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Resource-use efficiency among traditional agroforestry farmers in Ibarapa region, Nigeria

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Abstract

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This paper examined resource-use efficiency as well as cost and returns to agroforestry farmers who cultivated maize as arable crop under their agroforestry practices in Ibarapa area of Oyo State, Nigeria. One hundred (100) copies of questionnaire were administered on one hundred randomly selected respondents from ten communities chosen from two Local Government Areas out of the three LGAs that make up the region. Gross Margin and Multiple Linear Regression analyses were used in analyzing the data. The results showed that an average profit of N 48, 387.41 per hectare was realized by the farmers. The results further revealed that in spite of the profit made per hectare by the farmers, they were inefficient in terms of the allocation of their resources. It is therefore recommended that adequate policies should be put in place by governments at all levels to ensure the availability of farm inputs to farmers and farmers should also be enlightened on how to make efficient use of their resources.

Key words: Agroforestry, Ibarapa, Resource-use, Gross margin, Regression

Introduction

Agro-forestry is a sustainable land-use system that maintains or increases total yields by combining food crops (annuals) with tree crops (perennials) and/or livestock on the same unit of land, either alternately or at the same time, using management practices that suit the social and cultural characteristics of the local people and the economic and ecological condition of the area (Chundawat & Gautam, 1993). Agroforestry is a system in which different components are benefiting from each other in several different ways. The trees can give fodder to animals and fix nitrogen for the crops and providing different biological pesticides and an improved microclimate (Kiriba, 2011). Agroforestry also ranges from very simple and sparse to very complex and dense systems and it holds a wide range of practices. The aim of Agroforestry lies in optimizing production based on interactions between various systems` components and their physical environments leading to higher sum total and a more diversified and sustainable production (Abdelkadir et al., 2003). Agroforestry, therefore, has both ecological and economical importance to increase productivity of land and sustainability of the environment in developing countries (Bjorn, 1991).

Agriculture constitutes one of the most important sectors of the economy in Nigeria, especially the rural economy. The sector is significant in terms of employment of labour, contribution to Gross Domestic Product (GDP) and until early 1970; agricultural exports were the main source of foreign exchange earnings (Amaza & Olayemi, 2002). A key feature of the Nigerian Agriculture is the dominance of small-scale farms which are often referred to as peasant farms because of their small land holdings (Olayemi, 1980; Okuneye, 1988; Amaza & Olayemi, 2002). These constitute an important and invaluable component of the Nigerian economy. It is a known fact that over twelve million farmers, scattered in different ecological zones engage in the production of a wide variety of arable crops, including maize, which is the focus of this study, and this is often done under traditional subsistence agriculture.

With the ever increasing human population and consequence of increase in demand, there is the need for increase in the volume of food production towards meeting increase in demand. The importance of maize production in this regard cannot be over emphasized because it has been in the diet of Nigerians for centuries. It started as a subsistence crop and has now risen to a commercial crop on which many agro-based industries depend on as raw materials. It is the most important cereal crop in the world after wheat and rice (Fakorede et al, 1993). Therefore, it is important to give its production adequate attention in order to guarantee food security and improvement in farmers' welfare without relying on food importation. This can be made possible through the development of land resources that form the main inputs in agricultural production process and also effective harnessing of the surplus of human labour due to the increasing population growth in the country.

Quite a number of studies have been carried out on resource-use efficiency in agricultural productivity in the country. Anyanwu & Iyagba (2009) conducted a study on resource productivity and efficiency among cassava farmers in Rivers State, Nigeria. The result revealed that resources of farm land, capital, labour input, expenditure on planting materials and fertilizer were not efficiently utilized. Farm land and capital needed to be increased by 537% and 1284% respectively while labour input, expenditure on planting materials and fertilizer needed to be reduced by 99.99%, 563% and 98.29% respectively, if profit is to be maximized. In a similar study, Aboki (2007) carried out a comparative analysis of the productivity of improved and local varieties of cassava in selected Local Government Areas of Taraba State. The result revealed the technical efficiency of the farmers with the best and least practices for improved varieties to be 0.9873 and 0.394 respectively. The ones for the local varieties were 0.9705 and 0.2970 for the best and least practiced farmers respectively. However, there is dearth of research work on resource-use efficiency among farmers who deliberately leave tree on their farms to serve as cover for their arable crops like maize and to replenish soil nutrients. Therefore, farmers who deliberately spare trees on their farms are said to practice traditional form of agroforestry. Hence the needs for this study to find out how efficiently or otherwise resources were being utilized in maize production by the traditional agroforestry farmers in the study area, with the specific objectives of assessing the perception of farmers about agroforestry practices; determining factors influencing output of maize; estimating cost and returns on maize production to the agroforestry farmers and determining the resource-use efficiency among the maize farmers in the study area.

Materials and Method

Study Area

This study was conducted in Ibarapa Area, Southwest, and Nigeria. The Ibarapa people are a group of Yoruba people located in the South-western part of Nigeria (Abimbola, 2006). The name of the group is derived from a local cultivar of the melon plant, known locally as Egusi Ibara, which was historically acknowledged by neighbouring peoples such as the Egbas, Ibadans and Oyos to be extensively cultivated in the area.

The Ibarapa area falls within latitudes 70.15' N and 70.55' N and longitudes 30E and 30.30' E. It is located approximately 100 km north of the coast of Lagos, and about 95 km west of the Oyo state capital and neighbouring city of Ibadan. They border Yorubas of Onko extraction to the North (Iwajowa, Kajola and Iseyin LGAs) and Yorubas of Oyo extraction to the East (Ibadan). The Yewas or Egbados to the West, and the Egbas to the South (https://en.wikipedia.org/wiki/Ibarapa_people)

The area is approximately 2,496 km² in geographical size, and consists mostly of rolling savannah with forests situated along the southern border and in isolated patches along river courses such as the Ogun. The natural vegetation was originally rainforest but that has been mostly transformed into derived type savannah as a result of several centuries of slashes and burn agricultural practices (Abimbola, 2006). Most of the land lies at elevations ranging between 120 and 200 meters above sea level, but rocky inselbergs and outcrops can be seen rising to 340 meters (approximately 1,115 ft)

Ibarapa land is traditionally made up of 7 principal towns known as the Ibarapa-Meje (Ibarapa Seven), and their surrounding villages and farmsteads. These towns include Igangan, Eruwa, Aiyete, Tapa, Idere, Igbo-Ora, and Lanlate. Tapa and Aiyete are in Ibarapa North Local Government Area, Igangan, Idere and Igbo-Ora are in Ibarapa Central, while Lanlate and Eruwa are located in Ibarapa East Local Government. The three local governments were created by the federal government of Nigeria authorities in 1996 when Ibarapa East was carved out from the old Ibarapa Local Government while Ibarapa Central and North were carved out of the former Ifeloju Local Government Area.

Ibarapa region is agrarian and well suited for arable crops like maize, cassava, and yam. This therefore necessitated the choice of the region for the study.

Sampling Procedure

The data obtained were obtained from both primary and secondary sources and were collected from two Local Government Areas (LGAs) out of the three LGAs in Ibarapa land. The two LGAs were randomly selected through multistage sampling technique. The selected LGAs were Ibarapa East and Ibarapa Central. The second stage involved a simple random selection of five communities from each of the two LGAs, making a total of ten communities in all. Twelve maize farmers who spared at least twenty trees per hectare were purposively selected from each of the ten communities, leading to a total selection of one hundred and twenty (120) maize farmers. A well-structured questionnaire was used to source for the required information from the farmers. Only one hundred and eighteen (118) copies of the administered questionnaire were found useful for analysis. The input data collected included quantity of seeds used (kg), farm size (Ha), quantity of fertilizer (kg), labour (Man-days) and quantity of agrochemicals (Litres). Data were also collected on household socioeconomic variables such as age of farmer, educational level and farming experience.

Method of Data Analysis

The nature of efficiency measured in this study is allocative efficiency. The general production function used in the study is implicitly expressed as follows:

$$Y= f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, e) \quad (1)$$

Where Y= Maize Output (kg)
X_1= Farm size (ha)
X_2= Quantity of seeds used (kg)
X_3= Age of farmer (years)
X_4= Quantity of fertilizer (kg)
X_5= Amount of labour used (Man-days)
X_6= Educational level of farmers (years)
X_7= Quantity of agrochemical used (litres)
X_8= Farming experience (in years)
Budgetary analysis was used to determine the profitability of maize production and also to analyze the cost and return to the agroforestry farmers. The budgetary analysis is given as:

$$GM= TR-TVC \quad (2)$$

Π= GM-TFC

Where Π= Profit (N)
TR= Total revenue (N)
TVC= Total variable cost
GM= Gross margin
TFC= Total fixed cost

For the efficiency estimate, the coefficients of the relevant independent variables were used to obtain the marginal value products (MVP) and their corresponding marginal factor cost (MFC). The ratio of the MVP to MFC was used to determine the resource-use efficiency as shown below

$$r = MVP/MFC \quad (3)$$

Where
r = Efficiency ratio
MVP= Marginal value product of a variable input
MFC= Marginal factor cost (i.e. price per unit of input)

The value of MVP was estimated using the regression coefficient of each input and the price of the output, as given in equation (4)

$$MVP_{xi}= MPP_{xi} \times P_y \quad (4)$$

Where P_y= price of unit output
MVP_{xi}= Marginal value product of resource X_i (i= 1, 2, 3...n)
MPP_{xi}= Marginal physical product of input X_i

$$MPP_{xi} = d_y/d_{xi} = b_i\bar{Y}/\bar{X} \quad (5)$$

b_i = the estimated regression coefficient of input X_i
$\bar{X}$= Arithmetic mean value of input being considered
$\bar{Y}$= Arithmetic mean value of output (Rahman &Lawal 2003)

Prevailing market price of inputs was used as the marginal factor cost (MFC) since the farmers were assumed to be operating under purely competitive inputs markets.

Optimal allocative efficiency for a particular farm is confirmed with respect to a given input if r = 1. If

r >1, the resource is underutilized. Efficiency could therefore increased by an increase in the use of that particular input. However, if r <1, the resource is over utilized, hence a reduction in the use of that input is required to increase efficiency. To show the extent to which a particular factor of production should be increased or withdrawn from current use to achieve the objective of profit maximization, the formula below was used;

$$K_i = (1-r_i) X100 \quad (6)$$

Where K is the required percentage change in allocative efficiency and ri is as earlier defined.

If equation (6) is evaluated, a negative percentage implies that an increase in the use of the factor input is required, while a positive percentage implies that a withdrawal of some of the factors from current use is required. If K_i equals zero, then the resource is optimally utilized.

Results and Discussion

Table 1 shows that 55.08% of the farmers were above 50 years of age while those that were below 50 years of age accounted for 44.92%. This implies that most of the farmers were in their advanced age and would possess less energy to work on the farm and this could cause a decline in the productivity of such farmers. It was also discovered that 73.73% of the farmers were male while female accounted for 26.27% of the respondents. In addition, 83.90% of the farmers had farming experience of twenty years and above. It is believed that experienced farmers would be more efficient in their use of resources, thereby running a more efficient and profitable enterprise. In addition, majority (47.46%) of the farmers had no formal education. This possibly explains why they recorded low output resulting from their inability to use modern farm inputs or equipment. This is because the more educated a farmer is, the more exposed he or she would be and consequently, the more the chance that he would readily accept and adopt new innovations than those without education.

Many of the respondents in the study area were aware of the benefits derivable from agroforestry practices. The respondents were aware of the economic importance agroforestry practices. Figure 1 shows the perception of the respondents on agroforestry practices. Majority (34%) of the respondents believed agroforestry increased their farm outputs. They further affirmed that sparing trees on their farmland enabled them to meet their basic needs such as fuel wood, fruits, fodder, timber, vegetables etc. In addition, 28% of the respondents stated that agroforestry enabled them to generate additional income from sales of fuel wood, fruits, timber and other non-timber forest products (NTFPs). However, 6% of them claimed agroforestry system was difficult to practice.

Some of the agroforestry trees the farmers deliberately spared on their farmlands include *Milicia excelsa, Mangifera indica, Gliricidia sepium, Treculia Africana, Khaya ivorensis, Cola nitida, Chrysophyllum albidum, Parkia biglobosa, Afzelia Africana, Ceiba pethandra, Irvingia gabonensis*, among others.

Table 2 shows the results of the regression analysis of the factors influencing the maize outputs of the traditional agroforestry farmers. It was observed that farm size was statistically significant to the outputs of maize farmers at 5% level of significance and also positively related to their yields. This implies that as farm size increases, the yield of maize farmers will also increase. This is in line with earlier studies by Anyanwu (2013) and Obasi (2005) in Rivers State and Imo State respectively. It could also be seen from the table that labour input is statistically significant at 5% significance level and possesses the expected positive sign. This means that an increase in labour will result to an increase in output of maize farmers in the area. However, the quantity of seeds used was statistically significant but possesses a negative sign, contrary to the a priori expectation that it would be positive. This was in line with earlier study by Awe (2010) in Kogi State where the quantity of seeds used had a negative but significant relationship with maize output in the area. This may be due to the inefficient use of the seeds. In other words, more than the required quantity of seeds per hectare might have been planted by the farmers. This made the maize plants to compete for limited available space, thereby reducing their performance and consequently led to reduced yield. Fertilizer and agrochemical are not statistically significant at the 0.05 level of probability, though they are positively related to maize output. This also corroborates earlier study by Awe (2010) in Kogi State. This could be due to the fact that high prices of fertilizer and agrochemicals has made the inputs unaffordable to farmers and those that could afford little could not apply the needed quantity that will improve their yield. Similarly, farmers' level of education and their farming experience are not statistically significant at the chosen level of probability. This implies that farmers in the study area were not appropriately applying the knowledge they had possibly acquired in improving their productivity, though the variables have positive relationship with their output. In addition, age was statistically significant to farmers' output and it has an inverse relationship with farmers' yields. This means that as farmers advance in age, they become weak, causing a decline in their productivity.

Table 3 shows a total income of N 88, 424.65 per hectare for the maize farmers. The profit of N 42935.96 shows that maize farming was a profitable enterprise in the study area. This is because the amount is greater than the current minimum wage of N 30, 000 in the country. It could be seen from the table that labour was the most expensive factor in the production of maize in the area, as it accounted for about 83.05% of the total cost of production. This is because it is the main source of man power in rural Nigeria as a result of their little or no access to modern farming equipment.

Table 1. Socioeconomic Characteristics of Respondents

Variable	Frequency	Percentage
Age		
<30	11	9.32
30-40	19	16.10
41-50	23	19.49
>50	65	55.08
Total	118	100
Gender		
Male	87	73.73
Female	31	26.27
Total	118	100
Farming Experience		
<20	19	16.10
20-30	68	57.63
>30	31	26.27
Total	118	100
Educational Level		
No formal	56	47.46
Primary	32	27.12
Secondary	14	11.86
Tertiary	16	13.56
Total	118	100

Source: Field survey, 2019

Table 4 shows that if farm size is increased by one hectare, total farm output of maize farmers will increase by 41,507.12 kg. Similarly, if labour is increased by one man-day, the gross farm output of the farmers will be increased by 503.11 kg while additional use of one litre of agrochemical will increase gross output by 20,132.61 kg. From the table, it could also be inferred that all the resources, except seed, were underutilized, since the allocative efficiencies for the inputs were greater than 1. Therefore, for optimal utilization of the resources, farm size, fertilizer, labour and agrochemical should be increased by 337%, 6%, 11% and 1540% respectively. Since seeds were discovered to be over-utilized, for it to be optimally utilized, seeds utilization has to be reduced by 1246%.

Table 2. Regression Analysis Results for the Farmers

Variable	Coefficient	Standard error	t-value	R^2
Intercept	3.122	1.313	2.377	0.867
Farm Size (ha)	*21.121	2.337	9.037	
Seeds (kg)	*-7.830	2.113	-3.706	
Age (yrs.)	-5.330	1.126	-4.733	
Fertilizer (kg)	0.836	1.616	0.517	
Labour (man-day)	*15.231	1.422	10.711	
Education (yrs.)	12.539	16.352	0.767	
Agro-chemical (ltrs.)	6.668	3.575	1.865	
Experience (yrs.)	9.271	10.203	0.909	

Table 3. Budgetary analysis of the maize farmers per hectare

Items		Amount (N)
Total Revenue		88,424.65
Cost of labour	29,887.97	
Cost of fertilizer	3,543.57	
Cost of seeds	1231.73	
Cost of agrochemical	1325.42	
Total variable cost	35,988.69	
Gross margin		52,435.96
Total fixed cost	9500	
Profit		42,935.96

Source: Field survey, 2019

Table 4. Estimates of Allocative Efficiency

Variable	Mean	MVP	MFC	r
Farm size (X1)	1.214 ha	41507.12	9500	4.37
Seed (X2)	32.15 kg	-1375.65	120	-11.46
Fertilizer (X4)	22.80 kg	64.13	60	1.06
Labour (X5)	46.87 mandays	503.11	450	1.11
Agrochemical (X7)	0.88 litres	21322.21	1300	16.40

Source: Computed from regression result

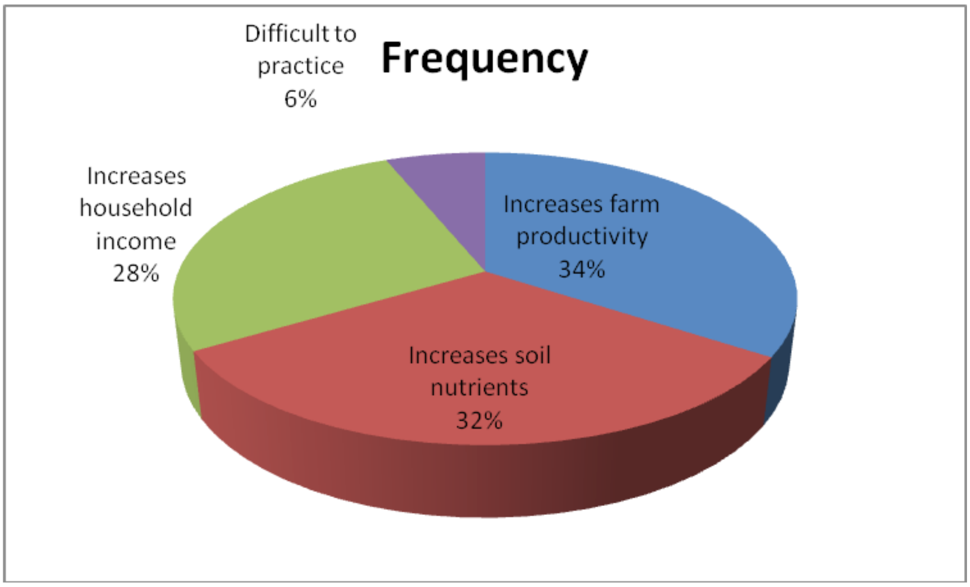

Fig. 1. Farmers Perception about Agroforestry Practices

Conclusion and Recommendations

This study assessed resource-use efficiency of maize agroforestry farmers in Ibarapa Area of Oyo State. The data for the study were obtained from 100 randomly selected maize farmers from ten villages in two Local Government Areas of the State. Multiple linear regression analysis was used to analyze the data. The analysis results revealed that farm size, labour and seed were the statistically significant determinants of the maize output in the study area, while fertilizer and agrochemical were not statistically significant at 5% level of significance. The outcome of the analysis showed that the maize farmers were inefficient in the allocation of their resources; owing to the fact that inputs such as land, seed, fertilizer; labour and agrochemical were all underutilized.

Furthermore, results of the analysis revealed that the farmers needed to increase the use of farmland, fertilizer, labour, and agrochemical by 337%, 6%, 11%, and 1540% respectively so as to achieve optimum allocative efficiency. From the study, it was also discovered that farmers did not have access to necessary farm inputs like improved seed varieties, fertilizer, chemicals and other farm equipment needed to increase their productivity.

Sequel to the findings of this study, it is hereby recommended that government should make affordable loan available to farmers across the country to be able to procure needed farm inputs such as fertilizer and agrochemicals in order to boost their production capacity. Government should also provide farmers with modern farming equipment like tractors at highly subsidized rate to enhance farming activities among the farmers. Training and workshops should also be organized for farmers to enlighten them on how to make efficient use of their resources.

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