Comparative Study of Taungya System and Alley Cropping in Ibadan Agricultural Zone of Oyo State, Nigeria

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Abstract: The study compares the yield of food crops of both Taunya and Alley farmers in Ibadan Agricultural Zone of Oyo State, Nigeria. A set of questionnaires was administered to 50 respondents each of both systems in the agricultural zone respectively. The data collected were analyzed using descriptive, inferential statistics, cost and return analysis to determine the level of their productivity. The result of descriptive statistics shows that there were fewer female than male farmers in the study area (98%). About 40 and 48% of the respondents were within the age range of 40-49 years. It was also discovered that 58 and 78% of them went to tertiary institution, 56 and 88%, respectively have farm sizes below 5hectare through inheritance. About 3% of the respondents have less than 5 years period of processing the land while the major constraints faced by the respondents was insufficient credit facilities with about 46% for the taungya system and 36% for the (alley cropping). The result of regression analysis shows that for production, pesticides and fertilizer cost were statistically significant at 0.05% level for both systems. The cost and return analysis shows that profit margin for both systems were N 128, 673 = and N 803, 845 = for Taungya system and Alley farming, respectively.

Key words: Comparative study, taungya system, alley cropping, production, pesticides fertilizer

INTRODUCTION

When tree plantations are established, crops may be intercropped with the young seedlings for at least one cropping season and often for several seasons (until competition for light makes it no longer productive). Trees are then left as pure stand with no additional uses of the land until after harvest. This agro-forestry practice is called the taungya system. The use of agro-forestry techniques to boost crop production has been the explicit aim of several projects. Up till now, however, none have been able to provide hand proof that can be achieved under field condition.

Taungya system is widely used by National Forest Department in the tropics as an efficient method for plantation establishment. A typical practice is to allow local farmers to plant for crops in newly planted government plantations. In taungya, tree spacing is defined by the species, environment and the purpose of the tree planting and to the taungya concept only in determining how long inter-cropping might continue.

Alley cropping is an agro-forestry practice with fast growing trees and shrubs are established in hedgerows on arable cropland and annual food crop cultivated in the alleys between the hedgerows. The hedges are pruned prior to and periodically surveying-cropping cycles to prevent shading of the companion food crops, with the pruning applied to the soil as green manure and/or mulch. Although, mystery of the hedgerow species is nitrogen fixing, leguminous species, several non nitrogen-fixing species have also shown promise. It is hoped that their productivity restoring attributes such as nutrient cycling, weeds suppression, erosion control would create soil conditions similar to those in the fallow phases can take place concurrently on the same land, allowing farmers to crop the land for an extended period column as socio-economic condition do not allow adequate long fallow period for sustaining soil productivity (Agro-Forestry System, 1997).

Akinsanmi (1998) remarked that site preparation, the farmers plant crops according to specifications laid down by the forest department, soon after the forest department interplant forest tree seedlings with the farm crops using paid labour in the following year the farmers harvested most of their crops. The farmers sometimes continue raising crops for two or three years after, which they are allocated another plot in a new area, farmers who did not tender the crops are not given new allocation.

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The total area of traditional taungya farms in Nigerian in 1979 was 9, 226ha; this is a decrease of about 3.6% since 1975. States like Oyo, Ondo, Cross-River, Imo, Rivers and Ogun state have practice taungya system mostly. Most states did not increase their acreage because of lack of funds and a reduced number of farmers participating in the practice. One of the major factors affecting employment in taungya farming is the introduction of universal primary education. There may be fewer young family members available, resulting in an increase in casual employment during land preparation (Akinsanmi, 1998).

In Nigerian, the agricultural crops cultivated in traditional taungya farms are many and varied; they are chosen because of their dietly habit or the farmers' families or the available markets rather than because of their interaction with the tree crops (Agro-Forestry System, 1997). In alley cropping-more correctly known as hedgerow, inter-cropping-hedge are planted in rows across farmers' field, 4-8m apart and the crops grown between these hedgerows. It was the International Institute of Tropical Agriculture (IITA) Nigeria, which started alley cropping trials in 1976, finding favorable effects on the soil fertility under experimental conditions, Young (2000), stated that alley cropping which is a system in which field crops are planted in the alley between hedgerows of nutrient cycling trees or shrubs which are kept pruned throughout the cropping season has been described as an improved fallow system. Adekunle (1998) stated some advantages of alley cropping such as:

- Combination of cropping and fallow phases.
- Longer period and increased land use intensity.
- Reduced requirement for external imports.
- Rapid effective soil fertility regeneration with more efficient plant species.

The beneficial effect of trees on crop is not yet understood by majority of the farmers despite the full participation and immense work done by extension agents in Nigeria. Extension agents' work is more or less futile, there is generally very low adoption of agro-forestry practices and the few in practice could not compensate for fast growing demand for food. There tend to be some basic facts that rural populations are dependent upon the forest resource for ensuring household's food and economic security (Adekunle, 1998). Since Taungya system and Alley cropping seem to have qualitative and quantitative characteristics effects on both utilization of limited and fixed available for simultaneously growing of trees and crops among many benefits and essentially give room for activities such as industrialization, building of houses etc. it is for these reasons that this research is being proposed to addressed the following questions:

- What is the cost implication of Taungya system and Alley cropping?
- What are the inputs in Taungya system and Alley cropping?
- Which one of the two farming systems is most profitable in terms of yield?

Objectives of the study: The broad objective of the study is to compare the performance and productivity of the cultivated crops under Taungya system and Alley cropping in Ibadan agricultural zone of Oyo state, Nigeria. The specific objectives are to:

- Examine the socio-economic characteristics of the respondents.
- Determine the cost and returns involved in the establishment of Taungya system and alley cropping.
- Determine if there is a significant relationship between farmers' socio-economic characteristics and yield.

MATERIALS AND METHODS

The study was conducted in Ibadan Agricultural Zone of Oyo State, Nigeria. Two forest reserves were used, which are Gambari reserve located in Oluyole Local Government and Ijaye reserve located in Akinyele Local Government Area. In the two areas, farming is the major occupation of which subsistence farming is more in practice than commercial farming, though some engaged in other businesses like trading, tailoring etc.

Fifty Taungya farmers' and fifty practicing Alley cropping farmers were selected. Each farmer was chosen from the entire population by using random selection procedure from the list of farmers practicing both Taungya system and Alley cropping of agro-forestry. The zone was divided into ten sections each; five farmers were selected from each section based on their period of farm practice and experience. Only farmers that have been practicing for at least ten years were chosen and interviewed.

Primary data was used in the study, through a well-structured questionnaire from the farmers practicing both taungya and alley cropping systems. The dependent variable of the study is the yield of crops in both taungya and alley cropping of agro-forestry systems. While the independent variables are fertilizer, farm size, seed, seedling labour, farm implement and machine. In measuring the yield of crops (food crops) the produce harvested was measured in kilogram which was further quantified in monetary term, the yield of both systems was then compared. The respondents given direct

information regarding their socioeconomic characteristics such as family size, farm size, educational level, gender, labour used, etc. These were analysed descriptively to determined their effects on yield.

RESULTS AND DISCUSSION

Socioeconomic characteristics of the respondents: From Table 1, the mean age distribution of the respondents coincides with highest relative age distribution of 44 years of age for taungya and alley farmers. This implies that the farmers still fall into mid-age, hence productivity is expected to be high. Few farmers fall within 20-29 age group with 4% for Taungya, 28% of respondents fall between age group 30-39 age group, while 40 and 48% has age distribution of 50-59 years and only 18 and 24% has the age of 60 years respectively. With the above age distribution most of the respondents fall within the active age group this will contribute to the level of adoption of the type of system practiced by the farmer.

About 40% of the Taungya farmers and 36% of alley farmers have family size between 0-5, while 52 and 60% of both systems have family size between 6 and 10, 8 and 4% have above 10 family size. The family size of the respondents may be dependent of the type of family system they are practicing that is either nuclear or extended family.

The table revealed that all the alley respondents have one form of education or the other, while 20% of the taungya farmers were not educated. Both taungya and alley systems have 2% with primary education and while 12% of taungya and 20% of alley cropping system are secondary school leavers, good enough majority of the respondents for the agro-forestry systems had tertiary education i.e., 58 and 78%, respectively. This will greatly enhance their level of adoption of new innovations and technology hence higher productivity could be ensured. Majority of the respondents for the taungya and alley cropping systems had below 5 hectares of land i.e., 56 and 88%, respectively. This hinders the level of expansion of their farms hence reduces productivity. This could probably be as a result of land tenure system that is operational in most African countries, making land to be fragmented and consequently small farm area being cultivated.

In term of mode of land acquisition 36 and 34%, respectively inherited their lands. Sixteen and twenty percent also own the land through subletting; land tenure and communal ownership of land also affect the mode of land acquisition.

Most of the farmers as revealed in Table 1 shows that 62 and 76% for taungya and alley respectively, while 38 and 24% do not use fertilizer, at all. These could be

Table 1: Age distribution of the farmers

Age	Mid-points	Taungya	(%)	Alley	(%)
Socio economic characteristics of farmers					
20-29	24.5	2	4	-	-
30-39	34.5	14	28	14	28
40-49	44.5	20	40	24	48
50-59	54.5	9	18	12	24
60-69	64.5	5	10	-	-
Total	222.5	50	100	50	100
Education of the farmers					
Educational level	Taungya	(%)		Alley	(%)
No Certificate	1	2		1	2
Primary	10	20		-	-
Secondary	6	12		10	20
Tertiary	24	58		39	78
Others	4	8		-	-
Total	50	100		50	100
Mode of land acquisition					
Mode	Taungya	(%)		Alley	(%)
Lease	14	28		15	30
Sublet	10	20		8	16
Inherited	18	36		17	34
Personal	8	16		10	20
Total	50	100		50	100
Fertilizer usage by the farmers					
Level	Taungya	(%)		Alley	(%)
Yes	31	62		38	76
No	19	38		12	34
Total	50	100		50	100
Chemical usage by the farmers					
Level	Taungya	(%)		Alley	(%)
Yes	27	54		15	30
No	23	46		35	70
Total	50	100		50	100

Source: Field survey, 2004

Table 2: Production constraints of farmers

Problem	Taungya	(%)	Alley	(%)
Land tenure	2	4	4	8
Insufficient land	23	46	18	36
Insufficient labour	13	26	9	18
Tree/crop combination	10	20	9	18
Low yield and crop response failure	1	2	2	4
Pest infestation	1	2	8	16
Total	50	100	50	100

Source: Field survey, 2004

attributed to the non-availability and high cost of fertilizer sometimes experienced by farmers in the procurement.

Majority of the respondents for both agro-forestry systems do not apply chemical to the farms, while 54 and 30% applied chemical. Non usage of chemical could be due to funds as most of the farmers source. Their fund through personal savings and cooperative societies.

Production constraints: From Table 2, 46% of the taungya and 36% for the alley cropping respondents mentioned insufficient fund as a major constraint caused by lack of credit and cumbersome procedures in loan processing. Labour also contributed substantially to the problems faced by the farmers as indicated in Table 2. About 20 and 18% of taungya and alley respondents lack knowledge of tree/crop combination experience, pest infestation have little effect on the crop yield of the respondents of both agro-forestry system.

Table 3a: Cost and returns distribution/analysis (Taungya system)

Items	Amount (N) ha^{-1}	Total (N) ha^{-1}	Relative %
Land cost	415,000		38.9
Fixed cost		415,000	
Variable cost			
Labour cost	231,076		21.7
Implements	133,921		12.6
Pesticide cost	35,616		3.3
Planting cost	131,491		12.4
Fertilizer cost	118,000	650,104	11.1
Total variable cost		1,065,104	61.1
Total cost items	1,193,777		
Revenue sale		1,193,777	
Total revenue	543,673		
Gross margin	128,673		12.1
Profit = GM-TFC			

Source: Field survey, 2004

Table 3b: Cost and returns distribution/analysis (Alley cropping)

Items	Amount (N) ha^{-1}	Total (N) ha^{-1}	Relative %
Land cost	244,000		
Total fixed cost		244,000	22.9
Variable cost			
Labour cost	317,600		29.8
Implements	220,880		20.7
Pesticide cost	47,400		4.5
Planting cost	117,700		10.5
Fertilizer cost	124,000		11.6
Total variable cost		821,580	77.1
		1,065,580	
Total cost items	1,869,425		
Revenue sale		1,869,425	
Total revenue	1,047,845		
Gross margin	803,845		75.4
Profit = GM-TFC			

Source: Field survey, 2004

Taungya cost and returns analysis: From Table 3a, it could be seen that with relative percentage of 38.9% total fixed cost i.e., land cost is about N415, 000. Total variable cost is 650,104. Total cost that is Total fixed cost + Total variable cost is ₦1, 065,104. The total revenue is ₦1,193,777. Gross margin is ₦543,673. From the above profit, Gross margin – Total fixed cost i.e., = GM – TFC = ₦543,673 – ₦415, 000 = ₦128, 673.

Table 3b (alley cropping) shows that the fixed cost (i.e., land cost) is ₦244, 000, with relative percentage of 22.9%. Total variable cost is ₦821, 580 with 77.1% relative percentage. The total cost is therefore ₦1,065,580, total revenue is ₦1,869,425 and the gross margin is ₦1,047,845 profit is = GM-TFC is ₦803,845 from the cost and returns analysis both agro-forestry systems are profitable.

Regression analysis: Regression analysis expresses the relationship between explanatory variables and the dependent variables. The postulated relationship between output as the dependent variable and explanatory variable considered implicitly as follows:

$$Y = (X_j, u)$$

Where j = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.

Y = Yield
u = Unexplainable variable
X_1 = Sex
X_2 = Religion
X_3 = Age
X_4 = Family size
X_5 = Education
X_6 = Farm size
X_7 = Labour
X_8 = Machine and implement cost
X_9 = Pesticide cost
X_{10} = Planting cost
X_{11} = Fertilizer cost
X_{12} = Land cost

Regression analysis results: Estimate production function for linear function (taungya system)

$$Y = \frac{-10.683 \quad -19.962X_1 \quad -1.512X_2}{(-0.354) \quad (1.402) \quad (-0.233)}$$

$$+2.358X_3 \quad +2.944X_4 \quad +0.887X_5$$
$$(-0.956) \quad (2.257) \quad (0.303)$$

$$+0.497X_6 \quad +34460X_7 \quad +37820X_8$$
$$(0.766) \quad (1.236) \quad (0.823)$$
$$2590X_9 \quad +2200 \quad +47970 \quad +4.8641$$
$$(1.345) \quad (1.930) \quad (1.262) \quad (1.203)$$

All the variables expressed in the linear function is presented in (Table 4 and 5) for taungya and alley cropping.

The equation above report the production function estimated by ordinary least square. The adjusted R for the lead equation was about 18.1% implying that, in the fitted equation, the independent variables explained 18.1% of the variation in the output of taungya system of all considered variables sex and religion has a negative regression coefficient, implying that they contributed to the yield and productivity of taungya food crop inversely while other variables contributed to taungya food crops positively.

Estimated production function for linear function (alley cropping):

$$Y = \frac{-29.418 \quad +7.166X_1 \quad -9.843X_2}{(-6.82) \quad (0.658) \quad (1.186)}$$

$$-0.445X_3 \quad +1.581X_4 \quad +4.467X_5$$
$$(-0.542) \quad (0.757) \quad (0.534)$$
$$+0.454X_6 \quad -1.290X_7 \quad -244800X_8$$
$$(0.669X_6) \quad (-1.389) \quad (-0.100)$$
$$-608700X_9 \quad +49436X_{10} \quad +1681X_{11} \quad +355100X_{12}$$
$$(-0.36) \quad (2.306) \quad (2.056) \quad (2.734)$$

Table 4: Linear functional form for taungya regression analysis

Variable	Coefficient	T-value
Sex	-19.962	1.402
Religious	-1.512	-0.233
Age	2.358	-0.956
Family size	2.944	2.257
Education	0.887	0.303
Farm size	0.497	0.766
Labour	34460	1.236
Machine & implement	37820	0.823
Pesticide cost	2590	1.345
Planting cost	2200	1.930
Fertilizer cost	47970	1.262
Land cost	4.8641	1.203
Adjusted R^2	0.181	
F-Ratio	1.816	

Sources: Field survey, 2004.

Table 5: Linear functional form for alley cropping regression

Variable	Coefficient	T-value
Sex	-1.166	0.658
Religious	-9.843	1.186
Age	-0.445	-0.542
Family size	1.581	0.757
Education	4.467	0.534
Farm size	0.454	0.669
Labour	-1210	-1.389
Machine & implement	-244800	-0.100
Pesticide cost	-608700	-0.36
Planting cost	49436	2.306
Fertilizer cost	1681	2.056
Land cost	355100	2.734
Adjusted R^2	0.567	
F-Ratio	1.426	

Sources: Field survey 2004

The figure in parenthesis is the t-value

$$\text{Adjusted } R^2 = 0.567$$
$$\text{F- ratio} = 1.426$$

The adjusted R^2 for the lead equation is 56.7% implying that in the fitted equation, independents variables explained about 56.7% of the variable in the output of the alley cropping of all the considered variables, the age, religion, labour, machine and implements cost land pesticide cost have negative regression coefficient, which shows that they contributed to alley cropping output negatively.

CONCLUSION

The descriptive analysis of socio-economic characteristics of Taungya and Alley farmers revealed that male respondents were majorly involved in both systems, with farm size of 5 ha and below, which establishes the fact that subsistent farming was predominant in the area, which serve as a major setback for the practicing of these agricultural systems. The total fixed cost for Alley and Taungya systems are low as the farmers have little or no access to financial assistance.

Despite the above constraints, the cost and returns analysis shows that there is higher yield and productivity in Alley than in Taungya cropping.

RECOMMENDATION

Based on the results of the findings, the following recommendations are made:

- Governments should review bank policy on loan to favour the potential farmers who are willing to embark on these agro forestry systems and at the right time.
- Also Non-Governmental Organization should be involved in practicing and sponsoring of the farmers by providing credit facilities and other subsidy that are necessary to enhance high productivity.
- Land should be made available for the willing farmers without difficulties in its acquisition.

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