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RESOURCE USE EFFICIENCY IN GUM ARABIC PRODUCTION AMONG FARMERS IN YOBE STATE, NIGERIA

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Abstract

This study aimed at assessing the efficiency of resource utilization among gum Arabic farmers in Yobe State of Nigeria; towards determining the parameters that could promote the commercialization of the crop in Nigeria. One hundred and twenty gum Arabic farmers were selected by multi-staged random sampling from six local government areas, and structured questionnaires were administered to obtain data for the study. The data collected included farm size, cost of farm tools, cost of labour, yield of gum Arabic, total revenue from gum Arabic; and socio-economic variables such as age, marital status, family size and educational level. Data were analyzed using descriptive statistics, budgeting technique and production function analysis. Results indicated that gross income, gross margin and net farm income per hectare of ₦ 30,000.00 (US Dollar 187.50), ₦ 20,980.00 (US Dollar 131.13) and ₦ 19,430.00 (US Dollar 121.44) were realized. Return to labour and naira investment were 3.08 and 1.84 respectively. Results also indicated that farm size, cost of farm tools, hired labour, family labour and transport cost were used within the rational zone but not at optimal levels.

Keywords: *Gum Arabic, resource, efficiency, rational, optimal, Yobe State, Nigeria*

1. Introduction

Gum Arabic (*Acacia species*) is the dominant leguminous tree crops that belong to the family *mimiosaceae.* The family is reported to have contained over three hundred species including A. *seyal* and A. seyal which are the most commercially exploited species of the whole Acacia family (Olori, 2002). Gum Arabic thrives well in soils that are sandy, droughty, and low in organic nitrogen and cation exchange capacity; best performing in areas with mean annual rainfall of 300-450 mm annual1y (Aghughu, 1998). It is a non-cultivated product, which is largely under exploited in spite of a strong production potential in Nigeria. Production in Nigeria is largely from the wild except in Borno, Yobe and Jigawa States where large plantations of several hectares have been established.

Socially, Gum collection or gathering is a source of revenue in rural areas. Rope is derived by the rural dwellers from the root bark fibers, which is suitable for making well ropes and fishing nets. The plants are useful for demarcating boundaries between farmers' farms due to the advantage of its thorny nature. The leaves and pods are valuable sources of livestock feeds, while the wood could be used as fuel wood, and for manufacturing of farm

and household tools (Duke, 1997; Hayward, 2004). During flowering of Gum Arabic trees, the extra floral nectarines are source of bee food for honey bees.

Environmentally, the Gum Arabic plantations indirectly contribute to the improvement of the environment in areas threatened by desertification. The tree has the potentials of improving soil fertility through the dropping of its leaves. The roots hold soil particles together and protect soil from being degraded. It also fixes and stabilizes sand dunes and combat wind erosion. The root has nitrogen fixing bacterial hence can add nitrogen to the soil. From environment perspective, the promotion of gum Arabic plantations have the potentials to act as shelter belt, thereby reducing the problems of desert encroachment, environmental degradation and poor soil nutrition, particularly in the Sudan-Sahellian ecological zones of Nigeria. Leaves dropped from the trees would help to improve soil fertility, while the roots hold soil particles together and protect soil from wind erosion.

Economically, the Gum is important in revenue earning for the country. The Gum also is a unique multi-functional food additive to fix flavour, used as emulsifier to prevent crystallization of sugar in confectionery products, as well as stabilizer and clouding agent in beer and soft drinks. In pharmaceutical industries, the Gum is used as stabilizer for emulsions, and as binder and coating for tablets. In cosmetics, it is used as adhesive or facial masks and powder to give smooth feel to lotions. In industries, Gum is applied as an adhesive, protective colloid and safe guarding agent for inks, sensitizer for lithographic plates, coatings for special papers and anti–corrosive coatings for metals. Nigeria is the second largest producer of gum Arabic in Africa after Sudan with a total national production estimate of 19,954 metric tones per annum as at 2010 and estimated revenue of $119,724 were realized (Okoro, 2011); yet the domestic production cannot meet the local demand for refined gum Arabic by industries in Nigeria. The Author added that Nigeria imported 964,208 kg of refined gum Arabic amounting to $81,240 in 2009. Nigeria has the potential to further meet the increasing world demand for gum Arabic. According to (Anon, 2010), in 2009 export of gum Arabic stood at 17,110 metric tones, which was less than 30% of the world demand of 57,250 metric tones (Anon, 2004).

In spite of its economic importance, sufficient attention has not been given to promote the production of gum Arabic as an economic crop. Specifically, there is information gap concerning optimal levels of resource utilization in gum Arabic production. This study was therefore carried out in order to determine how resources should be optimally utilized to increase gum Arabic production. The objectives were to estimate cost and returns and to determine resource utilization in gum Arabic production in Yobe State Nigeria.

2. Methodology

2.1 The Study Area

The study was conducted in six Local Government Areas of Yobe State which include Bade, Damaturu, Gujba, Nguru, Yusufari and Karasuwa; representing three main ethnic groups including Hausa, Kanuri, and Fulani. The area lies between latitudes 11^0 East and 12^0 North and between longitude 12^030 and 13^0 East of the equator; bound in the north by Niger Republic, East by Chad and West by Jigawa State. The study area falls in the Sudan Savanna agro ecology; with mean annual rainfall of 1002 mm, mean relative humidity of 15 percent annually and maximum temperature of up to 43.48^0c. The topography consists of valley with low lands, sloppy lands, and sand dunes. The soil is suitable for agricultural activities including tree crops (gum Arabic, mango trees and guava), arable crops (groundnuts, beans, rice, maize, sorghum) and livestock.

2.2 Data Collection And Sampling Techniques

Primary data were obtained through the use of structured questionnaire administered to gum Arabic farmers selected by multi- stage random sampling technique. Six (6) major gum Arabic producing local government areas were purposively selected out of the 17 Local Government Areas of the State, for having highest concentration of farmers producing grade one of the gum. Two villages were randomly selected from each of the six local government areas, and ten farmers from each of the villages giving a total of 120 farmers.

2.3 Data Analysis

Data were obtained on production variables such as farm size, cost of farm tools, cost of labour, yield of gum Arabic, and total revenue from gum Arabic; and socio-economic variables including age, marital status, family size and educational level. The data were analyzed using descriptive and inferential statistics. Means and percentages were used to summarize the socio-economic characteristics of gum Arabic farmers; gross margin budgeting technique was used to determine profitability of gum Arabic production, and production function analysis was used to determine resource efficiency. The production function is implicitly presented by equation (1).

$$Y = f(X_1, X_2, X_3. X_4, X_5, U_2) \quad (1)$$

Where: Y =Quantity of gum Arabic produced by the ith farmer (kg),
X_1 = Farm size (hectares),
X_2 = Cost of farm tools (Naira),
X_3 = Hired labour, (man days)
X_4 = Family labour, (man days)
X_5 = Cost of transport, (naira)
u_1 = the error term (was assumed to have zero mean and constant variance).

Four functional forms were tried using ordinary least square technique (OLS) and Cobb - Douglas functional form was selected in conformity *with apriori* economic criteria of the magnitude of coefficients, signs and significance of the adjusted coefficients of multiple determination (R^2), F- ratio and t-ratio. This is explicitly represented by equation (2)

$$Log\ Y = b_0 + b_1 log X_i + b_2 log X_2 + b_4 log X_3 + b_4 log X_4 + b_5 log X_5 \quad (2)$$

The Marginal value Product (MVP) of each input was calculated by using the regression coefficient of each input and the geometric mean values of gum Arabic revenue and gum Arabic production inputs. For a Cobb — Douglas function, the MVP is the product of the production elasticity coefficient of the input (bi) and the average physical product Y/Xi. The Marginal Factor Cost (MFC) of input was taken to be either the market price if purchased from competitive input market or the geometric mean values of the input costs, or depreciation of durable assets. The average annual depreciation of durable asset was used as the MFC because it is the part of the cost of the durable asset consumed during the production period. The ratio of MVP to MFC of each input was computed to measure the resource use efficiency.

The model of the budgeting technique used for the estimation of the Gross margin was explicitly stated thus:

Gross margin (GM) = GI - TVC

Where: GM = Gross Margin, GI = Gross Income, and TVC = Total variable cost.
Net Farm Income (NFI) = GM - TFC
Where: TFC = Total fixed cost.

$$\text{Resource use efficiency} = \frac{MVP}{MFC}$$

Where MVP = marginal value product and MFC = marginal factor cost.

The absolute value of the percentage change in the MVP of each input used was calculated thus:

$$D = 1 - \left[\frac{MFC}{MVP}\right], 100$$

Where D is the absolute value (Iheanacho et al, 2000).

3. Results and Discussion

Table 1 shows that majority (65%) of the respondents are in their prime (20 to 40 years); indicating that most of the farmers were in their economically active years, implying that productivity is expected to be high. Gum Arabic production in the study area is a male dominant profession; low participation of women is attributable to religious practice of confining women in purdah among Moslems. Results also indicated that 90 percent of the respondents are literate, with formal education; so, farmers are expected to be receptive to innovations of farming.

Results on table 2 indicate that land ownership in the study area is predominantly by inheritance. This may portend danger to production of' gum Arabic as family size of members increases thereby leading to land fragmentation and restrict farmers from adoption and expansion of gum Arabic farms. Also, majority (94.17 percent) of the farmers are small-scale holders; which could affect mechanization and adoption of innovations that require large-sized farms.

3.1. Estimated Production Function

LogY	=4.245**	+ 0.163X_1***	+ 0.0132X_2***	+ 0.0514X_3**	-0.192X_4	+ 0.306X_5***	(3)
	(1,827)	(0,034)	(0.0012)	(0.028)	(0.441)	(0.038)	

R^2 adjusted 0.79; F=26.540; ***Significant at 1%; ** Significant at 5%

The values in parenthesis under each regression coefficient are the standard errors of the coefficient. The estimated R^2 value showed that the dependent variables, X_1, X_2, X_3, X_4 and X_5 explained about 79 percent of the variations in the independent variable, Y, in equation (2); while the F-value indicated that the estimated production function was significant at one percent level. The entire estimated coefficients except X_4 (i.e. family labour) carried the expected positive sign, which indicated that an increase in these variables (farm size X_1, cost of farm tools X_2, hired labour X_3 and cost of transport X_5) would lead to increase in output of gum Arabic ceteris paribus.

Table1. Distribution based on Socio- economic Characteristics of Respondents (N = 120)

Variable	Frequency Number	Percentage
Age		
20-30	10	8.33
31-40	14	11.67
41—50	54	45.00
51—60	34	28.33
>61	8	6.67
Gender		
Male	93	77.50
Female	27	22.50
Marital Status		
Married	91	75.83
Single	21	17.50
Widowed	8	6.67
Education		
No Formal Education	12	10.00
Primary	63	52.50
Secondary	35	29.20
Tertiary	10	8.30
Family Size		
1-5	28	23.33
6-10	32	26.67
>10	60	50.00

Source: Field Survey, 2010

Table 2. Resource requirement and utilization by Respondents (N = 120)

Variable	Frequency Number	Percentage
Source of Land		
Inheritance	94	78.34
Rent	19	15.83
Purchase	7	5.83
Farm Size (ha)		
<1	26	21.67
1-3	87	72.50
4-6	5	4.16
>6	2	1.67
Labour Source		
Family	8	6.67
Hired	38	31.67
Family and Hired	62	51.66
Family and Communal	12	10.00

Source: Field Survey, 2010

3.2. Resource Productivity

Using the arithmetic mean values of output and inputs, marginal physical product (MPP) was obtained for each variable input used in gum Arabic production that were significant. Farm size recorded the highest MPP of 10.87.This implies that an increase by extra one hectare of land would give additional 10.87 kg of gum Arabic. The ratio of MVP to MFC was computed for every input in gum Arabic production to determine whether the resources were efficiently used or not. It was observed that the resources were over utilized and decreasing their uses would increase profit margin of gum Arabic production (Table 3). For optimal resource use to be achieved, the MVP must equal the MFC. To strike a balance, adjustment in the percentages of MVPs were made as seen in Table 4. This result indicated that for optimal use of farm size, cost of farm tools, hired labour and transport cost, decrease in MVP by 5135.50%, 75657.6%, 1845.5% and 325.8% respectively is required.

Table 3. Resource Use Efficiency of Gum Arabic Farmers

Resources	MPP	MVP	MFC	MVP/MFC
X_1 Farm size (ha)	10.870	81.50	500.00	0.163
X_2 Cost of farm tools (Naira/US$)	0.003	1.32	1000.00	0.001
X_3 Hired labour (Naira/US$)	- 0.733	7.71	150.00	0.051
Cost of transport (Naira/US$)	0.510	36.72	120.00	0.306

Source: Field Survey 2010

Table 4. Required Adjustments in MVP For Optimal Resource Allocation in Gum Arabic Production

Variable	**MVP Adjustment Required**
X1 Farm Size	-5130.50
X2 Cost of Farm Tools (Naira/US $)	- 75657.60
X3 Hired Labour (Naira/US$)	- 1845.50
X3 Cost of Transport (Naira/US$)	-325.80

Source: Field Survey 2010

3.3. Cost and Return Analysis

Table 5 shows that variable cost of production accounted for 85.34% while fixed cost was 14.66%. Return to investment on labour was found to be 3.08 while return to capital investment was 1.84; which implied that gum Arabic production was profitable. The profit margin may be as a result of the rising demand and prices of gum Arabic products in World Market with multiplier effect on producing countries. These results indicated that although gum Arabic was mostly produced by small scale farmers, it was profitable, and could be more profitable with increased farm size and efficient utilization of labour and capital. Hence policies that encourage cultivation of gum Arabic crops on a commercial scale could impact on revenue generation and increase the share of agriculture in national income, as well as increase income to farmers.

Table 5. Average Cost and Return Analysis

Item	Value (Nigeria Naira ₦/US Dollar $)
A. Variable cost	₦ 9,020.00 (US$ 56.38)
B. Fixed cost	₦ 1,550.00 (US$ 9.69)
Total Cost of production	₦ 10,570.00 (US$ 66.06)
C. Returns	
Total output	200kg
Price/kg	₦ 150.00 (US$ 0.94)
Gross income	₦ 30,000.00 (US$ 187.50)
Gross margin (TR-TVC)	₦ 20,980.00 (US$ 131.13)
NFI (GM-TFC)	₦ 19,430.00 (US$ 121.44)
Return to labour investment	3.08
Return to naira investment	1.84

Source: Field Survey 2010

4. Conclusion and Recommendations

The study assessed the resource use efficiency of Gum Arabic production in Yobe State, Nigeria; and specifically explored the profitability and rate of return on investment. A sample of 192 farmers selected by stratified random sampling was used; and data obtained through structured interview. Results showed the per hectare gross income, gross margin and net farm income values of Nigerian currency ₦ 30000.00 (US Dollar 187.50), ₦ 20980.00 (US Dollar 131.13) and ₦19430.00 (US Dollar 121.44); and return to labour and naira investment were 3.08 and 1.84 respectively; indicating that gum Arabic production is profitable and could be more efficient and more profitable by employing more labour. Also, the analysis indicated that the identified production resources including farm size, hired labour, cost of farm tools, family labour and cost of transport were used within the rational zone but not at the optimal levels; and that an increase in the use of family labour and decrease in farm size, cost of farm tools, hired labour and cost of transport would lead to increase in output of gum Arabic.

Therefore, it was concluded that decreasing the levels of farm tools, hired labour and transport cost and increase farm size would increase profit levels of gum Arabic production in the study area. Thus, policies that would enhance farmers' access to land and relevant tools for gum Arabic production are recommended.

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