The effects of rain-fall on gum Arabic production in North Kordofan State (1990-2012)
Dr. Ghada Yasseen a, Dr. Ali Salih b and Prof. Mohammed Ahmed c

Abstract
Gum Arabic is the trade name of a non timber natural forest product. It is produced from the trunk and branches of Acacia senegal (hashab) and Acacia seyal (talha) trees grown in the gum Arabic belt across the Sudan. Sudan is the major producer of raw gum Arabic in the world, supplying more than 80% of high quality product in the world market during the last decades. Most of the gum Arabic production in Sudan occurs in North Kordofan State and marketed through El Obeid crops market being the largest market for raw gum Arabic in the world. The paper used secondary data obtained from relevant official sources. It carried out the simple regression analysis to estimate the effect of the rain-fall on gum Arabic in North Kordofan State during 1990-2012. The results of the study illustrated that there is a significant positive relationship between rainfall and the quantities of gum Arabic produced. The R-square was reported to be low reflecting 44% of rainfall and the rest is related to other non-captured factors by the model. The study recommended better tapping technology to increase gum yield per tree, and to provide encouraging prices and marketing policies to increase the share of the producers out of the export price. The study also recommended the provision of tapping labor with drinking water needs during tapping and harvest time to develop a healthy atmosphere for gum Arabic sustained production.

a Ghada Ahmed Musa Yasseen: Assistant professor in Department of Agricultural Extension and Economics, Faculty of Agriculture, University of Dalanj, Sudan. E. mail: gadayasseen@yahoo.com

b Ali Abdel Aziz Salih: Associate Professor in Department of Agricultural Economics, Faculty of Agriculture, University of Khartoum, Sudan. E. mail: hadiasib@yahoo.com

c Mohammed Elawad DafaElla Ahmed: Professor – University of Dalanj. E. mail drmoh70@yahoo.com

Introduction:
The purpose of this paper is to shed light on gum Arabic production in Sudan and to estimate the effect of rainfall, as a main determinant, on gum Arabic production in north Kordofan state during (1990-2012). Sudan is the third largest country in Africa with an area of 1.9 million square kilometers. Its total population in 2008 was about 33.4 million people (Sudan Central Bureau of Statistics, 2009). Maps (1 and 2) show the Sudan location and main geographical and administrative features respectively.
Particularities of gum Arabic production in Sudan:

Gum Arabic is "The dried exudation produced from the stem and branches of *Acacia senegal* and the related species" (FAO, 1999 and Yasseen, 2001). Sudan is one of the leading global producers of gum Arabic which is primarily produced by small-scale farmers in “Gum Belt”. The Sudanese Gum Arabic belt is composed mainly of acacia trees and covers the whole poor savanna area from far western border with Chad to the far south eastern border with Ethiopia. Map (3) shows gum Arabic belt across Sudan.

Sudan is considered as a major supplier of raw gum Arabic in the world as it used to provide more than 80% of high quality gum Arabic in the world market (Larson, 1991; Macrae, 2002; and FAO, 2005). The financial returns of gum Arabic support the vulnerable small producers in the traditional rain-fed
area of Sudan. The acacia trees also contribute to the provision of energy and construction needs of these households supplying them with firewood, timber for building and furniture making up.

The acacia tree cycles ranges between 20-25 years when it becomes fully mature. The tree starts producing the gum at 5 years after planting. Gum Arabic is obtained from the sap of acacia trees.

The beginning of gum Arabic production season starts after the end of rains. By that time, the tree growth stops and loses its leaves and becomes dormant. The gum producer taps the tree using an axe or hook (sunki) tool which makes a scar on the bark of the branches and creates a wound thus facilitating the flow of the gummy sap over the following weeks. The amber-like gum glistens under sunlight (Yasseen, 2001).

The production of gum occurs as a physiological process in response to a wound made, and a gum sap exudes out to protect the branches of the tree against external factors and infection (Awouda, 1974 and Yasseen, 2001). Then, the producers come and collect crude gum in lumps.

There are two tapping seasons, the first one in October/November and the second is in March/April. The first collection is made after 3 to 6 weeks from tapping, followed at intervals of 10 to 15 days. About 4 to 8 collections can be made in the season (Awouda, 1974 and Yasseen, 2001).

Annual yield of gum varies widely among trees due variation in the level of husbandry practice and age of the tree. Yasseen (2001) concluded that in North Kordofan State, an average yield of gum tree would be about 250 grams per season. He expects high production based on optimal timing and procedure of tapping and number of collections per season.

**The performance of gum Arabic production in Sudan:**

During 1990 – 2012, the production of gum Arabic in Sudan witnessed an increasing trend rising from as low as 20000 metric tons in 1990 to a high 40000 metric tons in 1995 and down to 350000 metric tons by 2012. However this increasing trend was intercepted with ups and downs during the period. Figure 1 demonstrates the rising trend with fluctuations of gum Arabic production in Sudan during 1990-2012.

*Figure (1): Sudan gum Arabic production during (1990-2012)*

![Gum Arabic production graph](image)

Source: Bank of Sudan, various reports
The relationship between gum Arabic production and rainfall in North Kordofan State:

In Sudan, particularly in North Kordofan state the two species of acacia trees give the country the leverage of producing and exporting most of the high quality gum products in the world (Yasseen, 2001). This paper focused on estimating the relationship between rainfall and production of gum Arabic in North Kordofan State. The State has been selected as a case study due to its central location and largest area-size within the gum Arabic belt of Sudan. The State falls in the south savanna north semi-desert climatic region. The main activity of the population is agriculture and grazing. This state also has a number of crop-forest rehabilitation projects that aim at improving production and returns of the traditional farming sector and at rehabilitating, conserving and protecting the vegetative cove and consequently the environment. The capital of the State is "El Obeid", which accommodates the largest raw gum Arabic market in the world.

According to the metrology station and Ministry of Agriculture in North Kordofan State, the State is subjected to volatility of rainfall which is reflected on its production of gum Arabic. Figure (2) demonstrate the variation in rainfall in north Kordofan State (1990-2012) and figure (3) illustrates the pattern of gum Arabic production in North Kordofan State during same years.

![Figure (2): North Kordofan average rainfall during (1990-2012)](source)

Source: Ministry of Agriculture - El Obeid (2012)

The production of gum Arabic in North Kordofan State seems to be influenced by many factors. The main one is assumed to be related to the changes in rainfall pattern and intensity. Other factors are related to prices, transportation cost, poor enabling services especially shortage of drinking water for tapping and collecting labor during harvest season.
Empirical estimation of the relationship between gum Arabic production and rainfall in North Kordofan State:

Methodology for data collection and analysis:

The study used secondary data in order to investigate the empirical relationship between the level of gum Arabic production and the level of rainfall in North Kordofan. The data was obtained from official sources especially from the State Ministry of Agriculture of North Kordofan, Bank of Sudan and from the meteorology stations in North Kordofan. The data covered gum Arabic production quantities and rainfall during (1990-2012).

The study used the simple linear regression analysis method to detect the existence of a relationship between rainfall and level of production of gum Arabic in the State. The regression analysis was based on time series data. The study hypothesis was that there is a positive relationship between the level of gum Arabic production as a dependent variable and rainfall as an independent variable. The production function has been specified below:

\[ Q = b_0 + b_1(A) \]

Where:

- \( Q \): quantities of gum Arabic produced in North Kordofan State in tons per year.
- \( A \): Annual rainfall in North Kordofan in mm

Results:

Table (1) gives the results of the analysis. The coefficient of determination \( R^2 \) was found to be equal to 44%, which meant that about 44% of the variations in gum Arabic production in North Kordofan State could be attributed to rainfall situation during the period 1990-2012. The rest of the factors, about 56% could be attributed to other variables not captured by the regression model. However, the value of the F-test which was over 4.961 indicated the overall significance of the model.

The regression results indicated the existence of the positive relationship between the level of production of gum Arabic and the level of annual rainfall in the State during the cited period.

Annual rainfall had a coefficient of 5.495, which was significant at 10% level. This meant
that as the rainfall would increase by 100 mm per year, other variables remaining constant, the total production of gum Arabic would increase by 5.495 tons per year.

Table (1): North Kordofan gum Arabic production during (1990-2012)

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>Regression coefficient</th>
<th>t-statistics</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-3187.470</td>
<td>-1.063</td>
<td>.300</td>
</tr>
<tr>
<td>Annual rainfall</td>
<td>5.495</td>
<td>2.227</td>
<td>.037</td>
</tr>
</tbody>
</table>

$R^2 = 44\%$
F ratio = 4.961
Level of significance of $F = .037$

Since there is no evidence about increasing gum Arabic production and provision of supplementary irrigation, the study infers its recommendations from the non-captured portion of the regression model result. Therefore, the study recommends the provision of enabling services, especially drinking water during tapping and collection periods, and facilitating rational pricing and marketing policies to encourage more production of the gum Arabic commodity.

References:
