# Factors Influencing Farm Output and Income among Agroforestry Farmers of the Fringe Communities of Sapoba Forest Reserve, Edo State Nigeria

**[1]Idumah, F.O., F. Awe [1], and P.O. Owombo [2]**

[1]Forestry Research Institute of Nigeria, Ibadan. Nigeria.
[2]Department of Agricultural Economics and Extension,
Ondo State University of Science and Technology,
Okitipupa, Ondo State, Nigeria.
*Corresponding author e-mail: *idumafelix@yahoo.com*

**Abstract**

*The study was carried out to assess the factors influencing farm outputs and income among agroforestry farmers in the surrounding communities of Sapoba Forest Reserve, Edo State, Nigeria. A two-stage sampling procedure was used to purposively select five villages and 12 respondents from each village engaged in food crop production under agroforestry system. Sixty (60) farmers were thus selected from the area. Structured questionnaires were administered on the respondents to elicit answers on their socioeconomic characteristics and food production operations. Descriptive statistics was used to describe the socio-economic attributes of the respondents while the regression was used to determine the factors influencing farm output of the respondents. The study revealed that about 63% of the farmers were married while majority (72.16%) of them is male. About 59% of the sampled farmers were between the age brackets 21-50 years. Among the factors that were responsible for the variation in farmers' output and farm income, only farm size, household size, farming experience, educational qualification and access to credit were significant at 5%. It was also observed from the study that though farming activities in the study area is at a subsistence level, it can be said to be a profitable activity owing to the huge total gross margin of N57, 972,250 with an average farmer having a margin of N597, 652.06k. It was as well found that among the crops, cassava generated the most revenue to farmers. The study revealed that cassava was the highest revenue-generating crops for the agroforestry farmers. It can therefore be deduced that incorporating tree planting with arable crops helps in increasing crop productivity by improving soil fertility. It is therefore recommended that agroforestry system of farming should be further encouraged among farmers, especially the rural farmers. This will, in the mid and long term, help in conserving the forest and ensure sustainable forest management.*

***Keywords:*** Farm output, agroforestry, farm income, fringe communities, farm income, Sapoba

## Introduction

Many countries, especially developing countries, are preoccupied with the need to produce food and feed their ever-increasing population. Efforts have been made to produce food using the conventional and traditional slash and burn method of farming which is the prevalent method in the third world countries (Sofia *et al.,* 2006). These however have always resulted in wanton destruction of forest cover and the alteration of the dynamics of the forest ecosystem leading to climate change. Therefore, there is the need to balance the production of food as well as maintain good ecological environment for sustainable production and management of other forest resources. This, however, calls for the adoption of a system that offers a good opportunity

which can exploit the synergies that combine the characteristic advantages associated with forestry and agricultural practices. This system or practice is commonly called agroforestry.

Agroforestry refers to land use system in which woody perennials are intentionally grown with food crops and/or livestock leading to many beneficial, ecological and economic interactions between trees and non-trees components (Mcginity and Swisher, 2008). 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'. 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 different levels of human involvement in various management (Dawson *et al.,* 2013).

Studies have shown that agroforestry can improve and restore soil quality in degraded lands (Alao and Shuaibu, 2013; Bifarin *et al.* 2013; Owombo and Idumah, 2017; Dollinger and Jose, 2018). In countries that rely on small scale farms as their main source of income, agroforestry could improve the standard of living through increased agricultural productivity while also reducing carbon emissions (Ospina, 2016). 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 has been described as one of mankind best hopes to create a climate-smart agriculture, increase food security, alleviate rural poverty and achieve a truly sustainable development (Garrity and Stapleton, 2011; Waldon *et al,* 2017). 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.

Agroforestry practices in Sapoba Forest Area 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. Therefore, the farmers in the study area have been practicing agroforestry system of farming.

Though in Nigeria, especially rural farmers, have been sensitized on the importance of improving arable crop production through agroforestry practices, there is still need to encourage the practices among subsistent farmers to enhance their production in terms of crop yield and farm income generation. However, to evolve strategies that would increase the productivity of farmers through agroforestry practices, there is need to determine socioeconomic factors that influence farmers' output and income, with the aim of determining the gross margin of the farmers; determining the socioeconomic variables that influence the yield of the farmers and as well make policy recommendations for enhanced food production in the study area.

## Research Methodology

### Study area

The study was carried out in the fringe communities of Sapoba Forest Reserve in Orhionmwon Local Government Area (LGA) of Edo State (See Fig.1). Edo State is located between latitude 5°5′ N - 7°33′ N and longitudes 5°E-6°40′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 4-4°30′ and longitudes 6-6°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. It is located in Orhionmwon LGA, about 30 kilometres 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 and Ugboko-Niro, Iguere, Idunmwowina, Evbarhue, Idu, Evbueka, Iguomokhua, Ona, Abe, Igbakele, Adeyanba, Evbuosa in Area. Orhionmwon LGA has a population of about 182,717 according to 2006 census with a land area of 2.382 km$^2$ (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* (Gmelina), *Terminalia ivorenisis* (Black Afara), *Khaya ivorensis* (African/Lagos Mahogany) etc.

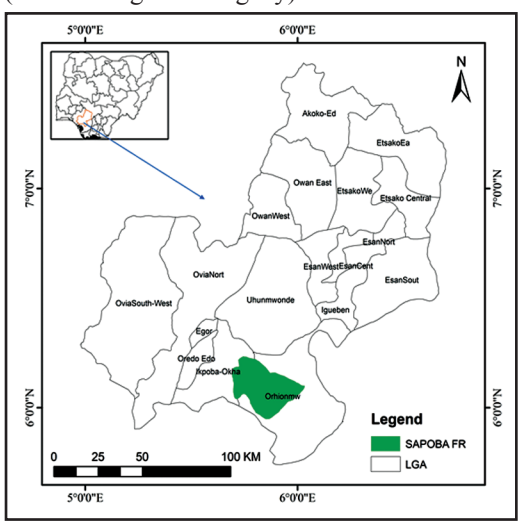


**Fig 1: Map showing Sapoba Forest Reserve in Edo State, Nigeria**

## Sampling technique and data

A two-stage sampling procedure was used to select respondents for the study. In the first stage, five villages namely: Ageka, Evbuosa, Ona, Iguomokhua and Forestry Research Institute of Nigeria (FRIN) Camp were purposively selected because of the predominance of agroforestry farming in the area. In the second stage, 12 respondents per village were purposively selected for the study. This was to ensure that only food crop farmers who practiced agroforestry systems were selected. A total of 60 respondents were used for the study. Data collected include the socio-economic characteristics of respondents and the input-out factors of farm enterprise.

## Analytical technique

Both descriptive statistics such as percentages, frequencies and mean distribution as well as inferential statistics such as production function were used in the analysis. The production function was used to determine the socioeconomic factors that influence the output of the farmers. Four functional forms of the production function were expressed: Linear, Semi-log, Exponential and Cobb-Douglas (Double-log) Functions. The best model of fit was determined by a combination of the criteria of the highest coefficient of multiple determinations ($R^2$), the level of significance of the overall equation (*F*-statistic), the level of significance of the coefficients (*t*-statistic) and the correct sign of the coefficients, relative to apriori expectation. The model in its general form is expressed below:

$$Y_i = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + e_i \quad .....(1)$$

Where:

$Y_i$ = Total output from crops such as maize, yam, cassava and plantain
$X_1$ = Age of farmer in years
$X_2$ = Total cost of farm inputs in Naira
$X_3$ = Farm size in hectare
$X_4$ = Household size (in number)
$X_5$ = Farming experience in years
$X_6$ = Cost of Labour in Naira
$X_7$ = Educational qualification
$X_8$ = Access to Credit facilities
$b_0$-$b_8$ = Parameters to be estimated
$e_i$ = Error term

The explicit forms of the functions are as

Linear

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + \varepsilon \quad .....(2)$$

Double Log

$$\log Y = b_0 + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + b_8 \log X_8 + \varepsilon \quad ...(3)$$

Exponential

$$\log Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + \varepsilon \quad ...(4)$$

Semi Log

$$Y = b_0 + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + b_8 \log X_8 + \varepsilon \quad ...(5)$$

Gross Margin Analysis was also employed in the study. It was used in this study to estimate the profitability level of crop production in the study area. It is a useful planning tool in situations where fixed capital is a negligible portion of the farming enterprise as in the case of small scale subsistence agriculture (Olukosi and Erhabor, 2005). It is expressed as;

GM = GR-TVC.....(6)

GM = Gross margin

GR = Gross or total revenue

TVC = Total Variable Cost

**Results and discussion**

Table 1 shows the socio-economic characteristics of farmers which are known to influence resource productivity and returns on the farms, according to Anigbogue *et al.* (2015). It was found from the study that about 63% of the farmers are married and majority (72.16%) of them is male. About 59% of the sampled farmers were between the age bracket 21-50 years. This shows 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 (Anigbogu *et al.,* 2015). Furthermore, 83.3% of the sampled respondents had one form of formal education or the other. Oduro-Ofori *et al.* (2014) and Reimers and Klasen (2013) observed that formal education has positive influence on farmer's output as a result of the acquisition and utilization of information on improved technology by the farmers. Majority of the farmers (73.2 %) have

**Table 1: Demography and Socio-economic characteristics of sampled farmers (N=60)**

| Variables | Respondents | Percentage | Cumulative Percentage |
|---|---|---|---|
| **Age in Years** | | | |
| 21-30 | 12 | 20 | 20.0 |
| 31-40 | 12 | 20 | 40.0 |
| 41-50 | 14 | 23.3 | 63.3 |
| 51-60 | 09 | 15 | 78.3 |
| 61-70 | 03 | 5 | 83.3 |
| 71-80 | 04 | 6.7 | 90.0 |
| Above 80 | 06 | 10 | 100 |
| **Total** | **60** | **100** | |
| **Level of Education** | | | |
| Informal | 10 | 16.7 | 16.7 |
| Primary | 23 | 38.3 | 55.0 |
| Secondary | 22 | 36.7 | 91.7 |
| Vocational | 3 | 5 | 96.7 |
| Tertiary | 2 | 3.3 | 100 |
| **Total** | 60 | 100 | |

| Variables | Respondents | Percentage | Cumulative Percentage |
|---|---|---|---|
| **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 | 40.0 |
| 11-15 | 7 | 11.7 | 51.7 |
| 16 and 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 | 100aw |
| **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

been farming for more than five years. This means that they must have acquired adequate farming experience over the years that is likely to have positive influence on their productivity.

Table 2 shows the total income generated from each of the major arable crops planted by farmers in the study area. It was discovered that cassava generated the highest revenue, accounting for 49.78% of the total revenue generated, followed by yam which accounted for 28.72%. This implies that cassava contributed the highest to revenue generation of agroforestry farmers in the study area.

Table 3 shows the gross margin result from the farming enterprise. From total gross margin of N 57,972,250, cassava contributed over 52%. Average margin per farmer was N966,204.17k. This is an indication that incorporating arable crop with tree planting can be a profitable enterprise, as experienced by the farmers in the fringe communities of Sapoba Forest Reserve.

Table 4 shows the results of the production function that was used to determine the factors that influence crop yields and income of the farmers in the study area. Out of the four functional forms that were fitted in the model,

**Table 2: Revenue Generation from major crops in Sapoba**

| Crops | Total Revenue(N) | Average Revenue(N) | Percentage (%) |
|---|---|---|---|
| Yam | 21,928,200 | 365470 | 28.72 |
| Maiza | 3,658,930 | 60982.17 | 4.79 |
| Cassava | 38,008,200 | 633470 | 49.78 |
| Plantain | 12,756,000 | 212600 | 16.71 |
| **Total Revenue** | **76,351,330** | **1272522.17** | **100** |

***Source:*** Calculated from field data

**Table 3: Gross Margin Analysis**

| Cost Item | Total Expenditure (N) | Total Revenue (N) | Gross Profit (N) |
|---|---|---|---|
| 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

the Semi-log functional form was chosen, as it satisfied most of the apriori conditions. From the result, variables such as farm size, household size, farming experience, educational qualification and access to credit were all significant at the 0.05 level of significance. This is an indication that these variables have significant influence the crop yield and farm income of the respondents in the study area. In other words, farmers with larger farm size have a better chance of increased crop yield and farm income than those with small farm size, while farmers with large household size also have the chance of higher crop yield than those with small household size. This means that as the number of people in a particular household increases, the demand for farmland to cater for the food need of the household may increase and this may lead to agitation for large farmland to boost their crop production and increase their farm income. This corroborates the work by Kola-Oladiji *et al.* (2016) where they attributed the increased use of forest reserve for farming and other activities to increasing household size and the quest to provide food the large households. In the same vein, farmers with higher number of years of farming experience are likely to produce higher yields than those with fewer years of experience. This may not be unconnected with the fact that farmers with higher number of years of farming experience might have experimented with different crop combination practices under agroforestry practices to ascertain what types of arable crops can perform better and produce higher yield under agroforestry practices. Similarly, educational qualification and access to credit play significant roles in farmers' crop output and farm income generation. Those with better education, have better chance of increasing their farm output especially when they bring the knowledge they have acquired in their years of education to bare in their farming activities. Those with access to credit also have a better chance of increasing their farm size and also purchasing necessary farm inputs required and consequently increase their farm output and income generated from such outputs.

Figure 2 shows the distribution of farmers according to the quantity of yam harvested. About 23% of the farmers harvested above 120 ropes of about 2400 tubers of yam while about 77% harvested about 120 ropes and less. This implies that majority of the farmers are small producers of yam under agroforestry system

**Table 4: Semi-log production function regression result**

| Variable | Coefficient | Standard Error | *t*-value |
|---|---|---|---|
| $X_1$ | 21.576 | 15.067 | 15.067 |
| $X_2$ | -11.511 | 10.455 | -1.101 |
| $X_3$ | 9.112 | 3.173 | 2.871* |
| $X_4$ | 6.432 | 2.069 | 3.108* |
| $X_5$ | 5.339 | 1.715 | 3.113* |
| $X_6$ | -4.033 | 2.937 | -1.373 |
| $X_7$ | 4.001 | 1.968 | 2.033* |
| $X_8$ | 1.081 | 0.539 | 2.003* |
| Constant | 19.324 | 5.615 | 3.441 |
| **$R^2$** | 0.737 | | |
| **F-value** | 5.611 | | |

**Significant at 5% level*

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 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.

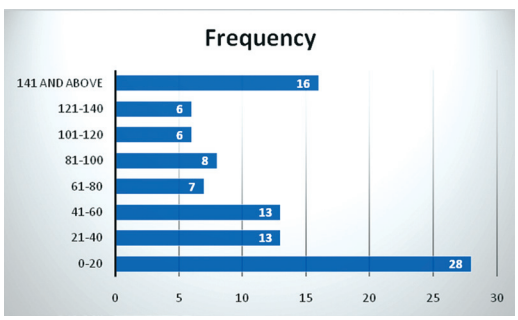


**Figure 2: Distribution of respondents according to the quantity of yam (ropes) harvested**

Figure 3 reveals the quantity of cassava harvested under the agroforestry system in the study area. About 76% of the farmers harvested between 1 and 200 bags of cassava while 24% harvested above 200 bags of the produce. This further corroborates the work by Ogunniyi *et al.* (2012) that cassava is a major crop cultivated because of its multiple uses. It was observed that 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.

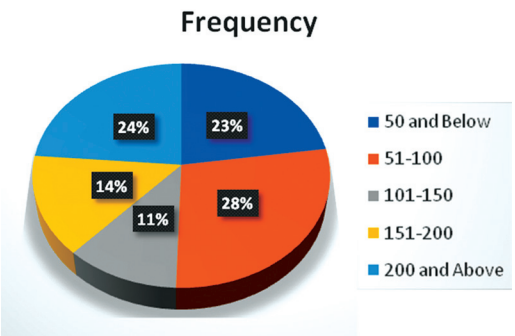


**Figure 3: Distribution of respondents according to quantity of cassava harvested**

Plantain is another major crop planted under the agroforestry scheme in the study area. About 46% of the respondents harvested from 1-200 bunches while about 21% harvested above 500 bunches (See Fig. 4). This implies that plantain is an important crop among the farmers in the area.

Figure 5 shows the distribution of farmers with respect to the quantity of maize harvested. Maize is one of the major crop produced under the agroforestry system in the area. However, not much is cultivated and harvested as revealed in Figure 4. Majority (41%) of the farmers harvested about 20 bags and below while only

14% harvested about 100bags and above.

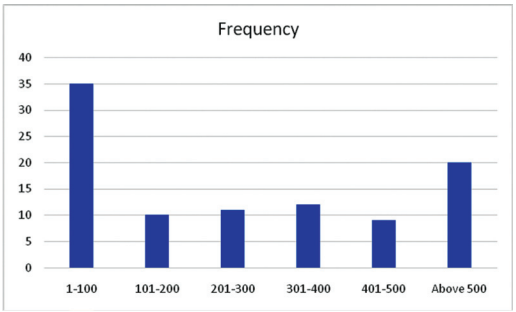


**Figure 4: Distribution of respondents according to the quantity of plantain (bunches) harvested**

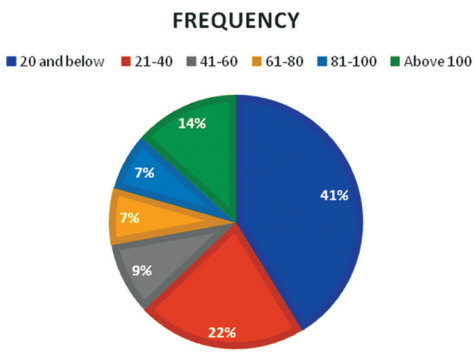


**Figure 5: Distribution of respondents according to quantity of maize harvested**

Results of the regression showed that farm size, household size, farming experience, educational qualification and access to credit were significant, at 5%, among the factors that influence the output and farm income of agroforestry farmers in the fringe communities of Sapoba Forest Reserve.

## Conclusion and Recommendation

This study concludes that farming activities in the study area is at a subsistence level and can be said to be a profitable activity, due to the huge total gross margin of N57,972,250 with an average farmer having a margin of N966, 204.17k. The study further revealed that cassava generated the highest revenue to agroforestry farmers. It can also be deduced that planting trees alongside arable crops helps in increasing the productivity of crops by improving soil fertility. In addition, results of the regression showed that farm size, household size, farming experience, educational qualification and access to credit were significant, at 5%, among the factors that influence the output and farm income of agroforestry farmers in the fringe communities of Sapoba Forest Reserve. It is therefore recommended that agroforestry system of farming should be further encouraged among farmers, especially the rural farmers. This will, in the mid and long term, help in conserving the forest and ensure sustainable forest management.

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