

Contribution of Gum Arabic Products to Rural Household Income in Sheikan locality of North Kordofan State, Sudan

Salih Omer Tutu¹, Ibrahim Elnour Ibrahim², Yahia Ibrahim Mohamed Abutabaa¹, Hassan Elnour Adam¹, Hatim Mohamed Ahmed Elamin³, Zeinab M. Hamad³ and Maruod E. Maruod²

¹ Department of Forestry and Range science, Faculty of Natural Resources and Environmental Studies, University of Kordofan-Sudan.

² Departments of Agricultural Economics and Agribusiness, Faculty of Natural Resources and Environmental Studies, University of Kordofan-Sudan

³ Institute of Gum Arabic Research & Desertification Studies, University of Kordofan- Sudan

Abstract - The current study was conducted in Sheikan locality in North Kordofan state, Sudan in the year 2016. The study focused on the contribution of gum Arabic to rural household income, determination of income sources, income distribution and expenditures of households. Primary data was collected using structured questionnaire for a sample of 300 gum Arabic producers representing 10% of population (3002 households) from 13 villages located in three selected districts (Taggat, Umashira and Umsomaima). The data was analyzed using descriptive statistics and gross margin analysis. Results revealed that the contribution of gum Arabic to the average household's income was found to be 38% (24% spent and 14% goes to saving). About 51.4% of the spent income has gone to consumed goods (foods and water) and 48.6% of it was spent in non-consumed goods. Finally according to the results, the study recommended that, comprehensive capacity building programs (tapping, collection and processing and quality) targeting the gum producers associations and farmers and farmer/herder unions across North Kordofan State are required.

Keywords: Gum Arabic production, income generation, Sheikan locality.

I. INTRODUCTION

Forest products in general are considered as vital support of rural livelihoods and food security in most developing countries due to dependence of many communities on forest resources (Mulenga, *et al.*, 2011; Choden, *et al.*, 2012). Many studies have been focus on the contribution of non-timber forest products (Ahmed, 2015 #81) in rural household income and other focus on determine household participating in extraction and trade of them. Accordingly to Mulenga *et al.* (2011) NTFP contribute 34% to household income on average in Zambia and it was indicated that NTFP contributes 45% to the income of the poorest and 29% for the wealthiest households. On the other hands, the poorest households in selected area of Zambia tend to be more reliant on NTFPs then the rich in compared relationship between asset value and

participation of NTFP activities. For examples of NTFP is Bamboo products as found in China which was considered as a major source of cash income and subsistence uses (Hogarth & Belcher, 2013). In Sudan investigation of the contribution of NTFPs to households were also highlighted by many authors Taha and Pretzsch, (2013) studied socio-economic conditions of gum farmers that influence their decision on retention of Hashab stands and develop mechanism for evaluation farmers' decision on Hashab stands in Kordofan and Blue Nile; (Koli, *et al.*, (2013) indicated that the importance of gum Arabic production becomes apparent during off farm seasons according to respondents in Dalanj area, South Kordofan, Sudan; Ibrahim, *et al.*, (2015) reported the Contributions of Non-Wood Forest Products to Household Food Security and Income Generation in South Kordofan State, Sudan; Ahmed, (2015) illustrated contribution of Non-timber Forest Products in Household Livelihood in the Rural Areas of Sheikan Province, North Kordofan State, Sudan. One of the main NTFP in Sudan is Gum Arabic that exudes from *Hashab* trees in the form of large (5 cm diameter)(Ahmed, 2015 #81) nodules or "tears". Mature trees, 4.5-6 m height and 5-25 years old, are tapped by making incisions in the branches and stripping away the bark to accelerate exudation. The *Hashab* tree is a multipurpose tree that has an important role in generating income, providing household wood energy and fodder demands, besides enriching the soil fertility, possibly also through biological nitrogen fixation (Ballal, 1991). Gum production is a pillar of family economy and considered as an income-generating source that requires only a low input of work after the rainy season (Gaafar, 2005). Ballal, *et al.* (2005a) in the Sahelian zones of Sudan, and Dione (1996) in Senegal showed that gum production occurs only during the dry season, when the trees are shedding leaves. A threshold of water stress, consecutive to rain stoppage and

dry air, seems required to trigger gum exudation (Dione, Vassal, 1998). Ballal, *et al.* (2005a and b), and Raddad and Luukkanen (2006) showed a positive relationship between gum yield and rainfall in the season preceding tapping and/or between gum yield and soil water content at the end of the rainy season. Ballal, *et al.* (2005a) found that gum yield was positively correlated with tapping intensity, rainfall, and minimum and maximum temperatures at tapping time, and negatively correlated with tapping time, and minimum and maximum temperatures at gum collection. Late tapping reduced the production of gum. The collection, use and trade of gums are age-old activities in Sudan. The forest subsector's contribution both to the national economy and to local communities cannot be overlooked. It offers one of the few opportunities available for dryland communities to supplement their cash incomes, particularly during dry seasons, and thus its role in food security is tremendous (Lemenih, *et al.* 2003). The great potential for gum production and marketing implies that the implementation of appropriate policy and resource management measures could enhance the socio-economic and ecological gains from the subsector (Tadesse, *et al.* 2002, Lemenih, *et al.* 2003, Eshete, *et al.* 2005). Another advantage of the gum resource base is that production can be integrated with other forms of production, particularly with livestock production, apiculture, agriculture and silviculture, to optimize returns per unit area.

According to (Elmqvist and Olsson 2006) about half the people in many villages practiced gum production until the drought in 1984 that killed between 50% and 100% of acacia trees. In some areas, gum production recovered, but in others trees were cut down for competing land uses as well as for firewood, building materials either personally or by selling them. People reported that low prices for gum prevented production, but often local people did not know the price for gum, which varies considerably.

In 2003, gum was providing an income varying between \$2-26 per person per year, or 10-50% of household income in some area, but little in others Gum Arabic production requires little investment apart from the trees, which can regenerate naturally, but it can be difficult to keep the trees when cropland or firewood is needed (Ibnaof, *et al.* 2013). This study is focus on the contribution of Gum Arabic products to rural households' income in Sheikan locality, North Kordofan State, Sudan.

II. MATERIALS AND METHODS

2.1 Study area

North Kordofan state lies between latitudes 16° 38' N and 12° 14' N and longitudes 26° 46' E and 32° 22' E. The state total area is 185,302 km² at an altitude of 1,500 feet,

divided into five Localities: Shiekan, Um Rowaba .Bara, Sodari and Gebret El Sheikh. Sheikan locality is composed of four administrative units. These are Kazgail, Abu Haraz, Khor Tagget and Umashira. In addition is a non-demarcated rural council for nomads, which represents the nomadic people who move within the previously mentioned demarcated rural council. Sheikan locality lies in the central part of greater Kordofan. Elobeid city is the capital of North Kordofan State and the center of the area councils. It is an important market and business place with the world's largest gum Arabic market. North Kordofan State lies in poor savannah zone. The latitude 13° N is divided the state into two parts, the desert area with annual rainfall 60 mm in north, and semi desert with annual rainfall 240 mm that of the south. At the far southern part of the state, the rain fall reaches 440 mm per year.

The vegetation classified into zones based on mean annual rainfall or rain belts and soil types. North Kordofan State is covered by the following three zones: desert (0-74mm) characterized by an association of *Acacia tortilis*, *Acacia raddiana*, and *Capparis deciduas*; semi- desert (74-300 mm), vegetations are *Cappers decidua*, *Salvadora persica*, *Ziziphus spina-chistic* and low rainfalls (300 – 1000 mm), vegetation are *Acacia senegal*, *Combretum spp.*, and *Leptadenia pyrotechnica*.

In North Kordofan there are many types of soils, sandy soils (*goz*) with low water holding capacity and poor fertility status, constitute more than 70% of the agricultural land, sandy clay soils (*gardud*), which constitute 20%, clay soils which are characterized with high fertility as Abu habel land, and cracking clay soil.

Shiekan locality has a population of 1,430,000 persons, 42.2% were Women (Department of Statistic, 2003). The population is distributed in villages of variable sizes. The number of village population at any time varies according to the agricultural calendar and nomadic season. The household on the average includes 8 members. In the past the family size was considered as a measure of wealth, status and hence, but now a day, and due to the prevailing harsh economic conditions, there is a tendency towards small family sized. There are two types of migration, external and internal .The male migration rate was 18 percent and female migration rate was 0.4 percent. External migration is mainly to the producing Arab countries, while internal migration is represented by casual labor for many agricultural areas of Sudan, this type of migration also constitutes as sources of marginal labor to the main urban centers and inter-rural migration, which takes many forms: the regular migration of the nomads, the farmers' movements to area of rich resources, and the drought displaced sufferers.

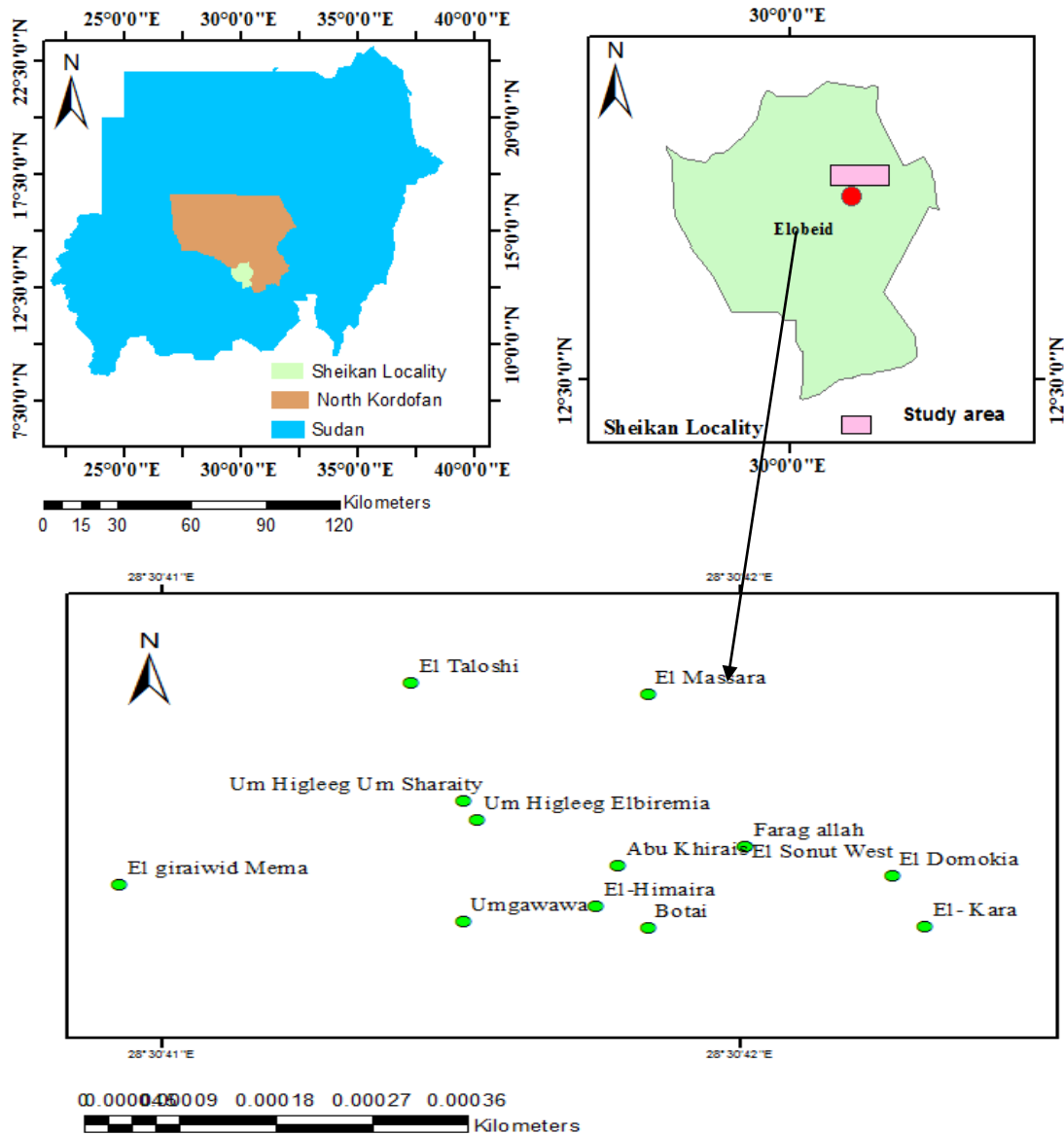


Figure 1: Maps of Skeikan locality, North Kordofan State, Sudan 2017.

2.2 Data collection

A three multistage sampling technique were used for the study. The first stage involved a purposive selection of three districts areas from namely (Khor Taggat, Umashira and Umsomaima) 5 districts of Sheikan locality based on the general population census in 2008. The second stage were a specific selection of 5 villages from each three districts making a total of 13 villages that were purposely selected because the villages are among the leading Gum Arabic producing areas and including Union for Arabic Gum producers in Sheikan locality. The final stage involved the selection of fifty two households from each of the 2 villages making a total of 300 households. Sampling frame was concentrated on Gum Arabic stakeholders from the three selected districts.

A questionnaire was developed for the collection of primary data from the field, keeping in mind the indicators and different aspects of the research study. The

questionnaire for the survey was pre-tested in El Sonut West village to assess the appropriateness of the questions in order to collect the required information.

Pre-testing was performed on form of questionnaire with different interviewees. Enumerators were supervised during the pre-testing of the questionnaire. Different comments from the enumerators were responded to avoid any sort of misinterpretation.

2.3 Data analysis

Data analysis was performed using Excel 2007 and SPSS version 20 software. Descriptive statistics such as means for continuous and proportion for categorical variables were calculated to check for any missing information and the distribution of key indicators. To assess the differences in different indicators stratified analysis was performed based on area, and other related variables. Partial budget, income statement and distribution were analyzed following Pyatt, *et al.* (1980) and Lerman and Yitzhaki (1985).

III. RESULTS AND DISCUSSION

3.1 Gross margin analysis result

The partial budget used to decide the most profitable production methods out of several alternatives. When constructing up a budget, the expected feddan under crops are then evaluated and the productivity are estimated. Then, we calculated Gross output and costs and finally the gross margin is estimated by subtracting the total variables costs from Gross output. If the budget is estimated for general system of farming, the more profitable system is predicted (Hala, 2003).

The various cost incurred on various resources used and the benefit (profit) obtained from the sales of the crop were estimated based on the market price at the period under consideration (2015 farming season) as presented in table (1) and table (2). The different variable cost of crop production calculated includes (seeds, planting, land preparation, ploughing, weeding, pesticides and harvesting) while the total variable cost of gum Arabic cultivation includes (seeds, seedling, planting, land preparation, ploughing, tapping, picking, packing, transporting, storing, tapping tools, and picking tools).

The average variable costs per feddan of crops production in the study area were 703.5 SDG, 769.91 SDG, 770.30 SDG, 252.78 SDG, 579.0 SDG and 111.84 SDG for gum

Arabic, millet, sorghum, sesame, groundnut and roselle crops, respectively. Sorghum, millet and gum Arabic production reported high costs of cultivation followed by groundnut, sesame and roselle which reported a low cost (Table 2) and (Table 13). The yields per feddan and prices were used to calculate the returns per feddan. On average the gross returns for the crops grown in study area were 1489.20 SDG, 300.2 SDG, 325.30 SDG, 518.22 SDG, 511.84 SDG and 254.68 SDG per feddan for gum Arabic millet, sorghum, sesame, groundnut and roselle respectively.

. After comparing the variable cost with gross return, on average the gross margins per feddan for gum Arabic, sesame and roselle showed a positive gross margin, while groundnut, sorghum and millet had a negative gross margin (Table, 1), (Table, 2) and (Figure, 2).

Table (1) Partial budget Analysis for Gum Arabic production /fed

| Items | Mean/SDG |
|---------------------|----------|
| Total variable cost | 703.5 |
| Average price (kg) | 16.0 |
| Yield (kg) | 88.84 |
| Gross output | 1489.20 |
| Gross margin | 785.70 |

Table (2) Partial budget for crops production /fed (SDG)

| Items | Millet | Sorghum | Sesame | Groundnut | Roselle |
|---------------------|---------|---------|--------|-----------|---------|
| Total variable cost | 769.91 | 770.30 | 252.78 | 579.005 | 111.84 |
| Average price | 466.87 | 353.6 | 345.7 | 313.4 | 176.23 |
| Yield | 0.643 | 0.92 | 1.45 | 1.63 | 1.45 |
| Gross output | 300.2 | 325.30 | 518.22 | 511.84 | 254.68 |
| Gross margin | -469.71 | -445 | 265.44 | -67.16 | 142.84 |

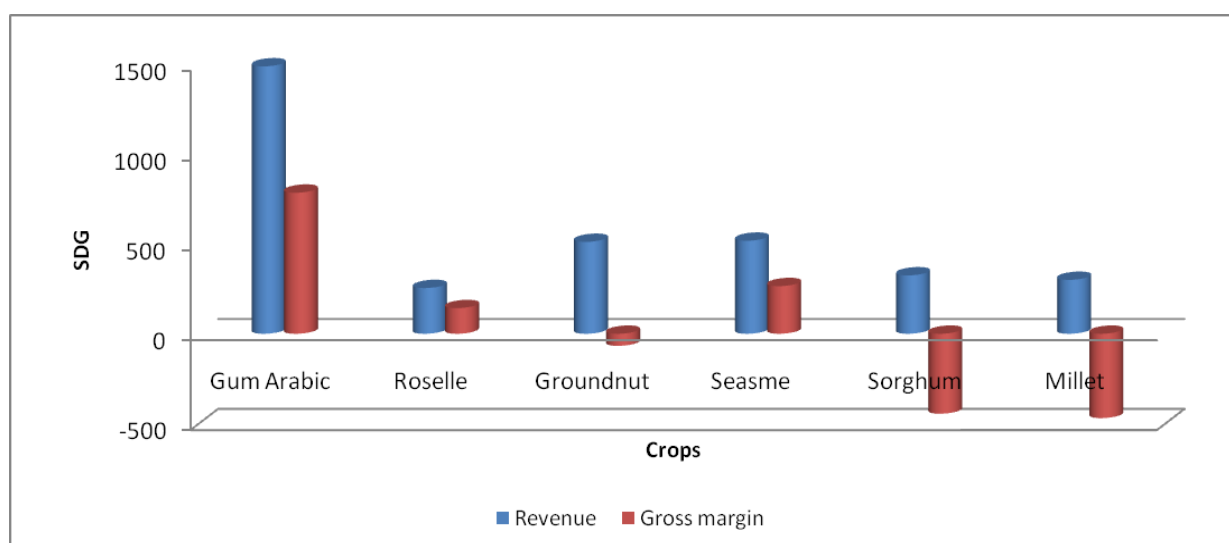


Figure (2) Gross output and gross margins in SDG

3.2 Sources of income and contribution of Gum Arabic to household income

The baseline survey identified different sources of income which includes crops production, livestock production, gum Arabic, other non-timber forest product, fodder and off-farm activities such as rent, trading, jobs, free duties, mining, gifts and transferring.

As shown in table (3) and figure (3), the study results revealed that the average total income per household in the year (2015) is 112222.7 SDG. The gum Arabic was found to be the main source of subsistence and cash income for household which contributed by 38% to total income followed by off-farm income (33%), crops income (17%), livestock income (6%), other non-timber forest product income (3%) and fodder income (1%).

Gum Arabic production contributed by 38% in the household income in the study area (Table, 2) Gum Arabic production recorded high contribution to the household income compared to other sources such as livestock income, crops income, other Non-timber Forest Products (NTPFTs) income and off-farm activities income.

Agriculture (crops production and livestock production) provides the most important income source for rural households in study area as reports in previous studies, in which it shared the income of the rural households. Recently, the contribution of agriculture to household income has declined from more than 50% to 23% (2015) compared to other sources of income. This result refer to many factors such as fluctuation of rainfall, low prices of

products, pests and disease and insufficient employment which decreased the production of crops. In addition to that, the migration of youth from rural to urban areas, which resulted in the increase labor cost in agricultural activities and abundance of land.

3.3 Expenditure and saving

As shown in table (3), figure (3), figure (4) and figure (5), the average annual expenditure cost of household was 47168.24 SDG (including consumed foods and non-consumed food). About 51.4% of the spent income was goes to consumed goods (foods and water) and 48.6 % of it was spent in non-consumed goods (health, education ...etc). The average annual expenses income is distributed as; 39% for food goods, 12% for water 7.1 for transportation, 6.84% for fuel wood and charcoal, 6.71% for education, 6.3% for social events 6% for health services, 4,96% for clothes, 4.7% for construction maintenance and 2.7% for communication.

Comparison between the annual income from different sources and annual expenditure, the results revealed that the majority of total income 63% (47168.24 SDG) goes to expenditure, while 37% approximately (65054.44) of it is saving (surplus).

The availability of surplus from household's income may be resulted from the use of their agricultural production subsistence for food goods and consumption (meats, milk, meals). In addition to that availability of free and low of firewood, charcoal.

Table (2) Household annual income, annual expenditures and saving

| Items | Annual in SDG | Contribution % | Consumed % | Surplus % |
|------------------|---------------|----------------|------------|-----------|
| Gum Arabic | 45679.19 | 38 | 24 | 14 |
| Crops | 14265.67 | 17 | 10 | 8 |
| Animal | 7103.678 | 6 | 4 | 2 |
| Other NTPFTs | 3102 | 3 | 2 | 1 |
| Fodder | 1514.583 | 1 | 0.8 | 0.2 |
| Rent | 3811.875 | 3 | 2 | 1 |
| Trade | 7452.955 | 6 | 4 | 2 |
| Job | 6872.727 | 6 | 4 | 2 |
| Free duty | 8850 | 7 | 5 | 3 |
| Mining | 8345 | 7 | 4.4 | 2.6 |
| Gifts | 2150 | 2 | 1.2 | 0.8 |
| Transfers | 3075 | 2 | 1.6 | 0.4 |
| Total income | 112222.7 | 100 | 63 | 37 |
| Total expenses | 47168.24 | | | |
| Surplus (saving) | 65054.44 | | | |

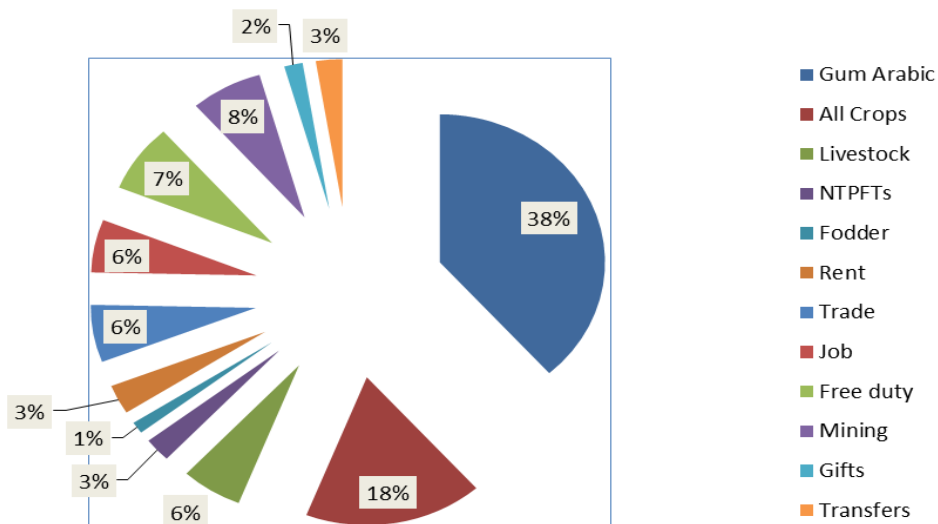


Figure (3) Contribution of Gum Arabic to household income versus different sources of income (%)

Table (3) Different sources of expenditure in year

| Items | Average expenditures/SDG | % |
|------------------------|--------------------------|------|
| Food | 18382 | 39 |
| Water | 5840.574 | 12.4 |
| Clothes | 2340.181 | 4.96 |
| Education | 3166.183 | 6.71 |
| Health | 2803.105 | 6.0 |
| Lightning | 753.8712 | 1.6 |
| Gas | 891.8345 | 1.9 |
| Fuel wood and charcoal | 3226.086 | 6.84 |
| Social sharing | 2974.909 | 6.3 |
| Construction | 2213.892 | 4.7 |
| Communication | 1247.597 | 2.65 |
| Transport | 3328.009 | 7.06 |
| Total expenses | 47168.24 | 100 |

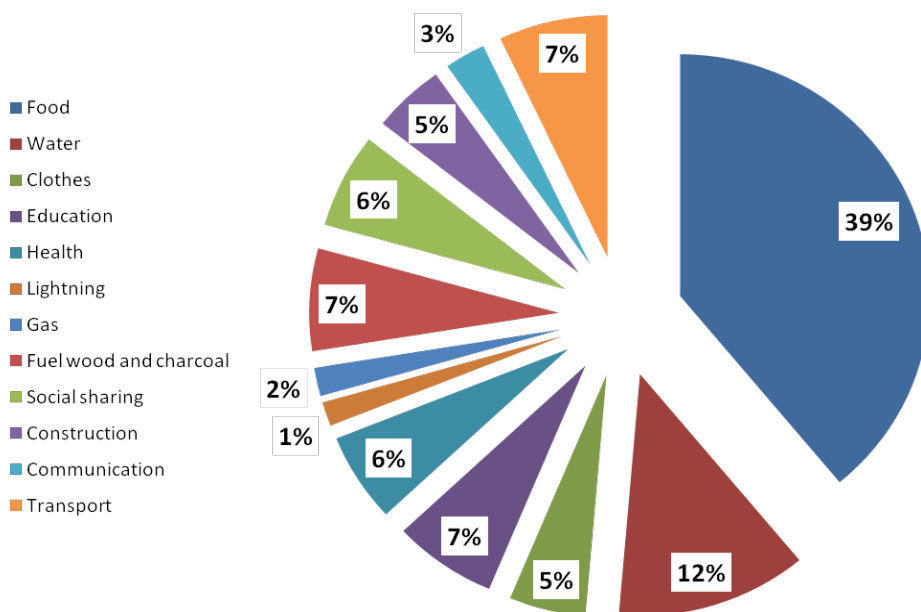


Figure (4) Household expenses distribution (%)

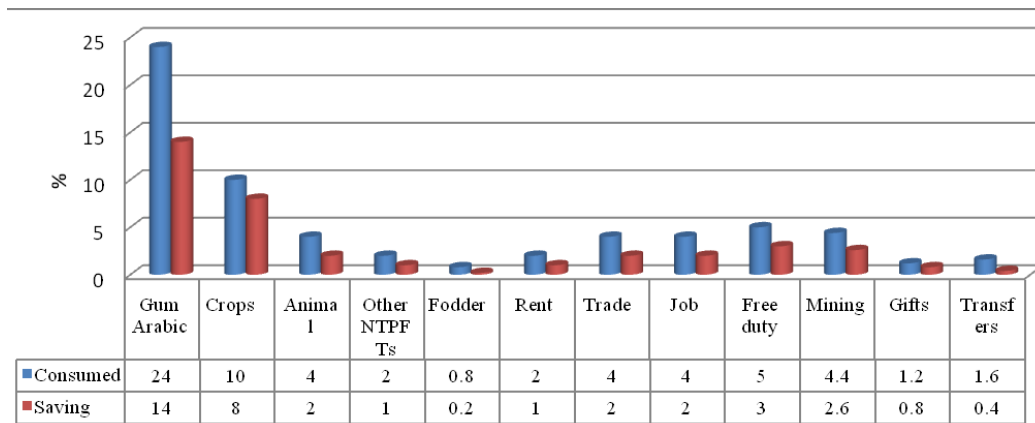


Figure (5) Expenditure and saving (%)

IV. CONCLUSION

Gum production is a pillar of family economy and considered as an income-generating source that requires only a low input of work after the rainy season. This study aimed to measure the contribution of gum Arabic to Gum Arabic producer's income, and specifically determines the income sources, income distribution and expenditures. According to the findings, the study conceded that, Gum Arabic production contributed to average total household income by 38%.

Acknowledgement

The authors are very grateful to French Agency of development and FNC in North Kordofan State, Sudan and University of Kordofan for their support by providing funds for the study. The data collection activities were supported by local community, FNRES and IGARDS, University Kordofan, Sudan. The assistance of colleges in verifying the information provided by the various supports (Gum Arabic associations and households) and advices are also greatly appreciated.

REFERENCES

- [1] Ahmed, M. (2015). Contribution of Non-timber Forest Products (NTFPs) in Household Livelihood in the Rural Areas Of Shiekan Province, North Kordofan State, Sudan, UOFK.
- [2] Ballal, M. E., Elsiddig, E. A., Elfadl, M. A. and Luukkanen, O. (2005a). Gum arabic yield in differently managed *Acacia senegal* stands in western Sudan. *Agroforestry Forum*, 63: 237-245.
- [3] Ballal, M. E., El Siddig, E. A., Elfadl, M. A., and Luukkanen, O. (2005b). Relationship between environmental factors, tapping dates, tapping intensity and gum arabic yield of an *Acacia senegal* plantation in western Sudan. *Journal of Arid Environments* 63:379-389.
- [4] Choden, Dechen; Janekarnkij, P. and V. (2012). Contributions of Community Forests to Household Income in Punakha, Bhutan, 1–21.
- [5] Dione, M., (1996). Recherches expérimentales sur le gommier *Acacia senegal* dans le Ferlo sénégalais. Thèse de doctorat, Université Paul Sabatier de Toulouse, France, 150 p.
- [6] Dione, M. and Vassal, J., (1998). Gommose et rythmes de production gommère chez *Acacia senegal* (L.) Willd. In : Campa C. (éd.), Grignon C. (éd.), Gueye M. (éd.), Hamon S. (éd.), L'acacia au Sénégal. Paris, ORSTOM, p. 123-134. (Collection colloques et séminaires). Réunion thématique sur l'acacia au Sénégal, 1996-12-03/1996-12-05, (Dakar, Sénégal).
- [7] Gaafar, A. M., (2005). Improvement of traditional *Acacia senegal* agroforestry: ecophysiological characteristics as indicators for tree-crop interaction on sandy soil in western Sudan. Doctoral thesis, University of Helsinki, Tropical Forestry Report no. 26, 100 p.
- [8] Hamid Faki, Eltahir Mohamed Nur, Abdelaziz Abdelfattah, A. A. A.-H. (2012). *Poverty Assessment Northern Sudan*.
- [9] Hogarth, N. J., & Belcher, B. (2013). The contribution of bamboo to household income and rural livelihoods in a poor and mountainous county in Guangxi, China. *International Forestry Review*, 15(1), 11.
- [10] Ibaof, Mirghani; Salih, Ali Adel Aziz; Mohamed, Asia Adam; Tom, Babikir Mohamed; Shomo, Faroug Ibrahim; Ahmed, Mohamed Eljack and Mohamed, J. Y. (2011). *The Economic Valuation of Ecosystems and Biodiversity, Finance and Its main Streaming into National Development Policy and Planning*. (B. Child, Ed.). Khartoum, Sudan: National Biodiversity Planning to Support the Implementation of the CBD 2011-2020 Strategic Plan in the Republic of Sudan.
- [11] Ibrahim, G. A., Abdalla, N. I., & Fangama, I. M. (2015). Contributions of non-wood forest products to household food security and income generation in South Kordofan State, Sudan. *International Journal of Current Microbiology and Applied Sciences*. Retrieved from <http://www.ijcmas.com/vol-4-6/Gammereldein A. Ibrahim, et al.pdf>
- [12] Koli, A. O., Eltayeb, A. M., Sanjak, E. M., & Mohammed, M. H. (2013). Socio-economic Aspects of Gum Arabic Production in Dalanj Area, South Korodofan, Sudan.

- Pakistan Journal of Biological Sciences*, 16(21), 1407–1410. <https://doi.org/10.3923/pjbs.2013.1407.1410>
- [13] Lerman, R. I., and Yitzhaki, S. (1985): Income inequality effects by income source: A new approach and applications to the United States. *Review of Economics and Statistics* 67: 151-156.
- [14] Lopez-Feldman, A. (2006): Decomposing inequality and obtaining marginal effects. *The Stata Journal* 6:106-111. (Freely available at The Stata Journal website!)
- [15] Mulenga, B. P., Richardson, R. B., Mapemba, L., & Tembo, G. (2011). *The Contribution of Non-Timber Forest Products to Rural Household Income in Zambia. Working Paper No. 54, Food Security Research Project, Lusaka, Zambia* (Vol. 2011).
- [16] Olukosi, J.O. and Erhabour, P.O. (1988). *Introduction to Farm Management Economics: Principles and Applications*. AGITAB Publishers Ltd Zaria, Nigeria
- [17] Pyatt, G., Chen, C. and Fei, J. (1980). The distribution of income by factor components. *Quarterly Journal of Economics* 95: 451–473.
- [18] Raddad, E. Y., Luukkanen, O., (2006). Adaptive genetic variation in water-use efficiency and gum yield in *Acacia senegal* provenances grown on clay soil in the Blue Nile region, Sudan. *Forest Ecology and Management*, 226: 219-229.
- [19] Shea, M. (1997). *The Measurement of Poverty , Welfare , and Distribution : Basic Issues*.
- [20] Taha, Mohamed El Nour and Pretzsch, J. (2013). Socio-Economic Role of *Acacia senegal* to Sustainable Development of Rural Areas in the Gum Belt of Sudan. In *Tropentag, September 17-19, 2013, Stuttgart-Hohenheim "Agricultural development within the rural-urban continuum"* (p. 54321). Stuttgart-Hohenheim.