FACTORS INFLUENCING ADOPTION OF GUM ARABIC PRODUCTION TECHNOLOGIES IN GOMBE STATE, NIGERIA

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ABSTRACT: *This study examined the factors influencing adoption of gum arabic production technologies in Gombe state, Nigeria. The objectives of the study were to: describe the socio - economic characteristics of gum arabic farmers and identify factors influencing adoption of gum arabic production technologies. Primary data were used which were collected from 46 registered gum arabic farmers who were members of National Association of Gum Arabic Producers, Processors and Exporters of Nigeria (NAGAPPEN) Gombe state chapter. Descriptive statistics and multiple regressions were used for the analysis. The results revealed that 93.5% of the respondents were males, 97.7 were, married, and a mean age of forty nine years old, attended tertiary institutions and earned ₦M3.04 annually. Multiple regressions revealed that age (X2) educational (X5), income(X7), farming experience(X8) farm size(X9), and access to extension (X10) were significant at varying levels and positively influence the adoption of gum arabic production technologies except age which has a negative influence. Increased government supports through sustained provision of inputs were therefore recommended among others.*

KEYWORDS: Factors Influencing, Adoption, Technologies

INTRODUCTION

Gum arabic was named as 'gum arabic' by Europeans for the Sudanese gums, because it was obtainable from Arabian ports such as Jeddah and Alexandria (Karl – Hermann, 1997). It was described as 'a hardened latex material which solidifies after oozing from a tree' (Adamu, Nasiru and Oguntunde 2008) or rather, it is a dried exudate obtained from the stems and branches of *Acacia senegal (L) Willdenow* or closely related species (Anon, 2004 in Abdullahi, 2004).

It has been observed that the acacia tree is made up of several species. Domdain and Philips stated in Nasir (2005) that the Acacia genus has about 11000 – 12000 identified species which produces gum of various grades. Out of these numerous species, only one, *Acacia senegal* is identified as producing the best quality gum in commercial quantity (Aghughu1998).

Gum arabic has several industrial, social and other uses. The industrial uses include its use in food, pharmaceuticals and textiles industries (Giroh*et al.*, 2010). It is also useful in beverages and cosmetics industries (Gwary*et al.*, 2013). It is socially an important revenue earner for the producing countries and employer of labour for rural people who are engaged in production and gum collection. In countries bordering the Sahara, the plants have proved useful as windbreaks and shelter belts against desert encroachment. Their canopies intercept rain drops while the root systems are effective in reducing soil erosion, thereby stabilizing soils. Species

in the genus *Acacia* improve soils due to their ability to fix nitrogen. The foliage and pods are valuable dry season fodder while the stem has wide application in fencing, wood, energy and construction. The environmental benefits of these plant resources in the regions are therefore significant (Yitebitu, 2004; Alkali, 2010).

In case of its production, Karl – Hermann (1997) explained that virtually all the gum arabic of commerce comes from Africa with Sudan accounting for up to 80% of the world production followed by Chad and Nigeria. About 12 other countries in the Sahel, stretching from Senegal/Mauritania in West Africa to Somalia in the Horn of Africa and southwards to Tanzania are also producers. Mokwunye and Aghughu (2010) are however of the view that chances are available for Nigeria to become the world leading producer and exporter of this noble crop. Coming to Nigeria, the gum arabic belt is the Sudano-sahelian zone of the country. The states in the zone are Borno, Yobe, Jigawa, Adamawa, Bauchi, Gombe, Taraba, Katsina, Kebbi, Zamfara, Sokoto, Plateau and Nasarawa states (Giroh, Valla, Mohammed and Peter, 2008.)

The high demand for the products necessitated the Federal Government of Nigeria to lay emphasis for its development especially grade 1 and 2 gum arabic (Giroh, Moses, and Umar, 2007).

Statement of the Problem

Several efforts were made over the years to boost the production of gum arabic in Nigeria. These include among others campaigns for individuals to plant *Acacia Senegal* trees by some state governments through their Agricultural Development programmes, and funding of free seedlings production to farmers, between 1995 and 2009. Others include establishment of research institutes, provision of technical assistance by the Research Institutes, (Mokwunye and Aghughu 2010) and teaching farmers the best silvicultural practices for gum arabic cultivation by USAID in 2002 (Afaf *et al.* 2005). However, Sagay and Mesike (2011) concluded that gum arabic production in Nigeria is still mainly from the wild, which means the recommended silvicultural practices have not been generally followed. This study attempts to uncover the farmers' socio economic characteristics influencing the adoption of those silvicultural practices, their absence of which retards adoption.

Theoretical Framework

Innovation refers to an idea, practice, object, or fact perceived as new by an individual (Singh and Mishra 2007). For a farmer to adopt an innovation, there are variables pertaining not only to the farmer but also related to the innovation and method of information dissemination that influence his response. According to Agwu (2004), a farmer is more inclined to accept (and participate in) a recommended practice if the practice is profitable, compatible with existing farming system, divisible, simple to use, has relevance for his labour use, farm inputs, marketing, credit, community values and crop situation. Ekpe and Obeten (2004) have also stated in Nasir (2005) that the adoption of an improved agricultural technology is influenced by socio – economic factors such as age, household size, educational level, occupation and the like. Other factor as mentioned by Bose *et al.* (2012) Include farm size, value of farm products sold, farming experience, leadership role, empathy and availability of farm credit. Similarly, Bzugu *et al.* (2012) conducted a research on socio economic factors influencing adoption of improved gum arabic seedlings among farmers in the Sahelian zone of Borno state, Nigeria and discovered that the socio-economic characteristics which had significant influence on the

adoption of improved gum Arabic seedlings by farmers include; marital status and household size.

Peter *et al.* (2012) concluded that literature on technology adoption emphasizes the role of fixed and variable costs of producing a particular crop. That is to say that farmers find it easier to adopt farm technologies which are relatively cheaper. In-spite of the government efforts to make farmers cultivate gum arabic in Nigeria, a crop in which was initially wild, and despite the researches involved in the process, yet, the production potentials are not optimized. According to a research discovery by the University of Khartoum ETD, (2013) Sudan, if productivity of gum arabic is to be increased, then there should be replanting of gum trees using modern technologies for tapping and picking, training the producers to improve their production efficiency and doing tapping at the right time.

Purpose and Objectives

The purpose of this study was to determine which socioeconomic characteristics which were responsible for the adoption of the gum arabic production technologies by farmers in Gombe state Nigeria. The specific objectives were to:

(1) describe the socio - economic characteristics of gum arabic farmers;

(2) identify factors influencing adoption of gum arabic production technologies;

METHODOLOGY

The area of this study was Gombe State. Gombe State is located between latitudes 9°30' to 12°30' North of the equator and Longitudes 8°45' to 11°45' East of the Greenwich meridian. The State which has 11 local government areas lies in the center of the Northeast geopolitical zone of Nigeria. It shares a common boundary with Adamawa, Bauchi, Borno, Taraba, and Yobe States. The State occupies a total land area of about 20, 265km^2.

Gombe state is generally warm with average maximum temperature during the hot season, not exceeding 30°C. Average annual rainfall is 850mm. The state is endowed with rich agricultural land, and about 80% of the people are mainly peasant farmers. (A R C N, 2011).

Out of the total land area of 20, 265 km^2 about 65% is cultivable (agricultural) area and others under forests reserve, woodlands and water bodies. According to United Nations Fund for Population Activities [UNFPA] (2008), the estimated population of the State will be 3,079,585 by 2014.

The population of this study was made up of all the 50 registered gum arabic farmers in Gombe state. The list and the addresses were obtained from the State's branch of the National Association of Gum Arabic Producers, Processors and Exporters of Nigeria (NAGAPPEN).

Data for this study was collected using semi - structured questionnaires which were administered on registered gum arabic farmers in the study area. However, 46 questionnaires were correctly filled and returned and were used for the analysis. The questions were made in such a way as to obtain information which helped in answering all the research questions.

Method of Data Analysis

Data relating to socio-economic variables of the farmers were analyzed using frequencies and percentages, while multiple regression analysis was used to determine the socio economic factors influencing adoption of gum arabic production technologies.

For multiple regression analysis the linear function was used. The model is

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \ \text{-------------------} + \beta_{11} X_{11+} e$$

Where:

Y = Adoption index expressed as a percentage of gum arabic production technologies adopted.

X_1 = Sex of household's head; Dummy (D) = 1 if male; 0 if otherwise,

X_2 = Age of farmer (years).

X_3 = Marital status of household's head; Dummy (D) = 1 if married, 0 if otherwise,

X_4 = Farmer's family size (number).

X_5 = Highest educational level, (number of years spent in school)

X_6 = Household Labour (number)

X_7 = Income (Naira),

X_8 = Farming experience (Years),

X_9 = Farm size (hectares),

X_{10} = Access to agricultural extension. Dummy (D) = 1 if have access; 0 if otherwise.

X_{11} = Membership of an association. Dummy (D) = 1 if have access; 0   if otherwise.

e = error term.

RESULTS AND DISCUSSION

Socio Economic Characteristics of Respondents

This section examines the socio – economic characteristics of gum arabic farmers in the study area. Table 1 revealed that majority of the respondents (93.5 %) were males while only 6.5% were females. This shows that men dominated gum arabic production over women in the study area.

The table also reveals that 95.7% of the respondents were married while only 4.3% were not married. This means that majority of gum arabic farmers in the study area were married. This is in line with the findings of Gwari*et al.*(2013), who conducted a study on producers, processors and marketers of gum arabic in Magumeri Local Government Area of Borno State, Nigeria. The findings of their study revealed that majority (71%) of the farmers were married.

The table further reveals that 30.4 % of the respondents were within the age brackets of 50 – 59, 26 % were 40 – 49 years, 21.8 % were 60 – 69 years, and 19.6% were 30 – 39 years while 2.2% of the respondents were less than 30 years old with a mean age of 49 years.

In a related survey, Giroh, Waizah and Umar (2010), conducted a research in Jigawa State, Nigeria and discovered that the mean age of gum arabic farmers was 49 years old. Also Agwu, (2004) in another study on farmers in Bauchi and Gombe States, Nigeria, reported that farmers

who fell within the age range of 30 – 49 years accounted for 69.3 %, and about 18% of the respondents were of the age range of 50 – 59 years,

The table also depicts the distribution of respondents based on household size. It reveals that 28.3% of the respondents have a family size of 6 – 10, 21.7% have 1 -5, 15.2% have 11 – 15, 13% have 21 – 25, 10.9% have 16 – 20 and above 26 respectively with a mean family size of 14. This means that the respondents have relatively larger family sizes in comparison to another study conducted on gum arabic producers, processors and marketers in Magumeri Local Government Area of Borno State, Nigeria which revealed that Family sizes of those respondents were mainly between 6-10 people (Gwary*et al.,* 2013).

The table further reveals the distribution of respondents based on level of education attained. It shows that 65.2% of the respondents attained tertiary institutions. 19.6% attended secondary schools while 13% attended primary schools. 2.2% had no formal western education. This shows that the present gum arabic production in the study area is carried largely by elites. In a study conducted on 1184 gum arabic farmers in 15 States in Nigeria by Sagay and Mesike (2011) it revealed that 47.4% had no formal education. Gwary*et al.* (2013) also conducted a study on gum Arabic producers, processors and marketers in Magumeri Local Government Area of Borno State, Nigeria. Their study revealed that 34.6% attended various tertiary institutions, which means that they have the required levels of education that enable them to easily understand and adopt new agricultural technologies. Farmer's level of education positively affects his ability to adopt new farming technologies due to his ability to read. The educational level could also facilitate efficient performance in terms of processing and marketing of gum arabic.

The distribution of respondents according to number of adults in their respective households is also explained in the table. 45.7% of the respondents had 1 – 5 adults in their respective households while 34.8% had 6 – 10 adults with a mean of 7 adults. Number of adults in a family that work on gum arabic farm determines the availability of family labour.

The findings further indicate the distribution of respondents based on their nature of farming. That is whether they are full time farmers or combine farming with other jobs. It reveals that 58.7% of the respondents were part time farmers combining farming with other jobs while 41.3% were full time farmers. This is in line to findings of Sagay and Mesike (2011), who stated that gum arabic production, is exclusively from gum bearing trees and local producers are typically peasant farmers picking gum exudates as a secondary or complementary source of revenue.

The table also shows the distribution of respondents based on their type of farming, that is, whether they cultivate gum arabic as a sole crop or grow other crops beside gum arabic. The table shows that 87% of the respondents cultivate gum arabic as a sole crop while 13% of them are involved in mixed cropping.

Table one further shows the distribution of respondents based on their years of experience in gum arabic farming. It reveals that 56.6% of the respondents have 1 – 5 years of experience in gum arabic farming. About 37% have 6 – 10 years of experience while only 6.5% have an experience of more than 10 years in gum arabic cultivation. This indicates that at present, gum arabic farming in the study area can be perceived as 'new' because 93.5% of the farmers do not have more than 10 years of experience in gum arabic farming. This is in line with the study of Sagay and Mesike, (2011) which revealed that gum arabic production in Nigeria is mainly

from the wild as there are 2.45 million hectares of wild groove in forest reserve while 1625 ha and 9766 ha of organized planting were owned by government and private sector respectively.

Table 1: Socio Economic Characteristics of Respondents.

Gender		**Frequency**	**Percentage (%)**
	Male	43	93.5
	Female	3	6.5
	Total	46	100
Marital status			
	Single	2	4.3
	Married	44	95.7
	Total	46	100
Age (years)			
	< 30	1	2.17
	30 – 39	9	19.57
	40 – 49	12	26.10
	50 – 59	14	30.43
	60 – 69	10	21.73
	Total	46	100
	Mean	49	
Household Size			
	1 – 5	10	21.7
	6 – 10	13	28.3
	11 – 15	7	15.2
	16 – 20	5	10.9
	21 – 25	6	13.0
	26 and above	5	10.9
	Total	46	100
Level of education			
	Informal education	1	2.2
	Primary school	6	13.0
	Secondary school	9	19.6
	Tertiary institution	30	65.2
	Total	46	100
No. Adults in Household			
	1 – 5	21	45.65
	6 – 10	16	34.78
	11 – 15	5	10.87
	16 – 20	4	8.70
	Total	46	100
	Mean	7	
Nature of Farming			
	Part Time	27	58.7
	Full Time	19	41.3
	Total	46	100

Type of Farming				
	Gum Arabic Only		40	87
	Gum Arabic With Other Crops		6	13
	Total		46	100
Years of Experience in Gum Arabic Farming				
	1 – 5		26	56.5
	6 – 10		17	37.0
	> 10		3	6.5
	Total		46	100.0
	Mean		5.24	
Annual Income (₦M)				
	< 1		5	10.87
	1 – 5		38	82.61
	6 – 9		2	4.35
	≥ 10		1	2.17
	Total		46	100
	Mean		₦3,035,260.87	
Gum Arabic Farm Size				
	1 – 5.9		20	43.5
	6 – 9.9		10	21.7
	≥ 10		16	34.8
	Total		46	100
	Mean		16.64	
Access to Agricultural Extension/Research Services				
	Have Access		46	100
	No Access		0	00
	Total		46	100

Source: Field survey, 2014

Table 1 also reveals the distribution of respondents according to the level of their annual income. It shows that majority of the respondents (82.6%) earn between $1 – 5$ million Naira annually. 10.9% earn < 1 million Naira, 4.4% earn $6 – 9$ million Naira while 2.2% earn more than 10 million Naira annually. This means that gum arabic production as well as all its technology adoption was taken by relatively 'rich' citizens in the study area with a mean annual income of three million Naira (3₦M). ARCN (2011) stated that about 80% of the people in Gombe State are mainly peasant farmers involved in farming food and cash crops, such as cassava, sweet potatoes, cocoyam, guinea corn (sorghum), millet, maize, rice, cowpea, gum arabic, date palm, groundnuts, beniseed, soyabeans, tomatoes, pepper, cabbage, green vegetable, cotton, sugar cane and kenaf.

The results of a study conducted on gum arabic producers, processors and marketers in Magumeri Local Government Area of Borno State, Nigeria stated that In terms of economic

buoyancy, 44% of the respondents earn between ₦100, 000 – ₦200, 000, while 33.3% and 22.6% earn between ₦201, 000 – ₦500, 000 and above ₦500, 000 possibly because of the high levels of education attained by the respondents (Gwary*et al.,*2013). The result is however in line with statements of Peter *et al.* (2012) who concluded that literature on technology adoption emphasizes the role of fixed and variable costs. This gave the relatively rich citizens upper hand over the peasant farmers in adopting gum arabic production technologies in the study area. It can be noted that the peasant farmers are usually involved in wild gum picking.

The table further reveals the distribution of respondents based on gum arabic farm size. It shows that 43.5% of the respondents have a farm size which ranges from 1 – 5.99 hectares. 34.8% have 10 hectares or more of gum arabic plantation while 21.7% have 6 – 9.99 hectares of gum arabic each with a mean of 16.64 hectares. This means that majority of the respondents are small – scale and medium scale gum farmers. This is in agreement with the statement of Sagay and Mesike (2011), who stated that local gum arabic producers are typically peasant farmers. More so, Gum Arabic Policy Note (2007) disclosed that in the case of Sudan, gum arabic is primarily produced by small-scale farmers.

This result is also in line with Afaf *et al.* (2005) who stated that model results confirm the critical importance of farm size and size of inherited land for the initial adoption of gum production. Considering the long term rotation of the plantation (20-30 years) only farmers with large holdings and stable ownership will be able to adopt gum agroforestry system. Previous research on the adoption of sustainable agricultural practices shows similar findings. In northern Honduras small farmers appear hesitant to commit their only plot to cover crops if no other land is available for the wet season.

The distribution of respondents based on access to agricultural extension/research services is also explained in the same table. All the respondents explained that they access agricultural extension/research services. Access to extension services influences adoption of agricultural technologies Atala (1992) in Bose *et al.* (2012). Access to extension services is known to influence adoption of modern farm technologies.

Socio Economic Characteristics of Respondents which Influence Adoption of Gum Arabic Production Technologies.

Socio economic characteristics of farmers influencing the adoption of gum arabic production technologies were evaluated using multiple regression analysis. Four functional forms (linear, semi log, exponential and double log) were tried. Linear function gave the best fit and the result is presented in Table 2. The result of the analysis shows that the coefficients of income and farm size were positive and significant at 10%, educational level and age were significant at 5% though age was negative which signifies an inverse relationship while that of farming experience and access to extension were significant at 1%. This implies that as farmers grow older, they tend to resist adoption of new farm technologies. Income also plays an important role in adoption of gum arabic production technologies in the study area. This was connected to the fact that gum arabic plant takes long term (20 – 30) years before it can complete one rotation of plantation which makes it very difficult or impossible for peasant farmers to adopt. But only the relatively rich individuals can have the capacity to do so. This might be the reason why peasant farmers resort to wild gum picking, Sagay and Mesike (2011).

Farmers' farm size also influences their ability to adopt gum arabic production technologies as can be seen from this result. This is connected to the high income and large farm size which

influence farmers' access to extension services, hence adoption. The result also revealed that respondents' educational level influences adoption of the said technologies. The adoption of any agricultural technology depends on some factors. Ekpe and Obeten (2004) stated in Nasir (2005) that the adoption of improved agricultural technology is influenced by socio - economic factors such as age, household size, educational level, occupation and the like. Other factors as mentioned by Bose *et al.* (2012) Include farm size, value of farm products sold, farming experience, leadership role and empathy.

Table 2: Regression Result on Factors Influencing the Adoption of Gum Arabic Production Technologies

Variable	Coefficient	Std. Error	t-Statistic
Constant	30.04395	20.67964	1.452828
Gender (X_1)	-11.10380	8.725163	-1.272618
Age (X_2)	-0.555926	0.263073	-2.113204**
Marital. Status(X_3)	0.150836	0.466648	0.323233
Family size (X_4)	-0.036208	0.487175	-0.074323
Educational level (X_5)	18.20535	8.335116	2.184175**
Household size (X_6)	0.185869	1.008548	0.184294
Income (X_7)	0.071133	0.041027	1.733794*
Farming experience (X_8)	5.415765	0.748284	7.237582***
Farm size (X_9)	0.142134	0.083007	1.712314*
Access to extension (X_{10})	11.29168	3.829817	2.948359***
Membership (X_{11})	14.08061	13.03936	1.079854
Adjusted R-squared	0.684761		
F-statistic	10.08373***		

*Source: Field survey 2014.   *** significant at 1%; ** significant at 5% *significant at 10%.*

CONCLUSIONS

The socio economic characteristics of registered gum arabic farmers revealed that 93% were males and 95.7% were married, with a mean of 7 adults in their respective households. This study has also shown that 58.7% of the respondents were part time farmers while 41.3% were full time farmers. It also reveals that 87% of the respondents cultivate only gum arabic in their farms. Also, 56.5% of the respondents have 1 – 5 years of experience in gum arabic farming. 82.2% of the respondents earn between 1 – 5 million Naira annually and majority (65.2%) attended tertiary institutions. As for the socio economic factors influencing adoption of gum arabic production technologies in the study area, results of the regression analysis revealed that age, level of education, farming experience, income and farm size were significant at various levels though age is negative signifying an inverse relationship. This means that gum arabic farming is taken up by relatively rich and highly educated elites in the area. Efforts are therefore necessary through extension services from ADP to extend such ideas to peasant farmers. Governments also through the financial institutions should create and sustain agricultural loans which should cater for long term investments such as establishment of plantations. The main extension agency should also encourage young farmers for their involvement and adoption of gum arabic production technologies.

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