Acacia-Senegal (Gum Arabic) Product Statistical Analysis Western Sudan: N. Kordofan State 1964 - 2017

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Abstract: *Gum Arabic (Acacia Senegal) is a multi-benefit tree. Socio-economic and environmental settings are the most to be provided by this species in all over the rural areas of western Sudan. The spatial extent of this valuable product is through the Savanna gum belt from the West to East Africa cross Sudan includes the main producer zone in North Kordofan State. This study has been carried out with the aim of analyzing the Hashab product that experienced remarkable fluctuating during the last three decades. Quantified data concern the Gum Arabic in North Kordofan (Sudan's main producer) had been used for the period 1964-2009. Statistical programs such as SPSS and excel has been used for the analysis. The main parameters analyzed are means, product values deviated from the mean, correlations, histogram, charts, and 10 years' periodical analysis. The results showed the significant fluctuations in the Hashab gum product that were depicted during the 1970s, 1980s, 1990s, and 2000s with remarkable decreasing during drought years. The reasons behind decrement are many, range from a high rate of deforestation, forestry mismanagement, and less attention to the Hashab afforestation programs.*

Keywords: Gum Arabic Acacia Senegal Hashab tree Gum-belt

1. Introduction

Acacias are distributed differently in the world. There are five hundred species ecologically grow in the Africa's Sahelian Region. There are two species present as major sources of gum arabic and are commercially exploited for this commodity: A. Senegal and A. seyal. About 80% of all commercial Gum Arabic is derived from A. Senegal (Gum Hashab) (Anderson 1977). The economic and environmental benefits of Gum Arabic production in the Sudano-Sahelian zone appear attractive (Barbier, 1992). The term Hashab tree is used here as local term refers to "Acacia Senegal" species. Acacia Senegal (Gum Hashab) the main source of gum Arabic is one of many tree species produce gums, such as gum karaya and gum tragacanth (Andreson, 1984). Gum Arabic is among the oldest internationally traded non-timber forest products. The commodity is extracted from Acacia species adapted to the drier agro-ecologies of tropical regions (Abtew, et al.,2013).

As far as the concept of Gum-Arabic is concerned, it is the dried exudation obtained from stems and branches of Acacia Senegal (Gum Hashab) and Acacia Seyal (Gum Teleh) (FAO, 1998). Gum Hashab constitutes about 85% of the total Gum exported by Sudan, while the Gum Teleh (Acacia Seyal) represents 15% of the exportation. The total amount of Gum Arabic exported by Gum Arabic Company (GAC), during the period 1970-2004 was 899824 metric tons, out of which 85.8% was Gum Hashab and only 14.2% was Gum Teleh (Mohamed,2008). Hashab tree has many indirect benefits such as controlling soil erosion as reducing the rate of the runoff, nitrogen fixation, wind breakers and dune fixation. Gum Arabic has a Physico-chemical property that introduced in many industries such as food and pharmaceutical (William, 2009).

The international demand for Gum Arabic is increasing and its annual demand expected to reach nearly a million metric tons, while the Sudan international share is continuously decreasing. Since the 1920, Gum Arabic was the Sudan's leading export product (Mohamed, 2008). Gum Arabic "Hashab" from Sudan is of the highest quality (FAO, 1990). Gum Arabic provides on average 12% of the gross domestic product of the country and accounts for about 10 – 15 % of the income of the gum producers and other farmers in the gum belt across Sudan, (Elamin, 2017). The Gum Arabic company (GAC) was established in 1969 to cater for the organization of the internal and external gum trade. Historically, in North Kordofan State, the Gum Arabic tree species was well adopted as the cash crop support economic revenues. Environmentally, Hashab Gum tree is practiced as a part of the crop fallow system. It provides soils fertility for cultivating annual crops such as millet, sesame, sorghum, groundnuts, watermelon, and karkadi (Ballal, 1991). Acacia Senegal is a tree of about 6 to 9 m high, which is abundant in the Sudan, particularly in the province of Kordofan (William, 2009).

There are about five main processes for gum arabic activity: planting, tapping, collecting, marketing, and exporting. Gum arabic production is mostly dependent on relatively small land holdings locally known "Guenina" or gum orchards (Taha, 2009). Guinana (garden) is defined as "An area where Hashab trees that roughly enclosed and where the tappers perform their annually tapping processes on September to November" (Ibrahim et al 2017). Depending on the seasonal climatic behavior, the optimum tapping data varied from October 10th to November 15th and the average gum productivity per tree varied from season to another.

The recent problem concerns Gum Arabic sector's policy comes as normal consequences of the 1992 economic liberalization policy in Sudan. Such policy is tended to

rearrange Sudan's Gum Arabic production and livestock based on its comparative advantages (Ghada, et al, 2014). There are many indicators over the study area that highly used in evaluating the Hashab Gum problems. The main as stated by (GAC) are; the reduction of the productivity per garden, the increasing prices of Gum Arabic product, rainfall fluctuation, the decrease number of tappers, the increase of drought events and the spread of land degradation signs.

2. Problem Characterization

In the arid and semi-arid regions of Africa, land degradation and soil fertility depletion are considered to be the major threats to natural resource conservation and food security (Garrity *et al.*, 2010). Hashab deforestation is a phenomenon that highly caused by human activities. Most of Hashab belt areas including North Kordofan have experienced a significant Gum product decreasing in the last three decades. Gum productivity highly affected by the traditional farming system, tapping intensity, rainfall variability and drought events. Recently, the revenue from Gum Arabic is depressed. The producers obtain only 15% of free on-board (f.o.b.) prices and have limited access to market information and formal credit (IFAD, 2009). Gum production accounts for about 15.3% of the household income of gum producers in the gum belt in Sudan (Taha *et al*, 2013). In 2011 Sudan exported 45.633 metric tons, while in 2010 only 18.202 metric tons were exported with sharp drop in revenues from 8108 to 23.8 million dollars that showed about 58 million dollars' difference.

The new trend in smuggling the Sudan's Gum Arabic product is emerged at the bordered countries. This new corrupted system displaced thousand tons of Gum product to be sold away from country's official regulations. This new system affected the Sudan's international marketing competition. As reported by the GAC (annual report for production assessment), consequences of two severe Sahelian droughts (mid 1970s and mid 1980s), political unrest and inadequate marketing arrangements have resulted in the emergence of new gum exporters (Chad and Nigeria), and the most Sudan's share of the world market was declined to 50% (GAC, 1999).

2.1 Previous Related Studies

Most of those who studied the Gum Arabic in Western Sudan in general or North Kordofan in particular from different views concluded the same results that there are significant changes in the production of the Gum Arabic (Hashab product). In 2019, Tutu, et al., published a paper about the contribution of Gum Arabic products to rural household income in Sheikan locality of North Kordofan State, Sudan. They discussed the contribution of Gum Arabic to rural household income and income sources distribution and expenditures of household. In 2018, Dodah and Abubaker Adam, published a paper about the effect of conflict on Gum Arabic production in Sudan, while in the same year **ElTohami** published a research about the threats to green Gum Arabic production in Sudan. He discussed the constraints that affected the Gum Arabic production. In (2017) many studies were published about the Gum Arabic in Sudan. Hassan (2017) wrote about the assessment of Gum

Arabic marketing systems in main Auction Markets of North Kordofan State-Sudan. Elamin (2017) in his master degree of science about the effects of the locust (Anacridium melanerhoclon) on Gum Arabic production was explained the infested of the locust over the areas of Gum Arabic. Ibrahim, et al., (2017) were done a research about productivity and economic of Gum Arabic in Sheikan locality, North Kordofan State, Sudan. They used statistical analysis methods such as gross margin and regression analysis. Khalifa, et al., (2016) were done a paper that relates the Gum Arabic with the climate change. They studied the North Kordofan Belt focusing on the frequent droughts consequences. Also, they investigated the climate change adaptation strategies adopted by local communities in the Gum Arabic belt of North Kordofan. Ghada (2014) in her master of science in agricultural economics discussed the main constraints of Gum Arabic production and its export system. She revealed that the market costs were very high that resulted negatively on Gum Arabic market margin and the traditional technology used by tappers had the lesser quantity and quality and the benefit for the farmers. Also, in **2014, ElNim**, and ElShiek wrote about the complication of Gum Arabic marketing at El-Obeid Gum Arabic market, North Kordofan State, Sudan. El-Sheik (2004) wrote about the adequacy of price incentives on production processing and marketing of Gum Arabic in Sudan.

The common point in all the previous studies related to this study is that there are many problems facing the Gum Arabic production in Sudan, includes the study area (the main producer).

3. Study Area

3.1 North Kordofan Geographical Location:

Western Sudan States are estimated to produce more than 50% of the Sudan's total Gum Arabic production (GAC,1999). For the purpose of this research, North Kordofan is defined to represents the study area. The North Kordofan State locates within a typical semi arid climate zone. It lies between 12° 14 and 16° 38 N, and 27° 30 and 32° 22 East fig (1). ElObeid is a famous city and the capital of North Kordofan State. The state covers an area of about 185.302 km^2 and consists of 8 localities. All of these localities are Gum Arabic producers, though they differ in their rate of production. The state presents Sudan's main producer and shared with greater than 80% to the overall product of the country. The characteristics of the area's rainfall ranges from 150 to 354 mm and maximum temperature of 37 C in an average. Hashab tree grow naturally under the climate condition with a rainfall ranges between 320-380 mm. In addition to Acacia Senegal, other dominant tree species over the study area are composed of; Leptadenia pyrotechnica (Marikh); Acacia albida (Haraz); Calotrpis procera (Usher); Acacia Mellifera (kiter); Acacia nubica (Loat); Balanites aegyptica (heglig). Annual grasses are scattered all over the study area, and its intensity also depends exclusively upon the rainfall levels and duration. Small-scale farmers practice gum Arabic represent up to 20% of Sudan's population, or around 6 million people (Ibrahim et al, 2017).
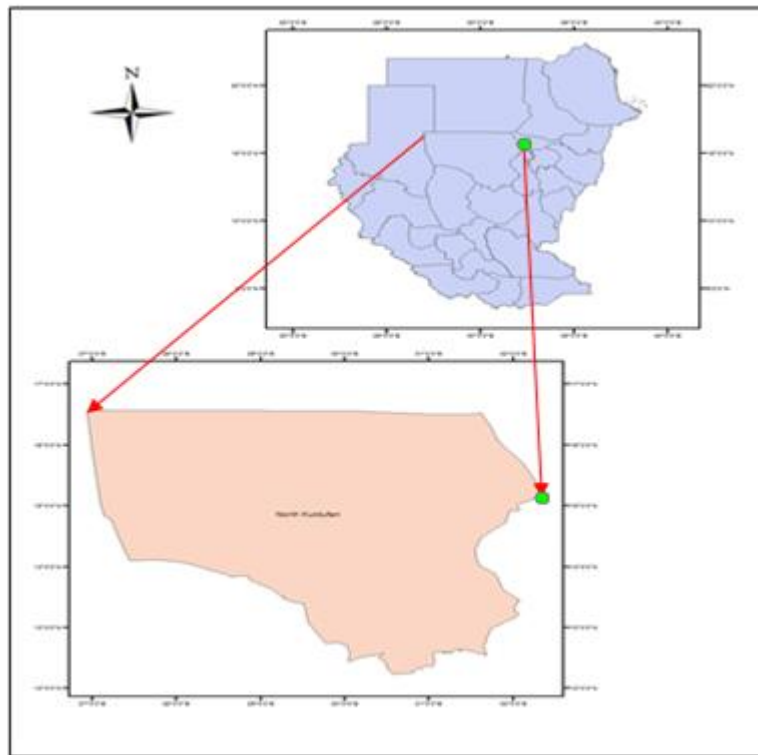
Figure 1: The North Kordofan State Spatial Extent

3.2 Gum-Arabic belt

The Acacia Senegal trees are widespread in Savannah and semi-arid Savannah areas between 10-15 north lines of latitude. The term "Hashab belt" or Gum Arabic belt refers to a sandy and clay plains transect in short grass savanna forming a continuous belt extends from east in the oceanic coast to the red sea coast at the west fig (2). Sudan country constitutes one fifth of the belt area, with so many environmental, social and economic benefits. The total area of Gum Arabic production belt is estimated to be about 10 million feddan (Mohamed, 2008). The belt covers the area of central Sudan that estimated to be 520.000 km2 (120 million feddan). It is recognizable that the gum Arabic belt within the Sudan consists of two parts (Awouda,1974). Eleven states constitute the Gum Arabic belt in Sudan from west to east are; Western Darfur, North Darfur, East Darfur, North Kordofan, Southern Kordofan, Western Kordofan, White Nile, Senar, Blue Nile and Gadaref. Al-Nuhud and Mazroub localities in the North Kordofan State are the main areas of producing high amount of Gum Arabic.
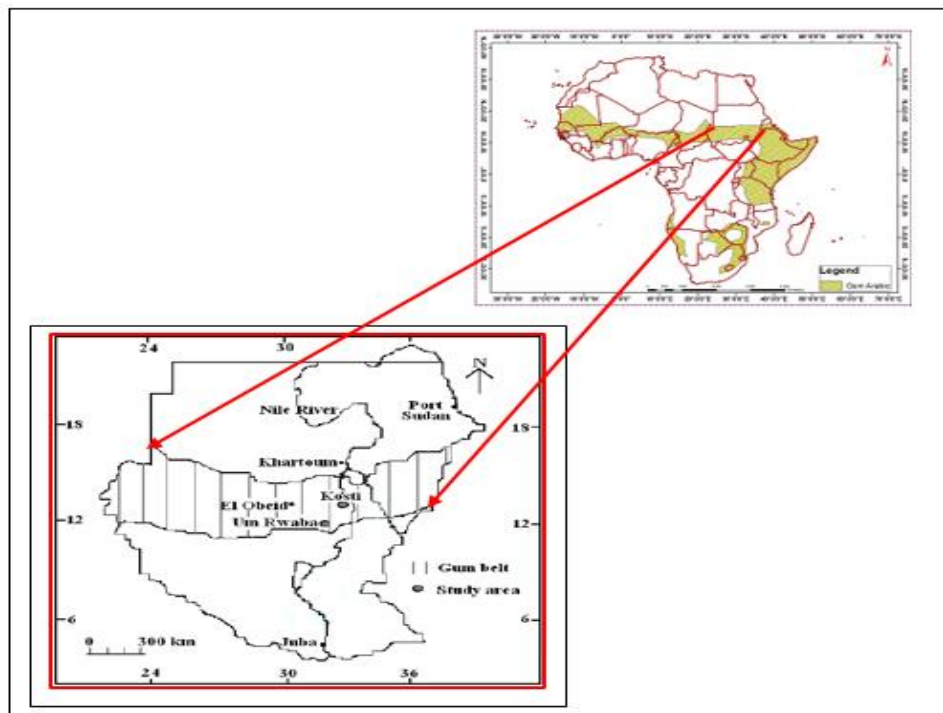

Figure 2: Gum Arabic Belt Sudan in Africa

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4. Methodology

4.1 Data used

As the Gum Arabic (Acacia Senegal) is influenced by several factors, long-term data concerns the product is required for statistical analysis. The availability of data helps in evaluating periodic production changes. The main data used for this paper was extracted and tabulated from two main sources, including Gum Arabic statistics office at Gum Arabic Market in ElObeid town and from GAC annual reports. The time series of the data used is from 1960 to 2009.

4.2 Analysis methods

Based on the nature of data, the researcher used statistical analysis, which has a significant gradient in geographical studies concern quantitative analysis. Quantitative approach becomes pre development demand that guide the problems to be solved in righteous decision. SPSS and excel are the most fundamental statistical packages of quantitative data analysis used in this paper. Each software includes many statistical parameters and specific advantages in analyzing data. The Statistical parameters applied for data processing and conversion are; tabulation, classifying data based on a periodic time series (each 10 years) and creating charts for more illustrations.

5. Results and Discussions

5.1 General Trends of Gum Arabic Production

As reported recently by the GAC, the overall Gum Arabic production in 2018 recorded 73.675 metric tons, which seems to be better than the previous years. The total amount of Gum Arabic exported by GAC during the 1970-2000 revealed 899824 metric tons, out of which 85.8% was Gum Hashab. The largest level of exportation was in 1970 (42057 metric tons) and the lowest level was in 1992 (8198 metric tons). This trend was realized the general analysis that the production of the Gum Arabic was started to decline since early 1970s. After that production was fluctuated till 1984-85 (the worst drought in Sudan) that affected all agricultural activities. In 1999-2000 again the product was witnessed a sharp decreasing at the level of the Sudan's total product. Table (1) presents statistical comparison between Gum Hashab (Acacia Senegal) and Gum Taleh (Acacia Seyal) exported during 1980-1999. During 1980s the product was better than 1990s as the differences calculated is 93489 metric tons.

Fig (3) presents the Sudan's Gum Arabic produced during 1949-1997. The clear trend of fluctuation had been shown during 1970s and 1980s and decreasing during late 1980s and earlier 1990s. The lesser products were harvested in 1984, 1990, 1991 1992, 1996 and 1997. During 1960s high amount of product were recognized, with one outstanding annual product in 1967.

Table 1: Exports of Gum Arabic from Sudan (metric ton) (1980-1999)

Years	Hashab Gum		Talhah Gum		total
	Met/tons	%	Met/tons	%	
1980	32221	13.37%	1080	3.20%	33301
1981	33554	13.92%	1990	5.89%	35553
1982	28534	11.84%	1700	5.03%	30234
1983	37840	15.70%	3408	10.08%	41248
1984	29603	12.28%	3632	10.75%	33235
1985	12618	5.24%	14210	42.04%	26828
1986	16482	6.84%	2235	6.61%	18717
1987	16099	6.68%	1645	4.87%	17744
1988	16672	6.92%	1931	5.71%	18603
1989	17385	7.21%	1967	5.82%	19352
Total	*241008*	***%100***	*33798*	***%100***	*274815*
1990	22960	15.56%	3952	7.86%	26912
1991	21543	14.60%	3435	6.83%	24978
1992	8198	5.56%	5870	11.67%	14078
1993	9925	6.73%	5805	11.54%	15730
1994	18359	12.45%	4396	8.74%	22755
1995	11564	7.84%	5283	10.50%	16847
1996	8388	5.69%	5334	10.61%	13722
1997	15576	10.56%	6972	13.86%	22548
1998	16107	10.92%	4882	9.71%	20989
1999	14899	10.10%	4367	8.68%	19266
Total	*147519*	***%100***	*50296*	***%100***	*197825*
Total	388527		84094		472640

Source: GAC, 1999

Fig (4) shows the percentages share of Sudan to the total world exports of Gum Arabic during (1991-1998). The trend showed declining in the Sudan's world contribution during 1990s, due to the new international markets direction that shift to import from other new producer countries. This as explained economically by agricultural researchers, affected the efficiency of Sudan's as the main world exporter. Table (2) presents world Gum Arabic main producers and their products during (1991-1998). Sudan, Chad and Nigeria are the top producers, while Sudan without rival stands as the main top producer and well known before the new markets emerged. From the table, we see the Sudan leads the twelve countries during 1990s except in season 1996.
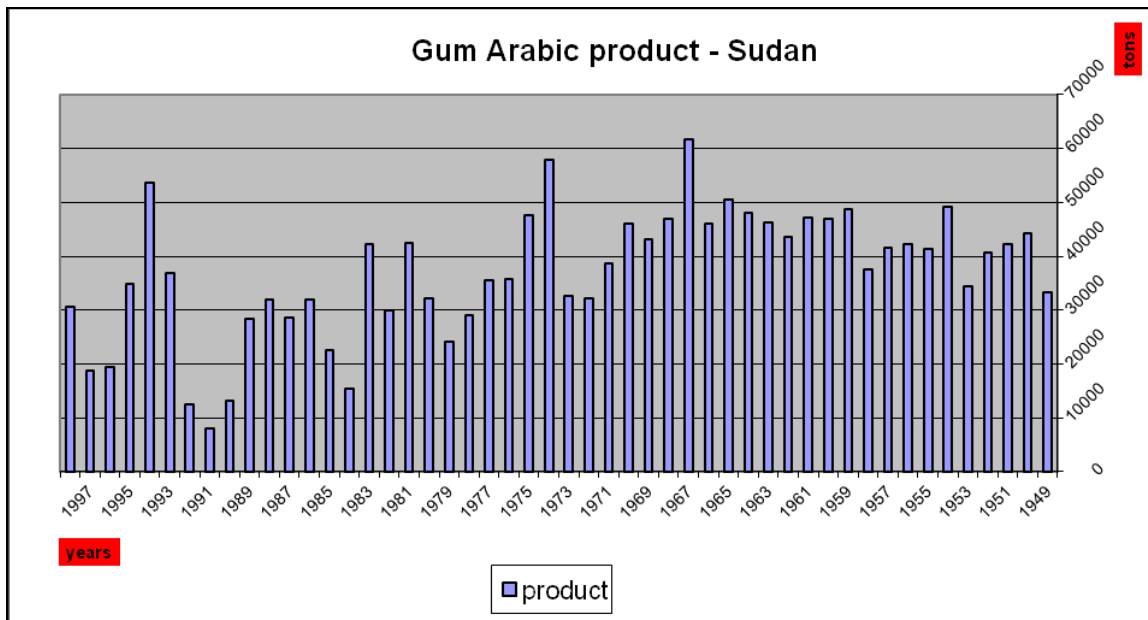
Figure 3: Overall Sudan's Gum Arabic product (1949-1997)

Figure 3: Gum Arabic Export from Sudan (1991-1998)
Source: GAC, 199

Table 2: Gum Arabic main producers and their scales of exports (000 tons)

Country	1991	1992	1993	1994	1995	1996	1997	1998
Sudan	25709	11596	12933	22.529	71.616	01.681	82254	92098
Chad	2188	2450	3696	4662	7021	7315	7714	31391
Nigeria	3734	7485	5224	6999	4569	4959	0	0
Mauritania	32	48	55	166	258	256	0	0
Senegal	262	261	459	362	662	229	0	0
Mali	112	31	77	249	295	242	0	0
Niger	27	155	228	240	110	242	0	0
C.Af.rep	74	78	33	119	126	639	0	0
Cameron	95	647	841	1031	161	560	0	0
Eretria	0	0	0	0	262	472	600	0
Ethiopia	35	58	98	329	127	15	0	0
Arab cont	117	43	87	30	11	20	0	0
Total	32385	72711	23731	36716	85218	16630	90568	123489

The Sudan's Gum Arabic belt includes many states. Fig (5) shows the product of the main five states, North Kordofan, Central, Darfur, Eastern and Upper Nile states. Without rival North Kordofan stands to be Gum Arabic main producer followed by Central and Darfur states.
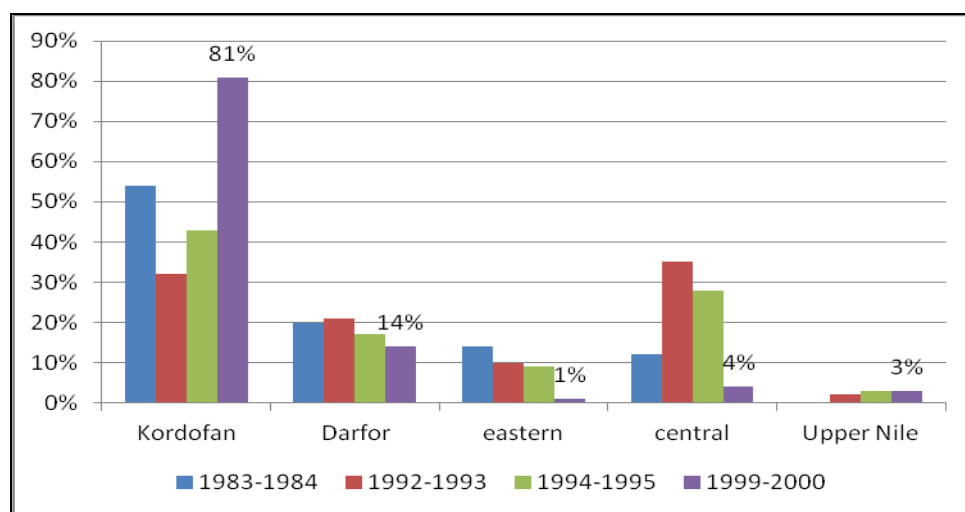

Figure 5: Sudan's states Gum Arabic production in Percentage

5.2 Study Area Gum Arabic Production analysis

The research classified the product of Gum Arabic in North Kordofan according to the periods 1960s, 1970s, 1980s, 1990s, and 2000s. An initial statistical view has been calculated. The results showed periodical variations table (3). From the records, the biggest quantity of gum product was produced during 1960s (49.97%) of the total product during the series times (1960-2009). The 1970s period showed sharp declined compared to the 1960s, when the product was dropped to 15.65% of the total product of the period, with a great difference value (2754454) Quantar. The trend of gum product shrinkages was reached its peak during 1980s when only (465598) Quantar were received at ElObeid gum market. This period represented only 6.63% as compared with the total product till 2009. With little increment the situation became better during 1990s as its percentage to the total product is 8.35%. During 2000-2009 the condition improved though there were years of less products, but the percentage to the total amount during the period of study was raised up to 18.76%, compared to 6.35%. Fig (6) presents the Gum Arabic product trends

during the time series from 1960 to 2009. We can assess from the figure the potential production during 1960s, while declining and fluctuating during the 1970s, 1980s and 1990s.

Table 3: Gum Product Periodical Assessment

Periods	Product	%
1960-68	3553172	49.97%
1970-79	1098719	15.45%
1980-89	465598	6.55%
1990-99	676606	9.51%
2000-09	1316980	18.52%
Total	7111075	100.00%

On the other hand, another statistical analysis has been done to show in more details the Gum Arabic declining trend in north Kordofan State. Fig (7) gives general statistical analysis of the product from two different views in percentage as calculated to be compared between percentage from periodic total (PFPT) and percentage from series total (PFST). The standard of categorization is the comparison between inter period seasons themselves, and later to the total product of the study period (49 years).
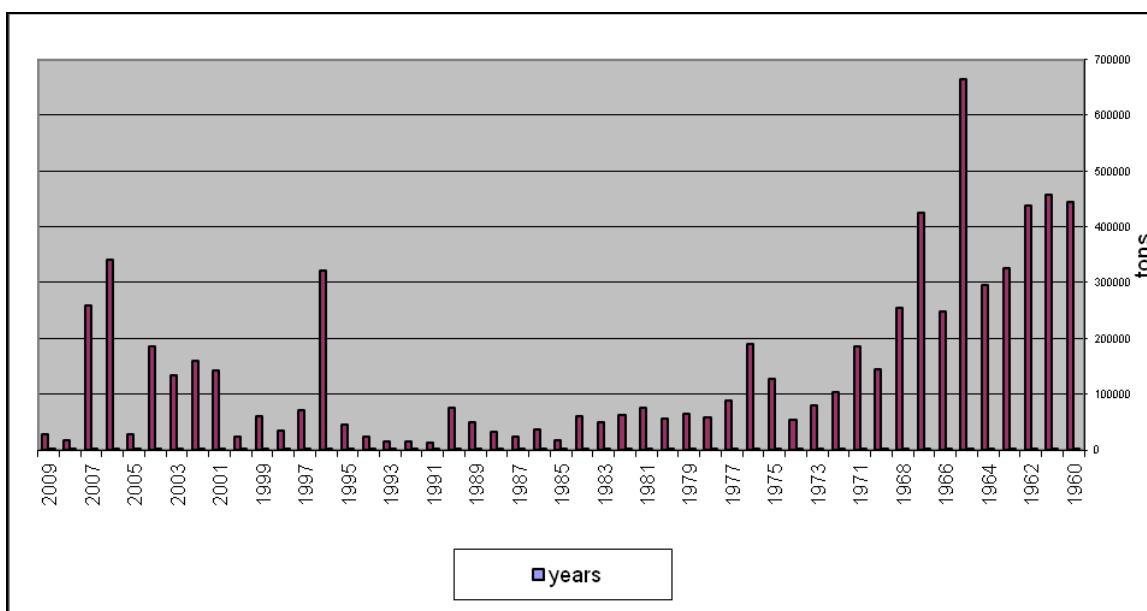

Figure 6: North Kordofan Gum Arabic Product trend of changes (1960-2009)
Source: ElObeid Gum Arabic Market Statistical Office 2012

The 1960s seasons showed no deviated records in Gum product. There were five outstanding years of gum product during this period, with only one year that the product was reached (663577) Quntar. The lowest product during this period was in 1967 and 1969 years when (247944) and (253912) Quntar were produced respectively. As compared 1960s with the 1980s and 1990s, results were depicted that in both periods, group of 10 years constituted nearly the product of a full one year in 1960s. So, the product during 1980-1989 was (465598) Quantar, while the product during the two lowest years of production in 1960s (1967,1969) was (491856) Quantar.

There were five years during the period 1970s showed less product as compared with the rest years in the same period. Their percentages are; 7.27%, 4.92%, 8.00%, 5.34%, and 5.96% in 1973, 1974, 1977, 1978, and 1979 respectively.

The worst years of product during this period were 1974, 1978, and 1979. During 1980s there were eight years that showed a clear trend of change in gum arabic product. As compared to the total product during the same period, each year shows 12.05%, 16.23%, 13.38%, 10.77%, 13.07&, 3.53%, 8.11%, 5.19%, 6.96%, and 10.71% in 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, and 1989 respectively. The less years of product were 1985, 1987, 1988, and 1986, which represents 0.23%, 0.35%, 0.46%, and 0.54% of the total amount of gum product during 1960-2009. The percentages of the product compared to the total amount produced during 1960-2009 for the years 1990-1999 are 0.68%, 0.17%, 0.22%, 0.35%, 0.66%, 3.29%, 1.02%, 0.48%, and 0.88%, with the worst years in 1991, 1992, and 1993.

When comparing between periods, we depicted that 1960s seasons were recorded high average amount (394,796.9) tons as the highest average. 1980s witnessed the drought years that influenced the Gum product that declined to (46559.8) metric tons, which is about 8.5 times than 1960s records. The product percentages ranked 1960s period at the top by 49.9% followed by 2000s (18.59%), 1970s (15.45%), 1990s (9.51%) and 1980s (6.55%).
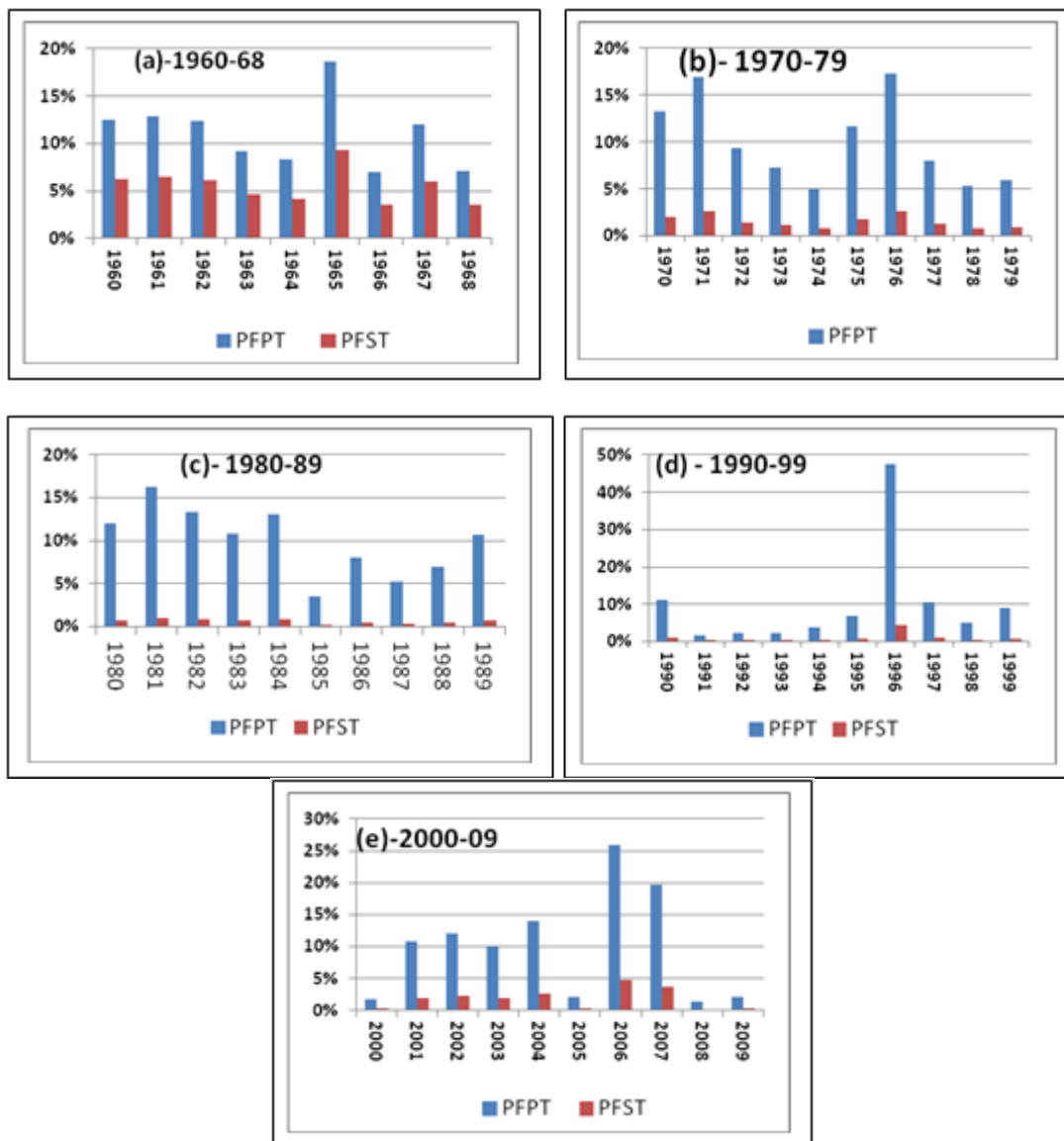

Figure 7: Gum Arabic product percentages

Based on the shared percentages that the seasons contributed by their Gum Arabic products, table (4) shows the evaluation of the periodical and overall Gum Arabic product shared percentages using frequently classes table. The higher products appeared in four upper classes were produced during 1960s. class 7 presents the higher product percentages where 3 years during 1960s are presented this class and nothing from other periods. On the other hand, class 1 presents lower product percentages. This class represents by all periods except 1960s, with most remarkable in 1980s as 9 years fall within the range of this class.

Table 4: Study area periodic and overall Gum product shared percentages

Classes %	No of seasons based on periodic classification					Total Season
	1960s	1970s	1980s	1990s	2000-09	
0.5 – 0.99	-	3	9	7	4	23
1.0 – 1.99	-	4	1	2	1	8
2.0 – 2.99	-	3	-	-	3	6
3.0 – 3.99	2	-	-	-	1	3
4.0 – 4.99	2	-	-	1	1	4
5.0 – 5.99	1	-	-	-	-	1
6.0 – 6.99	3	-	-	-	-	3
Total	8	10	10	10	10	48

The third statistic parameter used in analyzing Gum Arabic product is the mean deviation graphical presentation. This method has its significant value in showing the trend that relates all values with their mean. Subtracted product value from the mean of the product during the period (1960-2009)

was converted into graph, fig (8). There are 32 years in the chart their deviated values below the mean gave negative values.

Another statistical analysis histogram shows the distribution of the Gum Arabic Data used. The majority of the data are clustered on the left side of the histogram. The value of histogram in statistical analysis is to represent the frequency occurrences of Gum Arabic data along a data time series (1970-2010). From fig (9), the histogram presented right skewed shape, which means the data clustered in a positive

skewness. In this case, as we checked the mean and median, we concluded that the mean is greater than the median as calculated to be (88,747.58) metric tons and (61,166) metric tons respectively. The main statistical indicator is that the high values formulate the mean to the right (upward). From the figure we can identify the peaks of the data, which represents by the most longer cluster bars, compare to the lesser cluster bars. Also the histogram of data showed outliers as that occur in a selected bar at the end of the skewed bell.
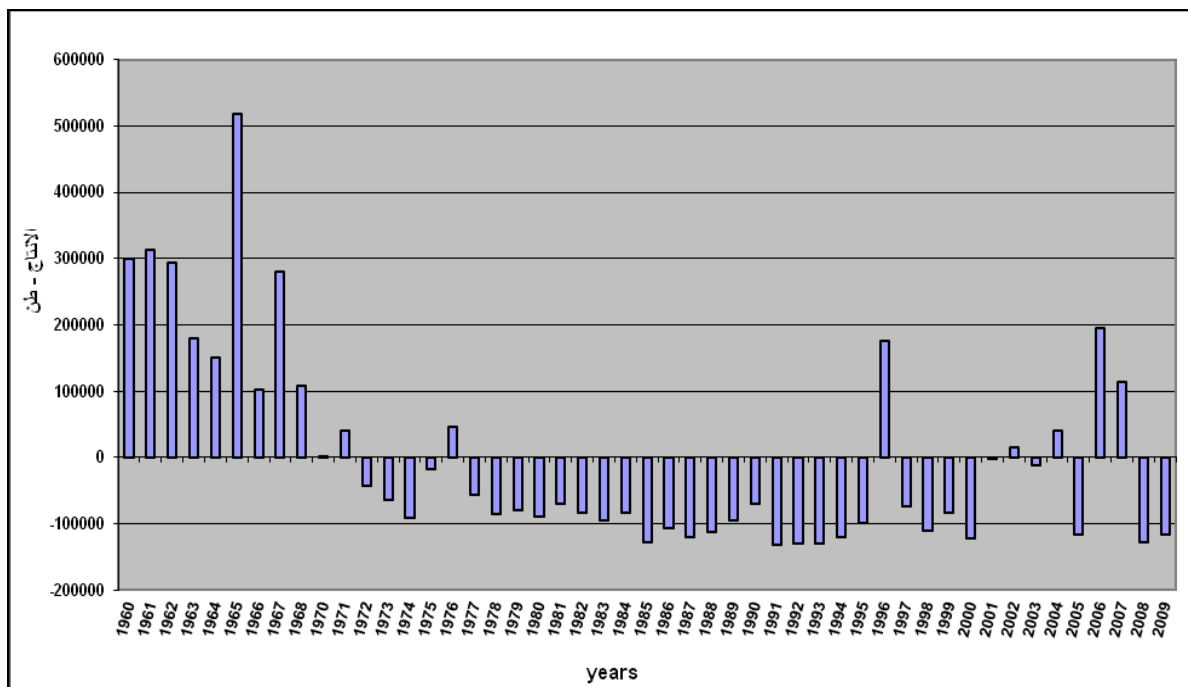

Figure 8: The deviated Gum product values from the mean
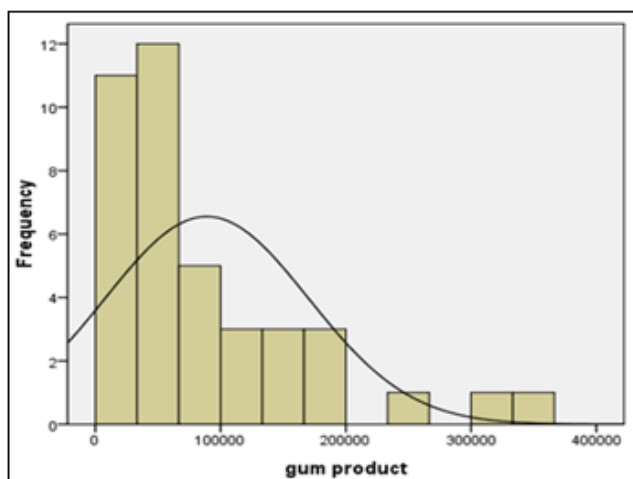North Kordofan State (1960-2009)

Figure 9: Study Area Gum Arabic Product Histogram Analysis

5.3 Gum Arabic Productivity Correlations

5.3.1 Gum Arabic and traditional strategies of farmers:
Acacia Senegal (Hashab) species lands are influenced by number of local factors that affect the annual production. The traditional system of cultivation practices by traditional farmers has a significant impact upon the quantity of Gum Arabic over the study area. The farmers exclusively depend on

opening new land for seasonal cropping at the expense of the Acacia Senegal plots. There are changes in seasonal crops productivity associated with the human activities. This was contributed much in adopting the new adaptation mechanism used by farmers. The easy way to gain money is to cut trees to compensate the crop failure economical deficit. The significant impacts upon Hashab lands were occurred during drought seasons mainly in 1984 and 1990 when the deforestation rate estimated by the forestry department to be the worst in the history of North Kordofan State. So, traditional farming was affected the overall Sudan's product via decreasing the state's annual product.

5.3.2 Rainfall and Gum Arabic product changes:
From general point of view, Gum Arabic trees throughout the region depend completely on rainstorms and no supplementary irrigation is needed. Also the trees do not need any fertilizers or any chemicals such as insecticides or pesticides. Acacia Senegal species depends on the rainy season intensity over the study area that extends from June to September. Whenever the rainstorms are of high soil moisture content, the Gum Arabic product expected to be higher in quantity and quality. In 2008 the rainfall was recorded extreme amount over the area (735.5) mm, but the gum product couldn't have exceeded (17824) tons compared to the (320,733) tons produced in 1996 though the rainfall

not exceeded 359.4 mm Fig (10). The explanation of this is that, the lands of Hashab lost the capabilities of producing much higher because Hashab plots were affected by deforestation and drought. The general trend is validated the

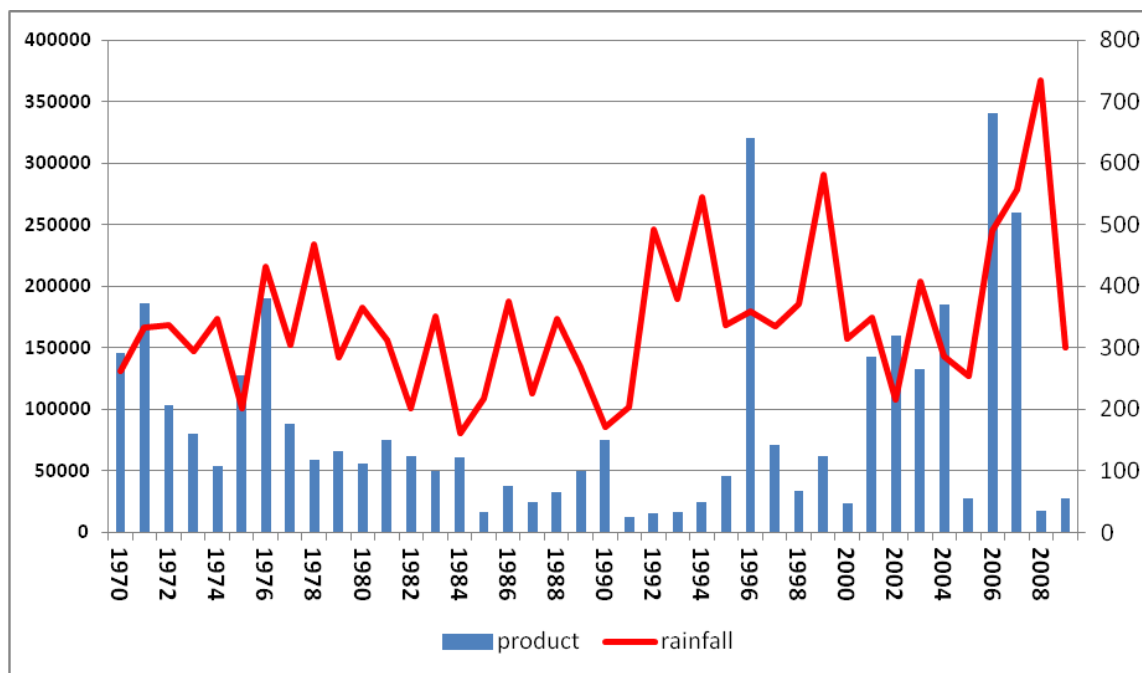Gum Arabic product with the rainfall amount during the same time series.

Figure 8: Gum Product and Rainfall condition
(1970-2009)

5.3.3 Farmers logical complaining

The most complaining issue concerns the lower benefit they gain from Gum tapping. The farmers said that they look for better benefit from Gum Arabic activity like the exporters or middle merchants. A new labor opportunities was complicated the availability of the Gum Arabic seasonal labor as the farmers are shifting to gold mining activity seeking much gain than Gum tapping activity.

As far as human traditional activities are concerned, there are many problems affected the contributing of high Gum Arabic production in the study area as ranked by the local farmers and Gum tappers are; unfair prices for the main producers, over cutting Hashab trees for different traditional purposes, Lack of interaction between producers and traders, high taxes and fees and duties and the weakness of GAC infrastructures. The reports conducted by National Forestry Corporation (NFC) (1990) was correlated between Gum product changes and human activities as the major causal factor for the extensive deforestation of the Hashab farms and forests in the whole region for firewood collection and charcoal production.

6. Conclusion

Gum Arabic is a value product for the Sudan's economical set up and for North Kordofan farmer's subsidiary resource. The leading factors of the changes are multi involves the institutional factors (mismanagement), natural factors (drought) and human factors (over cutting hashab tree). With the increasing of seasonal drought events, the Gum Arabic product is decreasing that influencing the general net product to be exported. International attitudes towards the

Sudan's market, was emerged and highly affected the annual Gum Arabic exportation. As far as the Hashab tree species conservation is concerned, future plans should be part of the Sudan's Forestry General Strategy. In 1986 the Ministry of Agriculture and Natural Resources approved an official committee responsible for many tasks with top priorities. One of the very important guidance is to apply a local community participation approach as the major guide in the process of forestry resources management especially areas undertaking Hashab plantations and rehabilitations

In concluding this section, only one recommendation can be viewed. For the benefit of the ecological balance as well as economical input, we need a decision that restrict gum production for a year by giving a proportion of the tree a rest from tapping full year in order to try to increase their long-term survival. It is a strategic idea applied by Indian authority after the collapsing in the gum productivity attributed to severe droughts during the seventies.

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