these lapses could contribute to decreased soil fertility.

Comparison of Arable Crop Productivity under Taungya and non- Taungya Plots

The yields of yam, cassava, rice, sweet potatoes, maize, groundnuts, soybeans, guinea corn, pepper and melon were obtained from all the six sampled wards in respect of

both *taungya* and non-*taungya* plots. Yam, rice, sweet potatoes, maize, groundnuts, soybeans, guinea corn, beans, and pepper**,** had means that were significantly higher on *taungya* plots than for non- *taungya* plats. The yield of melon was however, not significantly different on both *taungya* and non-*taungya* plots. Crop yields on *taungya* plots ranged from 306 .67 kg /ha (for melon) to 1698 .33 kg /ha (for cassava) . The corresponding yields on non-*taungya* plots ranged from 250.00kg/ha (for melon) to 1372.67kg/ha (for cassava). From Table 2, all t-tab values were lower than t-cal values, except for melon. This leads to the conclusion that there were significantly higher yields on *taungya* plots than on non-*taungya* plots ($p<0.05$). The higher yield could have emanated from the inorganic matter from decomposed tree trunks, and litter fall. The differential in yields is likely to encourage *taungya* farmers to adopt *taungya* so as to realize the benefit of increased productivity to offset the high cost of food production, as well as enjoy higher standards of living resulting from increased farm income. Over-dependence on costly inputs like inorganic fertilizers could discourage adoption of *taungya* farming considering the low income of the farmers (Akinsorotan, 2000).

Table 2: T-test of independence on crops yields per/ha for Taungya and Non- taungya Plots

Parameter	Mean yield per/ha (kg)	t-cal	t-tab	Df	P
Yam (Driel chips)					
Taungya	1223.333	2.4509	0.260	10	0.0342*
Non-taungya	1075.000				
Cassava (dried chips)					
Taungya	1698.333	9.8245	0.260	10	0.0000*
Non-taungya	1372.667				
Rice (unmilled)					
Taungya	1155.000	7.04661	0.260	10	0.0000*
Non-taungy	833.333				
Sweet potatoes (dried					
Chips) taungya	1471.667	7.687.839	0.260	10	0.0000*
Non-taungya	923.33				
Maize					
Taungya	1133.333	13.40187	0.260	10	0.0000*
Non-taungya	710.000				
Groundnuts(unshelled)					
Taungya	1083.333	6.134593	0260	10	0.0001*
Non-taungya	756.667				

Soyabeans					
Taungya	620.000	5.180438	0.260	10	0.0004*
Non-taungya	408.333				
Guinea corn					
Taungya	725.000	5.728162	0.260	10	0.0001*
Non-taungya	516.662				
Beans					
Taungya	458.333	2.423773	0.260	10	0.0358*
Non-taungya	408.333				
Pepper		1.801398	0.260	10	0.1018*
Taungya	366.667				
Non-taungya	320.000				
Melon					
Taungya	306.667	2.067643	0.260	10	0.0655
Non taungya	250.000				

*** Significant, p < 0.05**

Trends in forest area, annual forest fires and forest offences in VLG; 1955 and 2000

The total forest area for the six sampled wards declined significantly from 312.9 ha in 1955 to 83.5 ha in 2000 in defiance of reforestation efforts. The area of forests planted at the inception of afforestation in the base year and subsequent years gave rise to most observed differences in forest areas between the wards.

The following factors were identified as contributing to decline in the forest area: uncontrolled annual fires, hostilities and encroachment on forest land by the host communities, control/ownership tussle between VLG and the supervising State Ministry of Animal and Forest Resources, continued clearance of forest land for farming purposes, preference for use of exotic species in reforestation,, poor quality extension services, poor funding, official corruption, dearth of VLG legislation on forestry, top-bottom approach in formulation of forestry policy (excluding community participation) and use of executive fiat in enhancing dereservation of existing forests without recourse to due process.

There were significant differences in the forest area between the wards and for the years considered. Forest offences did not vary significantly between the wards. The number of forest fires ranged from 13 to 24 per annum within the same period. There were significant differences in the number of forest fires between wards and years ($p < 0.05$). The means of forest areas regenerated through *taungya* practice and non -*taungya* reforestation effort between 1955- 2000 (6.30 and 7.4 Ha respectively), were not significantly different ($p > 0.05$).

The decline in forest area in the face of reforestation did not portray sustainable

management. Since the number of forest offences were un-abating as graphically represented in Figure 2, these were likely to have resulted in the decline in forest areas observed between 1955 and 2000. Forest fires can cause extensive damage to fauna and flora, reducing the economic value of animals and plants. It is likely that the persistence of annual fires contributed to the decline in forest area. The combined influences of forest offences, annual fires and other factors already listed probably had an unprecedented negative influence on forest area as witnessed in the study area.

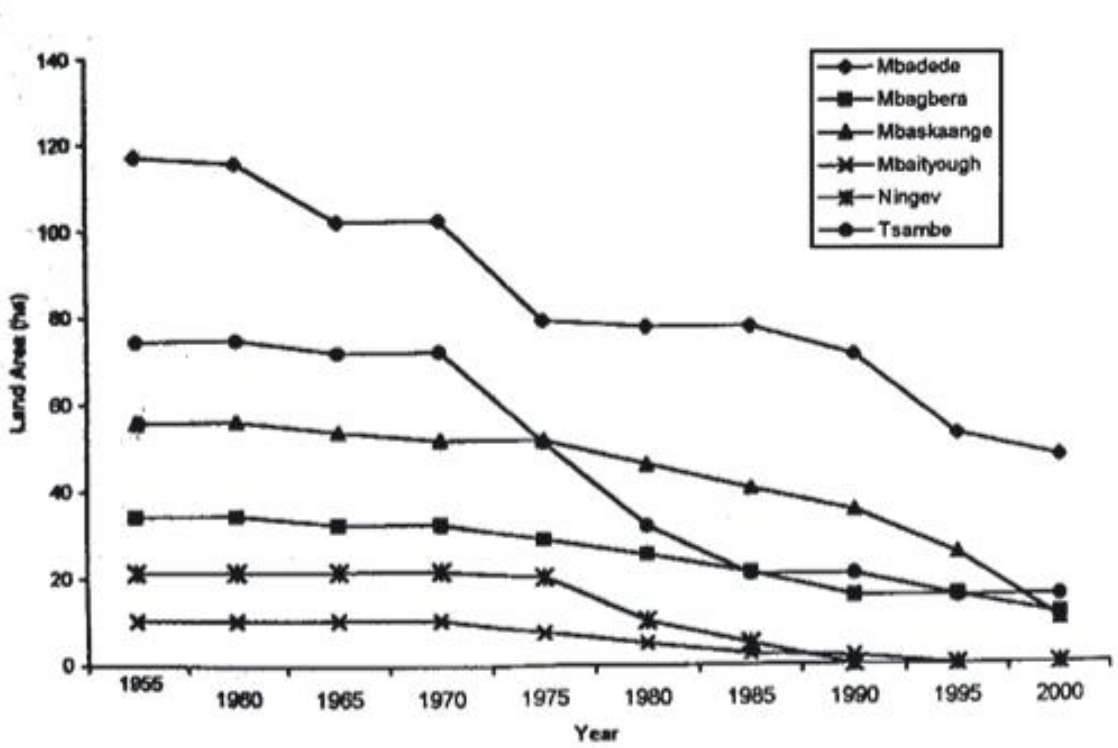

Figure 2: Graphs Showing Trends in Land Area (Ha) under Forest Cover in Selected Wards of VLG from 1955-2000

Taungya adoption in VLG

Only 6% of the farmers from the six sampled wards practiced *taungya* on both government forest estates as well as on their own lands. About two thirds of the farmers (62.5%) responded that they lacked personal land on which to practice *taungya,* but it was observed that they were willing to practice *taungya.* A total of 31.5% of the farmers were not favourably disposed to practicing *taungya* on their personal lands, while 68.5% were positively disposed to the adoption of *taungya* farming. Majority of the farmers were constrained by want of land. The scarcity of land could have emanated from the land ownership practice in the study area which placed premium on communal ownership of land. The land belongs to the whole family or communities and individual family members can hardly claim singular title to such land. The planting of trees confers title to the person planting trees. Ogungbile (1998) identified land fragmentation, increasing use and cost of agro-chemicals and fertilizers, socio-economic, climate and soil characteristics as factors that adversely influence adoption of improved on-farm practices. Vergara (1987) noted that factors affecting adoption include: land tenure and tree tenure, labour

requirement, management complexities and differential social prospects for adoption. Findings in the study area are to a large extent, in agreement with the references cited in literature (Vergara,1987; Ogungbile, 1998 and Akinsorotan,2000 and 2001).

Conclusion

The management techniques adopted for the forest estates of VLG fell short of sustainable management criteria . Agricultural productivity was significantly higher on taungya plots ($p<0.05$), However, forest land continued to decrease from 312ha in 1955 to 83.5ha in 2000. Taungya practice, in principle, is supposed to use cheap labour from participating taungya farmers to maintain young forest trees and to plant all cleared forest land. The declining forest area in the face of increasing farmland for *taungya* practice has reduced the expected symbiotic relationship between forestry and agriculture to a parasitic non-sustainable one.

Too much emphasis on planting of exotic tree species like *Gmelina arborea* without the incorporation of indigenous species such as *Triplochiton scleroxylon, Prosopis africana,* and *Khaya senegalenasis* is against the principle of ecological sustainability and species diversity advocated by agroforestry practice of which *taungya* is an integral part. Even though the chemical fertilizers used on *taungya* plots possibly increased both tree and agricultural productivity, their principal use without an integrated approach to soil fertility management neither reduces the operational costs of *taungya,* nor encourages sustained nutrient cycling. Land availability and land tenure were identified as the major obstacles the adoption of *taungya* farming in VLG, the willingness of farmers to adopt *taungya* on their own farmlands notwithstanding.

RECOMMENDATION

The establishment of seed and clonal banks could ensure availability of seeds and seedlings for all reforestation programmes. There is need for the local populace to be involved in policy formulation (bottom-up approach) and execution in respect of *taungya* practice, and private sector participation is necessary to augment government funding. Extension staff in the public service should have requisite training and knowledge to adequately and appropriately educate farmers on *taungya* practice. Legal and institutional reforms that can facilitate review of obsolete legislation can help overcome the constraints imposed by land ownership. There is also need to sensitize the public on the merits of sustainable land-use as well as the demerits of non- sustainable land use practices.

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