Global Scientific JOURNALS

GSJ: Volume 8, Issue 8, August 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

ECONOMIC ANALYSIS OF SMALL SCALE TAMBA (*Eluesine coracana*) PRODUCTION IN SOUTHERN KADUNA OF KADUNA STATE, NIGERIA.

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Abstract

The traditional African cereal grains, Finger millet (Eluesine coracana), locally known as Tamba, has not received much research study within the last decade. The tamba cereal has the potentials to contribute significantly to whole grain diets, wellness, economic status improvement, and play important role in food security in Nigeria. Thus this work investigated the resource use efficiency in Tamba production among small scale farmers in Southern Kaduna of Kaduna State. Primary data were collected from 250 small scale Tamba producers with the aid of structured questionnaire drawn from five villages based on their production strength using the simple random sampling technique. The analytical tools employed were descriptive statistics, gross margin analysis technique, correlation analysis and production function analysis. The result of the correlation analysis revealed that educational status, farm size and farming experience had strong positive correlation with Tamba grain output while the result of the Cobb Douglas production function revealed that the coefficients of the production inputs $x_{1,}\ x_2 - - - x_5$*, were positively significant at 1% level. These also explained that any additional unit of these variable imputes will lead to an additional unit of output of Tamba by 69%. The findings of the study showed that the total cost of production observed was N39, 433.08 per hectare with labor accounting for the highest cost item. The gross margin obtained was N40,319.40 per hectare. The showed that Tamba production in the study area is profitable. The study recommended expansion in farm size of Tamba (finger millet) production, in addition to reduction of cost of seeds, labor and chemical fertilizers.*

Key words: Cereal, Wholegrain, Tamba, Finger millet, Gross Margin, Southern Kaduna.

1. INTRODUCTION

At independence in 1960, agriculture stood out as the most important sector of Nigeria's economy. It employed over eighty percent (80%) of the nation's workforce, served as the most

important foreign exchange earner and constituted a major source of Government revenue (CBN, 2000). Given the vastness of the country, its diverse climatic and soil conditions, a wide variety of crops are grown for industrial use, exports as well as domestic consumption. The nation's agricultural production is still largely in the hands of the small scale farmers who are said to account for ninety five percent [95%] of the total agricultural production (Adesimi A.A.1997). Presently, there are relatively large quantity of undeveloped and underutilized resources, which if tapped and used effectively would lead to large increases in production and thus enable Nigeria to feed herself and also have excess to solve the world's food problem.

One serious problem facing Nigeria today is chronic and transitory food insecurity (World Bank, 1998). The contribution of agriculture to Gross Domestic Product (GDP) which was 65% on the average in the 60's dropped to 22.4% between 1976 and 1980. Even though it rose to 29.2% in the year 2001, it dropped further to 22% in 2015 (CBN, 2014).

Although Gana (1990) described Nigeria as a food insecure country, the food problem which started in the mid 1960's, has continued to deepen several decades after independence (Adesina, 1997). At the national level, the main food problems are food supply deficits, poverty and uneven distribution of income in terms of ability to buy food. On the economic front inadequate food has resulted in reduced export earnings, large food imports, small revenue for Government, shortage of raw materials for processing industries and increased inflationary pressure (Ojo, 1995).

Finger millet (*Eleusine coracana*) commonly known as Tamba in Hausa, raji (India) and Tsel (Mambilla), is a grass crop grown in Africa, India Nepal, and many countries of Asia. The plant and grain is resistant to drought, pests, and pathogens. Chandrashekar (2010) reported that finger millet is rich in polyphenols and calcium. It is high in essential amino acid: methionine. One major use for the grain is the making of fermented beverages after malting with α-amylase and α-amylase produced during germination. Food made from malted Tamba is traditionally used for weaning (Srimathi, 2010) and has been the source of low viscosity weaning foods that can deliver more energy per feed than those based on gelatinized starch. There is some evidence that foods from finger millet have a low glycaemic index and are good for diabetic patients (Srimathi, 2010; Chandrashekar, 2010). Traditionally, tamba cereal grain has been processed into various value-added products in India (Mbithi-Mwikya et al., 2002) including staple flat bread, steamed finger millet dumplings, Laddoo-sweet ball and in much of Africa, finger millet is commonly eaten as porridge, and also used for brewing millet beer.

Notwithstanding the vast potential of these traditional cereal grains, they are still being sidetracked in technological innovation by development and funding agencies. The input, investment in infrastructure, technology and agricultural research made to the "new rice for Africa drought-resistant rice variety" project that helped to boost production in Africa is equally needed for AIT cereal grains that are more nutritious. This is necessary as these grains grow under different agro-climatic conditions unfavourable to conventional cereal crops. To increase the value of fonio, European Union financed an international research project (INCO) under the 6th European Union Programme (FP6), in the priority area of "Bio-diverse, bio-safe and value

added crops" dealing with food security. This initiative is commendable with more of such expected in the near future on "minor" grains. As stated by IFT (Floros et al., 2010), scientific and technological advancements in agriculture and food technology must be accelerated and applied in developed and developing nations alike, if we are to feed a growing global population of which Nigeria in one..

The poor output realized by farmers may be an indication that resources needed in the production of the crop are not being used at their optimal levels or are inaccessible by farmers. The relatively little emphasis laid by farmers on the crop raises the question as to whether it is profitable to grow the crop or not. This situation calls for an assessment of the resources needed for its production and how these resources are managed by its cultivators. This vital information which is lacking at the moment has created a gap which the main objective of this research is aimed at filling. The objective of this study therefore is to estimate the production level of tamba and to determine the profit that can be generated from Tamba production in the study area.

Economic theory of the firm begins with theory of production. What is a firm? The essence of a firm is to buy inputs, convert them to outputs, and sell these outputs to consumers, firms or government. Therefore a firm is poised between two markets. It is a demander in factor markets. It buys the inputs required for production in factor markets (markets that supply inputs for firms). It is a supplier in market for goods and services. It has to adjust its production to satisfy the demand curve of its customers at profit. It is assumed that the firm or the owner of the firm always strives to produce efficiently, or at lowest cost. He will always attempt to produce the maximum level of output for a given dose of inputs avoiding waste whenever possible. The production function is the relationship between the maximum amount of output that can be produced and the inputs required to make that output. Put in other way, the function gives for each set of inputs, the maximum amount of output of a product that can be produced. It is defined for a given state of technical knowledge (If technical knowledge changes, the amount of output will change).

3. RESEARCH METHODOLOGY

3.1. Study Area and Data Collection

The study was carried out in Kaura Local government area of Kaduna State located at the North-West region of the country. The study area is located in the Hausa plain of the Northern Nigeria. The climate is savannah type and about 1000km away from the sea. The touch lies on latitude $11^0$10'N and longitude $7^0$45'E. It has two distinct season the dry season (November to march) and Wet season (April-October). Rainfall amount varies to years to year with an average of 1100mm. The long dry season necessitated the cultivation of much food and cash crops during raining season through the mixed cropping system. During the dry season, farmers are engaged in drying season farming and other secondary occupation such as fishing, hunting and rearing of cattle to make up for any deficiency in agricultural production. Relief of the Manchok area is a disserted portion of the Manchok-Jos plain developed on crystal metamorphic rocks of the Nigerian basement complex. The occupation of the people in the local government, is

predominantly farming, but some still engage in trading and vocational work (Survey 2015). Youth comprises of about 60 percent of the whole population and are mixed with educated, semi-educated and non-educated (i.e. real education as in having tertiary education, primary/post primary education and non-formal education respectively).

3.2. Sample Size

The population for the study was made up of 200 Tamba farmers purposively sampled from five villages namely Manchok, Kaura, Kagoro, Zankan and Sabon-gari. The study adopted a cross sectional sample survey. The random sampling technique was used to select forty (40) Tamba farmers from each village. Primary data were used for this study. These data were obtained through the use of structured questionnaire and oral interview. Descriptive statistics was used to explain the socio- economic characteristics of Tamba farmers and gross margin analysis was used to determine the profitability from the Tamba production and the production function analysis was used to determine the extent of resource use efficiency for production in the study area.

3.3. Data Analysis

The analytical tools utilized to capture the objectives of this study are;

1. Descriptive statistics (DS): measures of central tendency such as frequency distributions, and percentages were partly used to describe the socio - economic characteristics of Tamba farmers in the study area.
2. Production function analysis (PFA): production function as a physical/ technical relationship between factor inputs and outputs as described by Linguard and Raynar (1975), Koutsoyiannis (1970), Olukosi and Ogungbile (1989). It includes all the technically efficient methods of production. It describes not only a single isoquant but the whole array of isoquants each of which shows how output varies as the dynamic inputs changes. Production function provides measurement of useful economic tools such as marginal productivity of factor of production, factor intensity, efficiency of production and return to scale.
3. Gross margin analysis (GMA): The gross margin analysis involves evaluating the efficiency of an individual enterprise or a farm so that comparison can be made between enterprises of different farm plans.

The purpose of this analysis is to identify the cost, returns and profitability or loss per hectare. It is a very useful planning tool in situation where fixed capital is a negligible portion of the farming enterprise as is the case in subsistence agriculture. The gross margin by definition is the difference between the gross farm income (GFI) and the total variable cost (TVC) i.e. G.M = GFI-TVC. The gross margin analysis was used to determine the profitability from finger millet production in the study area.

4. RESULTS AND DISCUSSIONS

Table 1. Socio-economic characteristics of the respondents.

Index	Characteristics	Frequency	Percentage
Age	20 – 29 Years	09	4.50
	30 -39 Years	40	20.00
	40 – 49 Years	81	40.50
	50 – 59 Years	45	22.50
	60 & above Years	25	12.50
	Total	200	100
Education level	Adult Education	11	5.50
	Arabic Edu	03	1.50
	Primary Edu.	39	19.50
	Secondary Edu.	103	51.68
	Tertiary Edu.	44	22.00
	Total	200	100
Farming experience	1-10 year	87	43.50
	11-20year	45	22.50
	21-30year	48	24.00
	30 & above year	20	10.00
	Total	200	100
Family size	1-5 persons	22	11.00
	6-10 persons	111	55.50
	11-15 persons	43	21.50
	16 & above	24	12.00
	Total	200	100
Farm size	0.5 – 1.4 hectares	69	34.50
	1.5 – 2.4 hectares	67	33.50
	2.5 -3.4 hectares	40	20.00
	3.5 – 4.4 hectares	19	9.50
	4.5 – 5.4 hectares	05	2.50
	Total	200	100
Source of income	Farming only	55	27.50
	Farming/Trading	22	11.00
	Farming/Civil Ser	123	61.68
	Total	200	100
Extension Contact	Yes	17	8.34
	No	183	91.69
Agent	Inheritance	168	84.00
Land Ownership	Purchased	02	1.00
	Rented	30	15.00
	Total	200	100

Source: Field Survey Data, Jun, 2019

Table 1 illustrates that 40.50 percent of the respondents were between the ages of 40 – 49 years, 4.50 percent of them were between the 20 – 29 years while 12.50 percent were above 60 years. The result shows that most of the farmers were of middle age group which is in conformity with the rural-urban migration trend which has left the aged ones, on the farm. Illiteracy was observed as one of the factors militating against agricultural development among farmers in Nigeria. About 51.68 percent of the farmers attained secondary school, 22percent tertiary education while 5.50 percent attained adult education. Most researchers use years of farming experience of farmers in lieu of management as a factor of production. It is believed that the higher the years of

farming experience of a farmer, the more the management ability of such a farmer in making farm decisions (Adeniyi, 1998). About 43.50% of the respondents had farming experience of 1 – 10 years while only 10% of the farmers had above 60 years of farming experience. Norman (1972) defines household size as the number of people eating from one pot. It implies that the consumption unit is also the production unit. Under small scale farming, households provide most, if not all the labor requirements for farming. 55.50 percent of the respondents fell within 6 – 10 members per household, 21.50 percent fell within the range of 11 – 15 members while 12 percent fell within 15 and above group. Farmers in the study area were generally small holders with 61.67 percent of the respondents with farms not more than 2.5 hectares. 31.67 percent of the respondents have farm size of between 0.5 - 1.4 hectares while 6.67 percent had between1.5-2.4 hectares. About 61.67 percent of the respondents were full time farmers and have no other source of income apart from farming, 13.33 percent combine farming with trading while 25 percent of the respondents combined farming with civil service job. Land acquisition is believed to constitute much constraint for efficient utilization of land especially when it is purchased or hired. The result of the study revealed that this might arise since 83.33 percent of the respondents used family land or acquired their land through inheritance. Contact with extension agents will give the farmers good opportunity to get information on better management practices, new technology and other auxiliary services (Upton M, 1998). Only 8 percent of the respondents had contact with the extension agents while the remaining did not. This shows that Tamba farmers had relatively low chances of getting information about new and modern production practices from the extension agents (Olagoke, 1991).

4.1. Production Function Analysis

The production function was used to arrive at some judgment concerning the efficiency of the prevalent factors of production. An empirical production function enables us to do so because the marginal product of each input estimated from the production function could be compared with its marginal factor cost. The results of the estimated production function are presented in table 2 and the empirical Cobb-Douglas production function is given by the functional form as represented below:

$Y = aX_1^b X_2^c X_3^d X_4^e X_5^f + Ue$ ……………………………………………………………..………(1)

$Y = a + b\log X_1 + c\log X_2 + d\log X_3 + e\log X_4 + f\log X_5 + e$ ……………………………………..…(2)

Where: Y = output of Tamba
X1 – X5 = Quantity of input factors as defined in the general model.
a, b-g = parameters to be estimated
e = error term

Log Y= 2.170+0.447LogX1 + 0.367LogX2- 0.03LogX3 + 0.37LogX4+ 0.174L0g X5+ e….. (3)

Where: Log Y = Output of Tamba grain [kg]
Log X_1 = Land area put to Tamba production [ha]
Log X_2 = Total Labour [man days]
Log X_3 = Quantity of seeds/ clones [kg]

Log X_4 = Insecticides [litres]
Log X_5 = Chemical fertilizer [kg]
e = Random error term

Table 2. Coefficients from Cobb – Douglas production function for Tamba production.

Variable	Regression Coefficient	Standard Error	T-Value
Farm size Log X1	0.745	0.218	5.709***
Labor Log X2	0.612	0.265	3.857**
Quantity of seed Log X3	0.050	0.263	-0.315NS
Insecticide Log X4	0.050	0.153	6.675***
Chem. Fertilizer Log X5	0.290	0.145	3.331*
Constant [bo]	3.617	0.548	10.999***

Source: Field survey Data June, 2019

*** = Significant at 1% Level, ** = Significant at 5% Level, NS = Not Significant

From the Coefficient of Multiple Determination (R^2) of the Cobb-Douglas Production function, the specified inputs explained 68 percent of the variability in Tamba output. This is reasonably good considering the fact that other important explanatory variables such as soil fertility, weather condition, farmer's management abilities, and timeliness of cropping operation were not included. The F-Value of a model which determines the overall significance of the entire model was 38.159 and was significant at 1 percent level of significance. This implies that all variables included in the model were collectively important and responsible for the variation in the dependent variable of the model. The coefficient of farm size Log X_1 was positive and significant at 1 percent level. The positive sign of the farm size suggests that a unit increase in the area of Tamba cultivated will lead to an increase in output of Tamba. While other explanatory variables are held constant. This is in agreement with the a priori expectation, ceteris paribus, increase in farm size means that more inputs would be utilized and consequently more output would be expected.

The coefficient of labor (Log X_2) was positive and significant at 5 percent level of probability. The positive coefficient is in agreement with expected signs and implies that as the amount of labor in the farm was increased, the output will increase. The quantity of seed/ clones used (Log X_3) was negative and not significant at any level of probability. This implies that the quantity of seed used is inefficiently utilized along with other resources or over estimation from their previous year's reserve. The coefficient of insecticide (Log X_4) was positive and significant at 1 percent level of probability and in accordance with the expected sign. This means that the quantity of insecticide applied was directly related to output. The coefficient of chemical fertilizer (Log X_5) was positive and significant at 5 percent level of probability. This is in line with the expected sign and implies that the quantity of chemical fertilizer applied was directly related to output.

4.2. Gross Margin Analysis

The profitability of any form of business can be deduced from the relationship between the cost incurred in running the farm and the returns accruing from it. The gross margin associated with Tamba production was estimated based on the following assumptions,

1. Open market price was used for fertilizer instead of the subsidized price because subsidized price does not actually reflect the true cost (price) of input.
2. Since family labor is a substitute for hired labor in the study area, family labor was valued alongside hired labor at the prevailing market price of N400 = per man day.

4.2.1. Gross Return/ Revenue

The gross return was derived by multiplying the total quantity of produce harvested by the average market price at the period of the survey. The average gross return per hectare was N93,642.90 (14 times 7203.3).

4.2.2. Cost of Production

Variable cost elements were considered as the total cost of production. It was assumed that fixed cost was negligible for the small scale farmers in the study area. The variable cost of labour, fertilizer, insecticides and seed was calculated.

1. Seed

The average quantity of seed used per hectare was 145.00 kg and an average cost of N600. 00 for 50kg of seed was used for computation. It indicate that farmers on the average incurred about N1,740 = on seed. This contributed about 3.11 percent of the total variable cost of production.

2. Fertilizer Cost

The price of fertilizer in the study area varied but an average price of N3600 = per 50kg was used for this analysis. Table 4.5 indicates that the average cost of fertilizer was N12, 501 = per hectare. Fertilizer cost was the second highest contributor to total variable cost (29.77) percent.

3. Insecticide

The price of insecticide (karate and VAE) in the study area varied but an average of N1, 600.00 per gallon of one litre was used for this analysis. Table 4 indicates that farmers on the average incurred about N8,292= on insecticide per hectare. This constitutes about 19.74 percent of the total variable cost of production. The total variable cost of production include the cost of labour, fertilizer, insecticide and seeds and this amounted to N49, 069=

4. Total Labor Cost

The average wage rate was put at N400.00 per man day. The average cost of labor used for Tamba production was N26, 536.00 (N 400.00 times 66.33) per hectare. From table 4, labor accounted for 47.39 percent of total variable cost in the production of Tamba.

4.2.3. Gross Margin

The gross margin per hectare represents the difference between the total value of all output per hectare and the total variable cost per hectare. Table 3 shows that the farmer earned a gross margin of N 44,573.90 per hectare.

Table 3. Average Cost and Returns from Tamba production per hectare.

Variable	Unit per hectare	Unit price [₦]	Values per hectare [₦]
RETURNS			
Tamba yield (kg /ha)	7203.3	13	93,640.90
GROSS RETURN:			
Variable Cost			
Seed (kg / ha)	145	12	1740 .00
Fertilizer (kg / ha)	231.5	54	12,501. 00
Insecticide (litres / ha)	6.91	1200	8,292. 00
Labor input	66.34	400. 00	26, 536. 00
C.TOTAL VARIABLE Cost			49,069. 00
Gross Margin per hectare (A – C)= G R – TVC			44, 573.90
RETURN TO LABOUR (N /Man day)			672.01
AV RETURN ON GM= GM/TVC			1.01

Source: Field survey Data June, 2019

4.2.4. Return to Labor

This gives an idea of the productivity of labor input (family and hired labor). This was calculated by dividing the sum of Gross Margin and cost of labor per hectare by the total labor input per hectare. It shows that the productivity of labor was N672.01 per man day. This result shows that it was profitable for farmers to work on their own farms considering the wage rate of N400.00 in the study area. On the other hand, the average return on gross margin was 0.91, meaning that, for every one Naira invested; there was a gross margin of 97 kobo. The hypothesis that Tamba is not profitable was rejected at 1 percent level of significance. The test of significance computed (see appendix 1) shows a significant difference between cost and return. Thus, the study found that Tamba production was profitable in the study area.

4.3. Marginal Value Product and effectiveness of Resource Use

The estimated production function enables us to evaluate the efficiency of the factors of production in agriculture. Given the prices of inputs and output, the marginal value product is the yardstick for judging the efficiency of resource use. A given resource is optimally allocated if its marginal value product is just sufficient to offset its cost. Equality of marginal value product to marginal factor cost is therefore the basic condition that must be satisfied to obtain efficient use of resources. From table 4, the highest marginal physical product (MPP) was land with 1020 and the lowest was fertilizer with 5.86 while MPP for insecticide and labor were 338 and 13.18 respectively. The marginal Value Product (MVP) for land, labor, insecticide and fertilizer were ₦6,630, ₦67, ₦2, 197 and ₦38.09 respectively. This implies that land had the highest MVP and fertilizer had the lowest. When the Marginal Value Product of land, labor, insecticide and fertilizer for Tamba farmers were compared with their Marginal Factor Cost (Table 4), a ratio of 3.3, 3.4, 2.8 and 1.1 for land, labor, insecticide and fertilizer were obtained respectively. Table 5 show the contribution of tamba crop production to GDP of Agriculture of the second quarter of 2016. Of the 88.0% of Agriculture GDP Tamber farming will be capable of contributing 1.22% to the GDP of agriculture compare to other cereal crop.

Table 4. Estimated Marginal Physical Product's of inputs in Tamba Production.

Items	Land	Labour	Insecticide	Fertilizer
Marginal Physical Product MPP (Kg)	1020	13.18	338	5.86
Marginal \Value Product MVP (₦)	6630	85.67	2197	38.09
Marginal Factor Cost MFC (₦)	2,000*	25	800	36
MVP / MFC (₦)	3.3	3.4	2.8	1.1

Source: Field Survey Data June, 2019

Table 5: Crop (Tamba) GDP to Agricultural GDP 2nd Quarter 2016

Tamba gross margin per hectare	GDP Agric 2nd Quarter 2016	% GDP of Tamba to Agriculture	% GDP Agriculture 2nd Quarter 2016
44, 428.90	3, 635,533.13	1.22%	88.0%

Source: National Bureau for Statistics, June, 2019

5. CONCLUSIONS AND RECOMMENDATIONS

The study estimates the production function for Tamba and also determined the profitability of Tamba production among small scale farmers in Kaura Local Government Area of Kaduna State. Cobb – Douglas production function and gross marginal analysis were used in the estimation. The results indicated that all variables included in the model were collectively important and responsible for the variation in the dependent variable of the model. The results also showed that all variables were underutilized as shown by the corresponding efficiency ratio. It therefore, pays to re – allocate resources by increasing usage of such factor inputs that were underutilized for greater efficiency ratio since increasing such factor inputs will contribute more to total returns. These results call for policies aimed at encouraging new entrants to cultivate Tamba and the experienced ones to remain in farming. The emerging ancient grains, Tamba with excellent

culinary and nutritional properties have potentials in new product development as they are believed to represent the highest quality of vitamins, minerals, fibre and the sulphur containing amino acids. Food industries may look into their use as ingredients in product formulation considering growing awareness of a healthy diet and challenging cost of health care. Value addition and exploitation of these cereal grains require concerted and collaborative efforts in terms of infrastructure, funding, innovation, and purposeful policies from governments, international donors, academia, food industries, and the private sectors if the growing population in the sub-Saharan region is to experience the full benefits of cereal grains for active and healthy life. Credit and subsidy from governmental and non-governmental agencies should be made available to rural farmers, for this will go a long way in addressing their inefficiency problems; hence the essence of this research.

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