academicJournals

Vol. 6(8), pp. 64-71, September, 2014
DOI: 10.5897/JHF2014.0357
Article Number: FCCF1C047618
ISSN 2006-9782

http://www.academicjournals.org/JHF

Journal of Horticulture and Forestry

Full Length Research Paper

Contribution of agroforestry to food production and income generation in Sapoba forest area, Edo State, Nigeria

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Received 30 May, 2014; Accepted 17 September, 2014

This study examines the contribution of agroforestry to food production and income generation in Sapoba, Edo State, Nigeria. About 60 farmers were purposively selected from the area. Structured questionnaires were administered on the respondents to elicit answers on their socioeconomic characteristics and food production operations. Data were subjected to descriptive statistics, production function and gross margin analyses. Results show that average age of farmers was 49.2 years and about 83.3% are married while 82% were male. An average farmer has a fairly large household of 6.5, cultivating about 1.12 ha of land typifying a small scale holding. The results of the regression show that farm size, maize and cassava had positive coefficient and are significant at 5%. The study also reveals that an average farmer realizes up to N966, 204.17 from the sales of the major crops in the study area. It is hereby recommended that young unemployed graduates and school leavers should be encouraged by the government, through the provision of farm input and takeoff capital, to go into farming as it has been discovered that farming is profitable and a ready source of food supply.

Key words: Agroforestry, food production, income generation, Sapoba, Nigeria.

INTRODUCTION

The need to produce food to feed the ever-increasing population occupies a top priority in the agenda of many countries especially the developing ones. Attempts to produce food using the conventional and traditional slash and burn method of agriculture prevalent in the third world have always resulted in wanton destruction of forest cover and the alteration of the dynamics of the forest ecosystem leading to climate change. Balancing the production of food and creating as well as maintaining good ecological environment for sustainable production and management of other forest resources call for an adoption of a system that offers a good opportunity which exploits the synergies that combine the characteristic advantages associated with forestry and agricultural practices commonly called agroforestry.

Agroforestry has been defined as a land use system in which woody perennials are grown with food crops and/or livestock leading to many beneficial, ecological and

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economic interactions between trees and non trees components. The International Council for Research in Agroforestry (ICRAF) now World Agroforestry Centre defined agroforestry as a `dynamic ecologically based natural resources management system that through interactions of trees on farm and in the agricultural landscape diversifies and sustains production, enhancing social, economic and environmental benefits for land users at all levels''. According to Lundgren and Raintree (1982), agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. In agroforestry systems there are both ecological and economical interactions between the different components. This definition, they said, implies that: agroforestry normally involves two or more species of plants (or plants and animals), at least one of which is a woody perennial; an agroforestry system always has two or more outputs; the cycle of an agroforestry system is always more than one year; and even the simplest agroforestry system is more complex, ecologically (structurally and functionally) and economically, than a mono-cropping system. Agroforestry and silvopastoral land management both capitalize on the protective functions of trees and forests to increase food production over time (Calle et al., 2012).

Dawson et al. (2013) observed that more than 1.3 billion people worldwide practice the system which ranges from open packed assemblages to dense imitation of tropical rainforests such as home gardens to planted mixture of only few species to trees planted in hedges or on boundaries of field and farms with differing levels of human involvement of the various management. They observed that agroforestry supports food and nutrition through the direct provision of food, by raising farmers' income and providing fuel for cooking and through various ecosystem services. Agroforestry systems provide a variety of products and services that are important locally, nationally and internationally (Garrity, 2004). Garrity and Stapleton (2011) noted that agroforestry is one of mankind best hopes to create a climate-smart agriculture, increase food security, alleviate rural poverty and achieve a truly sustainable development. Kio (2001) stated that a wider application of agroforestry system will reduce the necessity to cut down additional forest and encourage a fuller use of natural forest ecosystems for the products and services which they only can provide. This, he said, is an addition to its potential to increase organic matters of the soil leading to a more efficient nutrient cycling and improvement of the soil physical conditions among others.

The practice of agroforestry in Sapoba forest area state started in form of `tuangya' system which is a Burmese word used to describe the practice of establishing tree plantations by planting and tending tree seedlings together with food crops. This was prompted by scarcity of land or what was generally regarded as land hunger in the area and to arrest the situation as well guarantee the planting of trees alongside food production, the taungya system was introduced by the early foresters operating in those areas.

The general objective of this study was therefore to evaluate the contribution of agroforestry farm system to food production and income generation in Sapoba forest area. The specific objectives were to(i) identify socio economic characteristics influencing food production in Sapoba forest area (ii) identify the costs and returns of food production in the area with a view to determining the level of profits or loss. (iii) Give appropriate policy recommendations for sustainable increase in food production in the study area.

METHODOLOGY

This study was carried out in Sapoba forest area in Orhionmwon Local Government Area of Edo state. Edo state is located between latitude 5° 5^{1} N to 7° 33^{l} N and longitudes 5° E to 6° 40^{l} E. It shares common boundary with Ondo state in the west, Delta State in the east and Kogi state in the north. The vegetation of the state is moist rain forest in the south and derived savanna in the north. Sakpoba forest reserve lies between latitudes 4° to 4° 30' and longitudes 6° to 6° 5' E. It is bounded on the south by Delta State, on the East by Urhonigbe forest reserve and on the West by free area, B.C. 30. It is located in Orhionmwon Local Government Area, about 30 km South-East of Benin City. Some of the major villages located within and around the reserve are Ugo, Ikobi, Oben, Iguelaba and Amaladi in Area B.C 32/4, and Ugboko-Niro, Iguere, Idunmwowina, Evbarhue, Idu, Evbueka, Iguomokhua, Ona, Abe, Igbakele, Adeyanba, Evbuosa in Area B.C 29.

Orhionmwon Local Government Area (LGA) has a population of about 182,717 according to 2006 census with a land area of 2.382km^2 (NPC, 2006). The people of the area are farmers and traders. Crops grown in the area include: yam, cassava, maize, plantain, and cocoyam planted with some tress like *Tectona grandis*(teak) *Gmelina arborea*, *Terminalia ivorenisis*, *Khaya ivorensis* etc. The primary data were obtained using well structured questionnaire. A total of 60 farmers were purposively selected and interviewed among the villages namely: Ageka, Evbuosa, Ona, Iguomokhua and FRIN Camp in the LGA where agroforestry system is being practiced. The tools of analysis used for this study are:

1. Simple descriptive statistics;
2. Production function analysis and
3. Gross margin analysis

Simple descriptive statistics were employed to have a summary description of the data collected. This involved the use of central tendency such as percentages, mean and frequency distribution. Production function analysis was used to determine the extent to which the inputs used explain the variability in the food crop output. For the regression the linear function, semi-log, exponential and the Cobb-Douglas were employed to estimate the production function. The best regression fit was determined by a combination of the criteria of the higher adjusted coefficient of multiple determine (R^2), the level of significance of the overall equation(F-statistics), the level of significance of each coefficient(t-statistics) and the correct sign of the coefficient relative to a priori expectation. The model in its general form is:

$$Y = f(x_1, x_2, x_3, x_4, x_5, ei)$$

Where Y= Gross Income (N), x_1 = land (area planted in ha (Farm size), x_2 = hired labour (N), x_3 = Family labour (man hour), x^4 =Expenses on seeds, chemical (N), x^5 = capital, ei = error term.

The explicit forms of the functions are as

$Y = a= b_1x_1 +b_2x_2 =b_3x_3+ b_4x_4+b_5x_5+ ei$ ----Linear

$Y= a +b_1\log x_1 +b_2\log x_2+ b_3\log x_3 +b_4\log x_4+ b_5\log x_5 +ei$ ---Semi-log

$\text{Log } Y = +b_1\log x_1 +b_2\log x_2+ b_3\log x_3 +b_4\log x_4+ b_5\log x_5 +ei$ ---Double log

$\text{Log } Y = a= b_1x_1 +b_2x_2 =b_3x_3+ b_4x_4+b_5x_5+ ei$ ----Exponential

The farm budgetary technique as used by Olukosi and Erhabor (1988) states that gross margin is the difference between the gross farm revenue (GR) and total variable cost(TVC) of production. It was used in this study to estimate the profitability level of food production in the study area. It is a useful planning tool in situations where fixed capital in negligible portion of the farming enterprise as in the case of small scale subsistence agriculture (Alabi et al., 2005).

Where GM =GR-TVC, GM = Gross margin, GR = Gross Revenue, TVC = Total Variable Cost.

RESULTS AND DISCUSSION

This section discusses the socio-economic characteristics of farmers which are known to influence resource productivity and returns on the farms. The summary of the demographic and socio-economic characteristics of farmers is presented in Table 1. The demographic and socio economic variables considered include age, gender of farmers, household size, farm size, years of farming , level of education and marital status.

About 83.3% of the farmers are married while 82% are male. About 63.3% of the sampled farmers were between the age bracket 20 to 50 years. This suggests that majority of the farmers were middle aged and this implies that the farmers were still in their economic active age which could result in a positive effect on production (Akinwole et al., 2012). This result agrees with the findings of Alabi et al. (2005) who observed that farmer's age has great influence on maize production in Kaduna state with younger farmers producing more than the older ones possibly because of their flexibility to new ideas and risk. Furthermore 83.3% of the sampled respondents had one form of formal education or the other. Onyeweaku et al. (2005) and Idiong et al. (2006) observed that formal education has positive influence on the acquisition and utilization of information on improved technology by the farmers as well as their innovativeness adoption of innovations. Some of the farmers (73.3%) have been farming for over 5 years. This means that they must have acquired good experience in agroforestry farming. Rahman et al. (2003) indicated that the length of time in farming business can be linked to age. Age, access to capital and experiences in farming may explain the tendency to adopt innovation and new technology.

Table 2 shows the summary statistics of some of the socioeconomic variables and farm outputs. It reveals that the average age of the farmers was 49.2 years. An average farmer has a fairly large household of 6.5, cultivating about 1.12 ha of land typifying a small scale holding with no one having more than one field suggesting that land fragmentation is not common in the forest reserve because farm lands are allocated to them by the government on year to year basis.

Table 3 below shows the total income generated from each of the major crops in the study area. Revenue from cassava amounted to 49.8% of the total, while yam, maize and plantain accrued about 28.7, 4.8 and 16.7%, respectively thus showing that cassava contributed the highest to the revenue. Table 4 shows the gross margin realized from the farming enterprise that is, after deducting the expenditure from the total revenue. Out of a total gross margin (TGM) of N57, 972, 250, cassava contributed over 52% while the least is from maize (6.3%). Average margin per farmer amounted to N966, 204.17 which is the TGM divided by the number of farmers while the expenditure per hectare equals N269, 527.50 (that is total expenditure divided by the total hectare).

Results of the regression analysis

The results of the production function that was used to determine the nature of the relationship between the inputs and output in food production are shown in Table (semi-log function was chosen as lead equation). Table 2 shows that the value of coefficient of multiple determinations (R^2) indicated that about 53.7% of the variation in output of food crops is explained by the variable inputs included in the regression model. In addition, only farm size, maize and cassava had positive coefficient and are significant at 5%.

Table 6 shows the distribution of the respondents according to income generation. The table reveals that 56.7, 70, 33.3 and 8.3% of the respondents earn income within the 0 to 50000 category for plantain, maize, yam and cassava respectively while only 6.7% earn above ₦500, 000 from plantain, 21% from yam and 18.35 from cassava. This shows that the respondents are subsistent small scale farmers.

Table 7 shows the distribution of farmers according to the quantity of yam harvested. Over 80% of the farmers harvested about 120 ropes of about 2400 tubers of yam while less than 20% harvested over 120 ropes showing the small scale level of yam production under agroforestry system in the area. A rope of yam contains an average of 20 tubers of sizes ranging from 7 to 10 kg each tied horizontally one over another. The cultivation of yam is usually the preserve of the men while the

Table 1. Socio economic characteristics of sampled farmers N=60.

Variables	Respondents	Percentage	Cumulative Percentage
Age in Years			
21-30	12	20	20
31-40	12	20	40
41-50	14	23.3	63.3
51-60	09	15	78.3
61-70	03	5	83.3
71-80	04	6.7	90
Above 80	06	10	100
Total	60	100	
Level of Education			
Informal	10	16.7	16.7
Primary	23	38.3	55
Secondary	22	36.7	91.7
Vocational	3	5	96.7
Tertiary	2	3.3	100
Total	60	100	
Marital status			
Single	4	6.6	6.6
Married	46	76.7	83.3
Divorced/ widow/widower	10	16.7	100
Total	60	100	
Year of farming experience			
1-5	16	26.7	26.7
6-10	8	13.3	40
11-15	7	11.7	51.7
16and above	29	48.3	100
Total	60	100	
Household size			
1-5	15	25	25
6-10 above	45	75	100
Total	60	100	
Gender			
Male	50	83.3	83.3
Female	10	16.7	100
Total	60	100	
Farm size(Ha)			
0-5-1.0	6	10	10
1.5-2.0	19	31.7	41.7
2.5-3.0	11	18.3	60
3.5-4.0	2	3.3	63.3
Above 4.0	22	36.7	100
Total	60	100	

Source: Field Survey 2012.

Table 2. Summary of socioeconomic variables of respondents in Sapoba N= 60.

Variables	Minimum	Maximum	Mean	Standard Deviation
Age(years)	20	90	49.18	18.02
Household size	3.0	11	6.5410	1.68
Years of Farming (years)	4.0	65	19.66	16.56
Farm size (hectares)	0.20	2.02	1.1179	0.52
Hired labour (mandays)	0	98	35.03	26.20
Revenue(N)				
Yam(N)	0	1,748,000.0	359,478.69	430,677.94
Maize(N)	0	350,000	59,982.46	86,589.77
Cassava(N)	0	3,750,000	623,085.25	987,794.92
Plantain(N)	0	2,250,000	209,114.754	378,735.23
Total Revenue (N)	1840.0	6,370,000	1,251,661.15	1,591,963.57

Source: Calculated from field data.

Table 3. Revenue Generation from major crops in Sapoba.

Crops	Total (₦)	Revenue per hectare (₦)	Average Revenue(₦)
Yam	21,928,200	321,575.01	359478.68
Maize	3,658,930	53,657.87	59982.45
Cassava	38,008,200	557,386.71	623085.24
Plantain	12,756,000	187,065.55	209114.75
Total Revenue	76,351,330	1,119,685	1,252,661.12

Source: Calculated from field data.

Table 4. Gross margin analysis.

Cost Item	Total Expenditure(₦)	Total Revenue(₦)	Gross Profit(₦)
Yam	2,525,000	21,928,200	19,403,200
Maize	20,180	3,658,930	3,638,750
Cassava	7,790,600	38,008,200	30,217,600
Plantain	4,231,800	12,756,000	8,524,200
Capital	606,000	-	-
Labour	3,205,500	-	-
Total	18,379,080	76,351,330	57,972,250

Source: Calculated from field data.

women take care of the planting and harvesting of crops such as cassava, pepper, melon etc. This finding agrees with Izekor and Olumese (2010) who also discovered that yam production in Edo state was commonly carried out by men probably due to its labour intensive nature.

The quantity of cassava harvested under the agroforestry system is shown in Table 8 above. Over 78% of the farmers harvested between 1 and 200 bags of cassava while 21.7% harvested above 200 bags of the produce. Cassava is a major crop cultivated because of its multiple uses (Ogunniyi, et al., 2012). It is usually planted by the women while the men take care of yam. It is usually processed into different products like *garri,* starch and *fufu* which are consumed by the local people.

Plantain is another major crop planted under the agroforestry scheme in the study area. Majority (56.7%) of the farmers harvested between 1 and 100 bunches of plantain from their farms while 23.3% harvested above 500 bunches and 20% harvesting between 100 and 500 bunches from their farms as shown in Table 9. This shows that plantain is a priority crop by the farmers in the area.

Table 5. Estimate Semi-log Production Function for Some major crops in Sapoba forest area, Edo State.

Variables	Regression coefficient	t-value
Constant	-4801642	-1.452
Age	2671366.124	1.155
Years of Schooling	486495.918	0.928
Household size	-2576268.098	-1.114
Farm size	1870493.621	1.855*
Years of Farming	1090211.358	1.061
Hired Labour	-143894.992	-0.507
Capital	95974.908	0.505
Yam	-96912.829	-0.409
Maize	195847.137	1.702*
Cassava	481260.075	2.002*
Plantain	284572.550	1.293
R	0.733	
R^2	0.537	
F	5.61	

*significant at 5%.

Table 6. Distribution of respondents according to income generated from the major crops in Sapoba forest area.

Income range (₦)	Plantain		Maize		Yam		Cassava	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
0-50000	34	56.7	42	70	20	33.3	5	8.3
50001-100000	4	6.7	9	15	2	3.3	3	5.0
100001-150,000	6	10	-		7	11.7	6	10
150001-200000	2	3.3	-		6	10	13	21.7
200001-250000	5	8.3	5	8.3	4	6.7	6	10
250001-300000	2	3.3	3	5.0	3	5.0	5	8.3
300001-350000	1	1.7	1	1.7	2	3.3	10	16.7
350001-400000	-		-		-		1	1.7
400001-450000	1	1.7	-		-		-	
450001-500000	1	1.7	-		3	5.0	-	
500001 and above	4	6.7	-		13	21.7	11	18.3
Total	60	100	60	100	60	100	60	100

Source: Calculated from field data.

Although maize is another major crop produced under the agroforestry system in the area, not much is cultivated and harvested as shown in Table 10 with 56.7% of the farmers harvesting between 1 and 20 bags of the crop. Essentially, majority of the farmers cultivate the crop for consumption and not necessarily for sales.

Conclusion

The results of the study show that although farming is practiced at a subsistence level in the area it is a profitable activity in the study area. The study also revealed that cassava generates more revenue to farmers than yam and plantain. Among the variables that contributed to food production in the study area, age, years of farming of the farmer that is farmer's experience, farm size, cassava cuttings and plantain suckers are positively significant. The study also revealed that an average farmer realizes up to N966, 204.17 from the sales of the major crops in the study area. It is hereby recommended that young unemployed graduates and school leavers should be encouraged by the government, through the provision of farm input and takeoff capital, to

Table 7. Distribution of respondents according to the quantity of yam (ropes) harvested.

Class	Frequency	%	Cumulative %
0-20	21	35	35
21-40	9	15	50
41-60	9	15	65
61-80	4	6.7	71.7
81-100	4	6.7	78.4
101-120	1	1.7	80.1
121-140	1	1.7	81.8
141 & above	11	18.3	100
Total	60	100	

Source: Calculated from field data.

Table 8. Distribution of respondents according to the quantity of cassava (bags) harvested.

Class	Frequency	%	Cumulative %
1-50	17	28.3	28.3
51-100	20	33.3	61.6
101-150	3	5	66.6
151-200	7	11.7	78.3
201 & above	13	21.7	100
Total	60	100	

Source: Calculated from field data.

Table 9. Distribution of respondents according to the quantity of plantain (bunches) harvested.

Class	Frequency	%	Cumulative %
1-100	28	56.7	46.7
101-200	4	6.7	53.4
201-300	5	8.3	61.7
301-400	6	10	71.7
401-500	3	5	76.7
501 & above	14	23.3	100
Total	60	100	

Source: Calculated from field data.

Table 10. Distribution of respondents according to the quantity of maize (bags) harvested.

Class	Frequency	%	Cumulative %
1-20	34	56.7	56.7
21-40	15	25	81.7
41-60	3	5	86.7
61-80	0	0	86.7
81-100	1	1.7	88.3
101 &above	7	11.7	100
Total	60	100	

Source: Calculated from field data.

go into farming as it has been discovered that farming is profitable and a ready source of food supply.

Conflict of Interest

The authors have not declared any conflict of interest.

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