Study of Socioeconomic Characteristics of the Sesame Value Chain Actors in Gaderif State/ Sudan(2019-2020)

Salwa Ali Mohamed El Hassan — General Department of planning and Agricultural Economics- Ministry of Agriculture and Natural resources- Sudan.

Prof. Hag Hamed Abd Alaziz — Head of Shandi University – River Nile State- Sudan.

Dr. Intisar Yousif Ahamed Elbashir — Department of Agricultural Economics- Sudan University of Science and Technology - Sudan.

Abstract:

The study aimed to analyze socioeconomic characteristics of Sesame value chain actors in Gaderif State in order to identify the functions and activities to the actors and estimate the factors influencing producer's profitability. The important of the present study is that the agriculture sector plays significant role of income and employment for majority of smallholders. In addition to that the socioeconomic factors are the key factors affecting agricultural production and producer's profitability. Primary and secondary data were used in the study a multistage random sampling technique and purposive sample procedure were used to collect primary data from the actors by means of questionnaires. The total sample size was 230 participants (150 farmers, 30 wholesalers, 15 processors, 15 exporters and 20 retail traders). The study used Descriptive, functional analyses and linear regression to analyze the data. The important results of the study are that the key actors of the value chain are; producers (farmers), wholesalers, processors, exporters, retail traders. About half of the participants fell within the economically active age range (41-60) years and the majorities have secondary and university level of education. It found that

about 65% of Sesame production in the sample was marketed. The results revealed that socioeconomic factors in the regression model were affected producer's profitability by 58.4%. The factors of planted area, Sesame yield, selling price, sale place and main occupation of the farmers were shown positive and statistically significant relationship with the producer's profitability whereas a stored quantity was shown negative relationship. The study proposed some recommendations to improve profitability of Sesame as; develop good varieties of Sesame with high productivity and resistance to diseases, improve Sesame quality and improve market information system.

Key words: *Sesamum indicum,* education level, main occupation, sold quantities, producer's profitability.

المستخلص:

هدفت الدراسة إلى تحليل الخصائص الاجتماعية والاقتصادية للفاعلين في سلسلة قيمة السمسم في ولاية القضارف من أجل تحديد الوظائف والأنشطة في إنتاج السمسم وتسويقه. وتقدير العوامل التي تؤثر على ربحية المنتج. تكمن أهمية الدراسة الحالية في أن قطاع الزراعة يلعب دورًا مهمًا في الدخل والعمالة لغالبية أصحاب الحيازات الصغيرة. بالإضافة إلى أن العوامل الاجتماعية والاقتصادية تعتبر من العوامل الرئيسية التي تؤثر على الإنتاج الزراعي وربحية المنتج. تم استخدام البيانات الأولية والثانوية في الدراسة ، وتم استخدم اسلوب أخذ العينات العشوائية متعددة المراحل وإجراء العينة الهادفة لجمع البيانات الأولية من الجهات الفاعلة عن طريق الاستبيانات. بلغ حجم العينة الإجمالي 230 مشاركًا (150 مزارعًا ، 30 تاجر جملة ، 15 مصنعًا ، 15 مصدرًا و 20 تاجر تجزئة). استخدمت الدراسة التحليلات الوصفية والوظيفية والانحدار الخطي لتحليل البيانات. تتمثل أهم نتائج الدراسة في أن الجهات الفاعلة الرئيسية في سلسلة القيمة هم المنتجون (المزارعون) وتجار الجملة والمصنعون والمصدرون وتجار التجزئة. يقع حوالي نصف المشاركين في الفئة العمرية النشطة اقتصاديًا (41-60) سنة وأغلبيتهم حاصلون على تعليم ثانوي وجامعي. ووجد أنه تم تسويق حوالي 65٪ من إنتاج السمسم في العينة. أظهرت النتائج أن العوامل الاجتماعية والاقتصادية في نموذج الانحدار قد أثرت على ربحية المنتج بنسبة 58.4٪. أظهرت عوامل المساحة المزروعة، انتاجية السمسم، سعر البيع، مكان البيع والوظيفة الرئيسية للمزارعين علاقة إيجابية وذات دلالة إحصائية مع ربحية المنتج بينما أظهرت الكمية المخزنة علاقة سلبية. اقترحت الدراسة بعض التوصيات لتحسين ربحية السمسم مثل: تطوير أصناف جيدة من السمسم ذات إنتاجية عالية ومقاومة للأمراض وتحسين جودة السمسم وتحسين نظام معلومات السوق.

الكلمات المفتاحية: السمسم، المستوي التعليمي، المهنة الرئيسية،الكميات المباعة، ربحية

المنتـج.

1.Introduction

Sesame, or *(Sesamum indicum),* is native to savanna area in sub-Saharan Africa and considered to be originated in Eastern part of Sudan. Sesame-seed is an erect annual plant, growing up to one meter. It is suitable for light (sandy), medium (loamy) and heavy (clay) soils and prefers well-drained soil. It is sensitive to salt, but tolerant to drought-like conditions making it an adapted plant for rain-fed cultivation in Central and Eastern Sudan (rainfall between 300 and 1,000 mm). Sesame-seed occur in many colors depending in cultivation areas the most traded variety of Sesame-seed is off-white colored, and other common colors are buff, tan, gold, brown, red, gray, and black [(1)]. Sesame produced in rain fed irrigation system in both semi-mechanized rain fed and traditional rain fed. Semi-mechanized rain-fed agriculture is practiced in a broad belt running from the north eastern portion of the country to the south-south west through Gaderif, Kassala, Blue Nile, Sennar, White Nile and South Kordofan states. Semi mechanized rain-fed agriculture constitutes about 45 percent of sorghum production and 56 percent of Sesame in the Sudan. Sorghum, Sesame, sunflower and millet considered as the main crops in the sector while cotton and guar are grown in small areas. Farms in semi-mechanized sector are often very large, with some over 50 000 ha, or more, in the semi mechanized sector, the normal time of planting ranges from early July to mid-August, it determined by the onset of rain, and it is preferable not to delay planting in order to avoid exposure of the crop to pests which leads to a significant decrease in productivity. Land is prepared using a disc harrow no rotation of crops is practiced and no fertilizer is used. Hard pans caused by repeated use of disc harrows is widespread, inhibiting root growth and water holding capacity and hence lowering crop yields. Seed rate is 1.1 – 1.6 gram per feddan [(2)] the majority of the farmers use the seeds

retained from their previous year or purchased locally from the market. The Sesame seeds produced are classified into two types, based on physical appearance, that is, white Sesame seeds and red Sesame seeds. The higher-quality white Sesame seeds have 40–46 percent oil content, are considered more refined, and are used for direct consumption. The lower-quality red Sesame seeds contain 50–52 percent oil content and are processed domestically; either crushed for oil with byproduct Sesame cake or sold to processors of a sweet confectionary product Tahnia Halwa [3]. There are three types of edible oil extractors are being used the traditional manual (camel-driven) oil extractors, small-motorized oil extractors, and large-capacity oil extractors. Many traditional small- and medium-scale oil extractors are in Kordofan and Gaderif states. Modern manufacturers with higher processing capacities extract oil using specialized machines those are located in Khartoum, and a few are located in other cities, with the overall daily processing capacity exceeding 5,000 tons. The byproduct Sesame cake is sold to animal feed that blend it with other ingredients also small quantities of it are export.

According to FAO, 2019 the production of Sesame in 2019 was estimated at 1.21 million tons, 26 percent higher than in 2018 this increasing was mainly due to expansion of the planted area. However, the unfavorable weather and the pests outbreaks, only 68 percent of the area planted at national level were eventually harvested. Drought, floods and pest attacks at the beginning of the season led to pronounced losses and forced farmers to switch to shorter cycle crops. Production of Sesame influenced greatly by some factors as socioeconomic factors which considered as a key factors in agricultural production because of their influence on farmers' productivity and efficiency those like; sex, age, education, household size, planted area and so on. Moreover marketing for agriculture crops as general are characterized by underdeveloped,

fragmented, lack of standards, widespread variations in product quality, poor infrastructure and weak interaction between actors in the value chain [4]. Therefore study socioeconomic characteristics of all Sesame value chain actors in Gaderif State can provide important information about how actors coordinate and interact with each other within the horizontal and vertical chains.

2Previous studies

Nuha Saeed Elameen Ahmed 2016

The study aimed to analyzed the socioeconomic characteristics of small scale farm in the rain-fed sector of Gaderif state, investigated the social profitability and competitiveness of the main crops grown in the state and determined the optimal cropping sequence in season 2012/2013. To achieve the objectives of the study four types of analytical techniques were used these are; descriptive statistics to analyze the socioeconomics characteristics of the farmers, F-test to test the significant indicators of socio-economic factors of farmers in the study area, Policy Analysis Matrix (PAM) to examine the competitiveness and social profitability of the crops produced in the study area and the linear Programming (LP) approach to determine optimal cropping pattern. The study revealed that crops yields of small-scale farms in the rain-fed sector of Gaderif State are far below the research station majority of farmers had low education level or illiterate and enter the agricultural season with minute amount of money. And the majority of them was in the active age group with a reasonable family member, and has long experience in agricultural practices. Both on-farm and off-farm small-scale farm's returns were so poor, with annual expenditure exceeding their returns by more than 41%. The net private profitability reflected that Sesame was the most profitable crop grown in the study area under the available financial prices, policy measures, technology, costs and returns. Other profitable crops in chronological order were millet, sorghum and

groundnuts [5].

Ryoba Emmanuel Magabe, 2016

The study used value chain analysis to assess the profitability of Sesame actors along the value chain in Masasi District (Tanzania). One of its specific objectives was to determine the factors effects on the profitability along the Sesame value chain in Masasi District. The finding showed that the farmer's gross margin was influenced by household education level, household age, extension services and market information. To increase farmer's gross margin the study recommended improve availability and accessibility of the market information network, farmers training and intensification of land utilization [6].

Munyua.B et al, (2013)

They investigated the value chain of Sesame in Uganda they characterized it by numerous small producers, sellers, and buyers. A map of the Sesame value chain was developed showing the volume handled by the various actors along the chain as the commodity moves from farm gate to the consumers and export markets. Of the total Sesame production, 50 % passes through rural assemblers, and 6 % is handled by rural wholesale they transport to regional centers where it is bought by regional wholesale traders. Regional wholesalers sell Sesame to export and domestic processors [7].

Kindie Aysheshm Tesfahun 2007

He was analyzed the Sesame marketing chain particularly the case of Metema woreda, Amhara Region in Ethiopia. The study revealed that 94% of the Sesame production was supplied to the market much of the marketed surplus was channeled through wholesalers, assemblers and cooperatives which accounted 34.47%, 22.5% and 17.66% of the marketed supply. The major determinant factors for market supply were estimated by linear OLS regression. Six variables out of the expected fourteen found significant and affect the household marketable supply of Sesame. Variables

that affect the household supply of Sesame include: Yield, number of oxen available, modern inputs used, Sesame area available, time of selling and foreign languages spoken [8].

Therefore this study conducted to analyze socioeconomic characteristics of the Sesame value chain actors in Gaderif State in order to identify the structure and functioning of the actors and volume of Sesame flow also to estimate the socioeconomic factors that affected producer's profitability by influencing the sold quantities of Sesame. In order to verify these objectives certain hypotheses were used; firstly; no well-functioning Sesame market structure in study area secondly; socio-economic factors have no influence on producer's profitability.

3 Literature review

Value chain concepts have been defined differently by different scholars, Hobbs et al (2000) defines the value chain as one particular form of the supply chain. In this approach, the supply chain refers to the entire vertical chain of activities: from production on the farm, through processing, distribution and retailing to the consumer – in other words – from gate to plate, regardless of how it is organized or how it functions [9].

In the mid-1980s, the term 'Value Chain' was used by Michael Porter in his book "Competitive Advantage: Creating and Sustaining superior Performance" (1985). Porter used the framework of value chains to assess how firm should position itself in the market and in the relationship with suppliers, buyers and competitors Porter argued that the sources of competitive advantage cannot be detected by looking at the firm as a whole; the firms should be separated into a series of activities and competitive advantage found in one or more activities. Porter distinguishes between primary activities, which directly contribute to add value to the product or services and support activities, which have indirect effect on the final value product [10].Figure (1) represent the basic

model of Porters Value Chain.

Value chains in Sudanese agriculture sector involve multiple actors from the formal and informal sectors. In the Sesame value chain several actors are exist, including farmers, traders at different administrative levels (village, district, state, and national), transporters, small-scale and large-scale processors, and exporters. Farmers sell their Sesame within two or three weeks after harvest to a village collectors or traders those take it and sell the purchased Sesame seeds to intermediate traders in the regional markets, who in turn collect larger quantities and sell them to the wholesaler, processor, or exporter. Large commercial farmers usually have direct purchase agreements with the wholesalers, processors, and exporters and they have storage facilities to store their product and wait for better prices. Additionally, there are some institutions that play an important role in the Sesame seeds marketing these institutions include the Ministry of Agriculture and Forestry (MOAF), the Ministry of Industry (MOI), Agricultural Research Centre (ARC), Sudanese Standards and Metrology Organization (SSMO), Industry Stakeholder Associations, international organizations and NGOs [11].

4 **Materials and Methods:**

Primary and secondary data were used in the research, a structured questionnaire was designed to collect the primary data from the actors in the value chain, the data include age, education, experience of the respondents, production cost, marketing cost, transaction cost, prices and challenges faced the respondents. Secondary data included time series data of area, production, yield, cost, quantities export and prices were collected and used to provide background information of Sesame. Also a reviewed of published and unpublished materials from Federal Ministry of Agriculture, State Ministry of Agriculture, Central Bank, input suppliers, researches, on line publications were used. The survey conducted on

January 2020.

4.1 **Sampling Frame**

The frame consisted of Sesame farmers (producers), traders, exporters and oil processors. A multistage random sampling procedure was used to select the farmers sample from the Gaderif state with three stages. Firstly purposive sampling technique was used to select the localities representative to different locations of the state. Secondly systematic sample procedure was used to select areas from each locality according to area cultivated in season 2019, lastly simple random sample technics was used to select farmers from the lists obtained from agricultural office in the area. The study used Steven K. Thompson formula [12] to calculate the sample size of the farmers.

$n = N \times Z^2P (1-P)/e^2 / [(N-1) + Z^2P (1-P)/e^2]$ ..... (1)

Where:

n = sample size N = population (about 11000 farmers)

z = critical value (1.96) p = sample proportion (10%)

e = margin error (4%)

The sample size calculated from the formula was 212 respondents. Unfortunately only 150 respondents were participated in the survey and these due to time and financial constraints. Distribution of farmers according to selected areas was (35) Al Gaderif, (34) AL Shouwak, (26) Doka, (26) AL Hawata, (12) Glea Al Nahal, (11) Al Hiorey and (6) Al Greisha.

Purposive sample procedure was used to select traders, exporters and oil processers. The respondents participated (30) wholesalers, (15) exporters, (15) processers and (20) oil traders.

4.2 Analysis Methods

Descriptive analysis was used to describe the characteristic of the value chain actors in study area (frequency, mean, total and

percentage). Functional analysis was used to provide a detailed profile of Sesame value chain through identified the main actors in the value chain and their activities and quantified physical flows of Sesame. Regression analysis was applied to estimate the socioeconomic factors that influence producer's profitability by influencing sold quantities of Sesame.

Profit= Revenue – Total cost

Profit=Quantities sold ×selling price/unit–Total cost ……(2)

Sold quantities are the surplus quantities that farmers actually delivered to the markets, factors affecting marketed surplus leads to influence producer's profit. It is not possible to include an exhaustive set of variables that could affect the level of marketable supply of Sesame in study area so the study attempted to estimate some determinant factors. Ten explanatory factors examined in this study which are; age of the farmer, education level, experience, occupation, yield, planted area, consumed quantity, stored quantity, selling price and sale place. The empirical model of regression was specified as follows [13]:

$$Y\tau = \beta + \alpha_1 D_1 + \alpha_2 D_2 + \alpha_3 D_3 + \beta_1 Age + \beta_2 Exp. + \beta_3 Yield + \beta_4 Area + \beta_5 Q. + \beta_6 Q. + \beta_7 \beta + \varepsilon \quad \ldots\ldots (3)$$

Where:

$Y\tau$ = Marketed surplus of Sesame (sold quantities).

D_1 = Education level (dummy, 1=illiteracy, 2= primary school, 3= secondary school, 4= university, 5= post graduated).

D_2 = Agricultural occupation (dummy, 1= main occupation, 0= otherwise)

D_3 = Sale place (dummy, 1= farm, 0 = otherwise).

Age= Farmer's age (continuous variable measured by years).

EXP= Experience in agriculture (continuous variable measured by years).

Yield= Yield of Sesame (continuous variable measured by sack = 90kg).

Area= Planted area of Sesame (continuous variable measured by feddan= 4200 m^2).

C.Q= Consumed quantity (continuous variable measured by sack).

S.Q= Stored quantity (continuous variable measured by sack).

SP= Selling price of Sesame (continuous variable measured by SDG/sack).

β_τ = Coefficients of explanatory variables

α_τ = Coefficients of dummy variables

ε = Error term.

4.3 Description of the Variables Used in the Model

Some of the factors listed above in the model may have a positive relation or negative relation on marketed surplus and so profit.

1. Age is a demographic variable and is measured by years the expected influence of age is positive since the active age range can easily gain skill and experience and adopted a new innovations which can enhance their productivity [14].
2. Education level is human capital for agricultural production farmer with good knowledge can adopt better practices than illiterates that would increase marketable supply. Magabe, (2016) implies on his study that "better education of the producers has advantages as it enlightens them on how best to strategize and adapt better production and marketing conditions of Sesame business"[15].
3. Experience in the farming expected to influence the profit positively according to (Zubaidah O. & Fazleen A., 2020) more experience that the smallholders have, the more output that they will get and hence increase their profits[(16)].
4. Producers practiced farming as the main occupation they became more specialized and devoted to their jobs so it have positive influence on the production.

5. Area under cultivation is the major input for agricultural production and it characterized the farmer as small household or large household it influence crop output positively and hence the profit.
6. Yield is an economic factor that can affect the household level marketable supply and measured in sack per feddan, sack equals 90 kg. Kindie A, (2007) indicated that yield is assumed to affect the marketable supply positively, because a farmer that obtains high yield can supply more to the market than a producer who had less yield.
7. Selling prices are economic factors but it reflects farmer abilities in delivering crop to city markets or sold it in the farm. Kindie A, 2007 mention in his study that Tomek and Robinson (1985) argued that "the product price has direct relations with marketable supply and hence it was expected to affect the household marketable supply of Sesame positively."
8. Sale place have positive relationship with price if the farmer sold his product in village or city markets he will gain high prices. So sale place affects profit positively.
9. Consumed quantity affect sold quantities negatively and it depend on the farmer family size.
10. Stored quantity expected to influence sold quantities negatively because farmers stored a big portion of their production to use as seed next season or waiting for better prices.

5 Results and Dissection

5.1 Descriptive Analysis

Descriptive analysis of value chain actors presented in table (1) it revealed that the majority of the respondents interviewed fell within the economically active age 20-60 years. More than half of the farmers falling within the age range of 41-60 years old, whereas 29% of them fell in age range 61-80 years old and this age reflects positive relation with the experience of the production. Sim-

ilarly the wholesalers, exporters, processors and oil retailers were fell within the active age 20- 60 years with high concentration in range 41-60 years accounted to about 47% for wholesalers, 60% for exporters and processors. The oil retailers concentrated in age range 20-40 years, this reflects the trend of young people to trade.

Education level among most of actors was primary and secondary education except the exporters 93% of them have university level. About 27%, 15%, 14% and 13% of the wholesalers, oil retailers, farmers and processors respectively have university level. 10% of wholesalers and 3% of farmers have post graduate level of education. Age and education level are used as indicators of awareness and abilities of taking decisions on crop cultivation, marketing, finance, resources allocation, and new agricultural technologies adoption. High level of education insures high awareness of their business environment and ability to take right decisions [17].

Majority of the respondents have got a good experience in their jobs. About 41% of farmers gained experience in Sesame production between 21-30 years which gave them high skills in adoptions technologies and minimizing losses. Similarly 47% of the wholesalers and exporters, 60% of the processors and oil retailers have got a good experience in their jobs between 10- 20 years. 87% of the farmers practiced farming as their main occupation, whereas 13% of them considered it as secondary job. 77% of wholesalers, 80% of exporters, 87% of processors and all of oil retailers their occupations was the main jobs. These results indicate that the respondents are specialized and devoted on their jobs.

Most of the farmers in the sample cultivated Sesame in their own land, whereas18% of them rent land and small fraction of them used to share land with other. Providing machines in time of planting is important element of season success, more than half of the farmers in the sample used their own machines in cultivation

of Sesame, while 38% of them rent machines from others.

Table (1): Percentage of socioeconomic characteristics to the actors

Items	Farmers (N=150)	Wholesalers (N=30)	Exporters (N=15)	Processors (N=15)	Traders (N=20)
Age					
20-40	19	40	40	33	45
41- 60	51	47	60	60	25
61- 80	29	13		7	30
>80	1				
Education level					
illiteracy	19				
Primary school	34	30		40	50
High school	29	33	7	47	35
University	14	27	93	13	15
Post graduate	3	10			
Experience					
<10	5	13	13	40	20
10- 20	25	47	47	60	60
21-30	41	33	40		10
>30	29	7			10
Occupations					
Main	87	77	80	87	100
Secondary	13	23	20	13	

Source: Survey results, January 2020

Area, Production and Yield of Sesame

Table (2) showed total planted area, Sesame area, produc-

tion and yield by different areas; it found that Sesame covered about 28% from total planted area. The average of Sesame area was 182.6 feddans per farmer. AL Hawata, AL Shouwak and Doka are the main producing areas in the State, the average areas per farmer are 313, 260 and 230 feddans respectively. The average yield from feddan was very weak this season it was 67 kg compare to the last year (135 kg/fed) [18].

Table (2): Total planted area, production and yield of Sesame (season 2019/2020)

Areas	Total planted area ((fed	Sesame areas ((fed	of % area	production (tion (sack	Yield ((kg/fed
AL Shouwak	868.94	260.4	30	248.6	85.9
Al Greisha	187.83	59.5	32	50.2	75.9
Doka	860.58	230.2	27	160.5	62.8
AL Hawata	954.15	313.4	33	202.8	58,3
Glea Al Nahal	535.83	149.2	28	97.2	58.6
Al Gaderif	968.63	168.6	17	141.4	75.4
Al Hiorey	110.73	96.6	87	53.2	49.6
Total	4486.7	1277.9	28	954	67.2
Average	640.95	182.56	28	136.3	67.2

Source: Survey results, January 2020

Distribution of Sesame Production

Sesame is grown for commercial purpose, as table (3) showed that 65% of the production in the sample was marketed. Marketed surplus is determined by deducting household consumption, Zakat and reserved seeds from the total production it was about 618 sacks per farmer. The home consumption was 2% from production and the farmer stored around 25% from total production as reserved seed for the next cropping season. Zakat represent about 8%.

Table (3): Distribution of Sesame production (sack)

Areas	Production	Zakat	Consummation	Reserved	Marketed surplus
AL Shouwak	249	17	3	105	124
Al Greisha	50	5	1	21	23
Doka	161	13	5	29	114
AL Hawata	203	15	3	35	150
Glea Al Nahal	97	9	2	16	70
Al Gaderif	141	11	3	25	102
Al Hiorey	53	5	2	11	35
Total	954	75	19	242	618
Average	100	8	2	25	65

Source: Survey results, January 2020

5.2 **Functional Analysis of Value Chain**

Functional analysis provides a detailed profile of the Sesame structure through identification, description and quantification in physical terms the sequence of operations concerning commodity production, processing, marketing and final consumption [19]. There are many steps were required to complete a functional analysis: setting boundaries of value chain, identifying the main actors and their activities, mapping the flows and volume of the products.

1. Boundaries of the Value Chain

A value chain is often defined as the sequence of value-added activities, from production to consumption, through processing and

commercialization. There are many products produced from Sesame and reached to final consumers through different chains, the study concentrated only on Sesame seed and processing Sesame to oil. There are different options identified in the study area, it involved the main key actors in which the traders or wholesalers play a key role in the distribution of Sesame from producers to processors or exporters. The options differently according to the products passed through the chain.

Option 1: Sesame seeds flow which started from Input suppliers - farmers - wholesalers - exporters- consumers in other countries.

Option 2: Sesame edible oil flow started from input suppliers – farmers – wholesalers - traditional processors - oil retailers - local consumers.

Option 3: Sesame cake flow started from input suppliers – farmers – wholesalers – traditional processors - cake traders - animal breeding consumer.

Option 4: Sesame edible oil and cake flow started from input suppliers – farmers – wholesalers - modern processors – foreign consumers (oil & cake). This option unfortunately not covered in the study because the data was not available.

2. Identifying the Main Actors and Their Activities

The value chain actors are those directly involved in value chain activities. They are includes inputs suppliers, producers, wholesalers, processors, exporters, retailers and consumers. Actors in the value chain added value through marketing costs such as transportation, loading, cleaning, packaging, sorting, storage cost like rent, pest control and weight loss. There are different institutions involved in the chain and gives support activities to the actors representing in the State Ministry of Agriculture, Agricultural Bank, Research Institutions and private companies selling pesticides and herbicides.

1/ Inputs Suppliers

Inputs include seeds, labor, farm equipment, fertilizers, pes-

ticides and sack. It cleared from table (4) that most of the farmers bought their inputs from the markets. A bout 53% of the sample farmers bought Sesame seed from the market, 44% of them used their reserved seed from previous season and 2% provided their seed from some companies in Al Gaderif State. Just (18) farmers from the sample treated their seed chemically and they bought the chemicals from the markets, except 22% of them provided it from the special companies. Only (27) farmers from the sample used herbicides and pesticides in their farm activities most of it from the market and some companies especially herbicides. While only 7% of them provided their herbicides and pesticides from State Ministry of Agriculture. As for the sacks the farmers bought it from the markets and only small fraction provided it from the banks.

Table (4): Inputs suppliers of Sesame in the study area (%)

Kind of inputs	Market	Re-served	Bank	Companies	Ministry of Agri-culture
seeds (N=150)	53	44	0	2	0
seed treatment (N=18)	78	0	0	22	0
herbicides (N= 27)	48	0	0	44	7
insecticides (N= 27)	89	0	0	4	7
sacks (N=150)	99	0	1	0	0

Source: Survey results, January 2020

* (N) Number of farmers used the inputs

2/ Farmers

Farmers are the first link in the marketing chain there are two types of farmers in the study area small and large scale farmers,

basically the main distinction between them is the size of land holding and capital. The roles of farmers in Sesame production include land preparation, cultivation, weeding and harvesting. The farmers depend on machines in the preparation and planting of Sesame and on labor in weeding and harvesting. A few farmers of the sample sold the Sesame in their farm whereas 49% of them preferred to transfer it to near village markets to the traders or collectors. Those collectors transported it to the cities they called primary collectors they sold to processors, exporters, regional traders. Half of the examined farmers transported Sesame themselves directly to city markets where the assemblers or wholesalers have well-established businesses and capacity to handle large volume of Sesame-seed.

3/ Collectors/ wholesalers

Collectors or wholesalers are the first connection between farmers and other actors in the value chain in the study area their role is to collect Sesame from the farmers. About 7% of them in the sample purchased Sesame directly from the farm, 30% collected Sesame from the villages and transport it to the cities, whereas 63% of them purchased it from the city market directly from the farmers. The wholesalers sold Sesame to the exporters, traditional and modern processors. A significant proportion of the crop is auctioned in Al Gaderif city by the wholesalers they act as middlemen or brokers this leads to raise the prices of Sesame without adding any value.

4/ Exporters

Exporters delivered Sesame to consumers outside the country. They screen, clean and bagged Sesame-seed into 50kg bag. The bagged Sesame-seed is then packed into 20 and 40 metric ton containers and transported to the shipping lines for onward shipment to the export destinations. A few exporters in the sample bought Sesame from the village markets whereas 80% of them

prefer to purchase Sesame directly from the wholesalers in the Al Gaderif city to avoid transportation and to select good Sesame varieties from the collection.

5/ Oil Processors

Sesame oil is produced primarily from red Sesame seeds three types of extractors are being used, the traditional manual (camel-driven), small-motorized, and large-capacity oil extractors. Traditional and small motorized processors handle limited quantities of Sesame-seed and processed into oil. Cake was result from processing as by product and it used for feeding the animals. 27% of the processors in the sample bought Sesame from the village markets and 73% bought it from the wholesalers in the city. Large capacity processors processed large quantities of Sesame seed and export oil and cake to outside for foreign consumers they bought their Sesame seed from the wholesalers in the city.

6/ Oil and Cake Traders:

They bought oil and cake directly from traditional processors in small quantities and sold it in the retail markets for local consumers and animal breeding consumers.

Table (5): Functional analysis of the Sesame value chain

Stage of the chain	Functions	Agents	Outputs
Input supply	Supply of inputs	Ministry of agriculture (Federal and state), Banks, private companies.	Seeds, chemicals, sacks
Production	1/ Production of Sesame 2/Primary marketing	Farmers (small and large scale) Village collectors	1/ Production of Sesame 2/ Sesame delivered to village and city markets

Stage of the chain	Functions	Agents	Outputs
Assembling	Transportation and Collection of Sesame from different farmers	Village collectors, wholesalers	Sesame seed delivered to wholesalers in city markets and Auction
Export	Transport and export Sesame seed to foreign markets	Exporters, foreign consumers	Sesame seed delivered to international markets
Processing	Transforming Sesame seed to oil and cake	Traditional and modern processors	Sesame oil and cake delivered from millers and factories to local market.
Retail	Transport oil and cake to final sales	Oil retailers, animals breeding, local consumers	Oil and cake delivered to final consumers

Source: Survey results, January 2020

3. Mapping the Volume and Flows of Sesame Value Chain

Farmers planted Sesame for commercial purpose so they preferred to deliver their produce to the markets by themselves. The average quantities delivered per sample farmer was 312.6 ton. Only 11% was sold in the farm whereas the fifty percent of the volume sold in the village markets and about 39% sold in city markets. Many rural collectors act as middle agents they collect Sesame from different farmers and sold it without adding value to wholesalers. Wholesalers purchased Sesame from the rural and urban collectors in the

village or city markets but only 7% of them purchased about 34.6 ton directly from the farm. 57% of Sesame collected from the city markets and 27% from village markets. The exporters delivered an average of 260.8 ton of Sesame, 62% of it from city markets and 38% from village markets. Processors handle small quantities of Sesame as they have traditional factories the average quantities purchased was about 1.08 ton mostly from village markets figure (2) showed flowchart of Sesame value chain.

5.3 Linear Regression Analysis

Linear regression analysis was done to estimate the socio-economic factors that affected producer's profitability which depend on marketed surplus or sold quantities of Sesame. Ten predictor variables were used in the model which are; farmer's age, education level, occupation, experience, planted area, yield, stored quantity, consumed quantity, sale place and selling price. Sold quantity was the dependent variable. Entered method in SPSS statistics version 20 was used to analyze the data for 150 farmers.

The results of model summary showed that 58.4% of the variations of the dependent variable obtained due to the independent variables included in the model. The R Square in a multiple regression represents explained variance that can be contributed to all predictors in a progression it gives explanatory power [20]. ANOA table revealed that the variations in the dependent variable was a statically significant and that is because p= .000 was less than 0.05 significant level so the null hypothesis was rejected and the alternative hypothesis was accepted. This means that the socioeconomic factors presented in the model were influence producer's profitability by 58.4%. This result was similar to Zubaidah O & Fazleen A, (2020) in their study of factors affecting agriculture profitability of coconut production, R^2 was 51%. They reported that "according to Frost (2017) a smaller R-squared value is not always a problem and a higher R-squared value is not necessarily good due to the

outcome variables, such as the human behavior, which are unpredictable. In addition, a moderate value of R-squared indicates a good model and otherwise; an extremely high value of R-squared indicates a biased mode" [21].

An important step in a multiple regression analysis is to ensure that the assumption of no multi-collinearity has been met. Multi-collinearity is a statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated [22].The level of multi-collinearity can be assessed by looking to certain conditions; Pearson Correlation Coefficient (r) of predictor variables should be more than 0.80, the variance inflation factor (VIF) more than 10 and R^2 more than 90% [23]. As the table (6) showed none of the correlation coefficients reached 0.80 this indicates no variables are closely related. Also all VIF values range between 1.05 and 1.7 it means less than 10 and R^2 equals 0.584, hence multi-collinearity cannot be suspected.

Table (6): Regression coefficients on quantities sold of Sesame

Variables	Coefficients	Sig	Correlation (r)	VIF
(Constant)	-132.350-	.012**		
Age	-.630-	.355	-.104-	1.621
Education	4.201	.549	.082	1.486
Occupation	53.230	.019**	.181	1.574
Experience	-.183-	.808	-.232-	1.721
Planted area	.366	.000***	.569	1.429
Consumed quantity	1.029	.642	.127	1.055
Stored quantity	-.207-	.025**	.103	1.400
Sale place	73.938	.015**	-.123-	1.523
Selling price	.008	.012**	.303	1.719
Yield	102.558	.000***	.228	1.405

Source: survey results, January 2020

R= 0.754 R^2=58.4% Adjusted R^2 =55.4% F=19.5 DW=1.75
Std. error of the estimate= 74.2
***significance at (p<0.0) ** significance at (p< 0.05)

From the table (6) regression coefficients indicates that from ten predictor variables only six have significant effects on the sold quantities two of them were highly significant at p< 0.000 level those are; planted area and yield of Sesame. Other four variables were significant at p<0.05 level which are; selling price, sale place, occupation and stored quantity. All predicted variables have an expected signs, except the farmer's age and experience.

Planted area and yield of Sesame were positively significant with the sold quantity. Coefficient of correlation implies moderate correlation with sold quantity (r= 0.569, 0.228 respectively). The regression coefficient of planted area was (B= .336) it revealed that increase in one unit of the planted area (when other predicators are constant) the sold quantity increase by 0.336. The coefficient of yield implies that yield was highly influencing the sold quantity (B=102.56), increase in one unit of yield (when other predicators are constant) the sold quantity increase by 102.56. This reflects the high effects of productivity of Sesame on the farmer's profitability.

Selling price has positive coefficient and significant relation with sold quantity as it expected, this indicates that the prices stimulate production especially previous year prices, Kindie A, 2007 indicated in his study that Tomek and Robinson (1985) used cobweb model, according to their model they stated that "the recursive nature of price and quantity relations, a high price leads to large production; the large supply results in low prices, which in turn result in small production, and so forth" [24].

Sale place has positively significant relation with sold quantity (B= 73.938) but it has negative correlation coefficient (r= -0.123) this because the farm is used as dummy variables= 1 and the big quantities of Sesame sold out the farm (in the village or city mar-

kets). Transport Sesame to village or city markets will access the farmers to gain better prices. Moreover if the farmers sold directly to exporters or processors they will maximize their profits.

Occupation has a statistically significant impact on quantity sold and has positive relationship (B= 53.230). When the producers practiced agriculture as the main occupation it means that they are devoted and concentrated on their job and they have good knowledge and information about the marketing.

Quantity stored has negative, statistically significant to quantity sold (B= -0.58). The farmers stored their crop for next season to use it as seed other farmers stored it for better price. Increase in one unit of the stored quantity (when other predicators are constant) sold quantity decrease by 0.58.

The coefficients of farmer's age and experience were not shown significant impact on sold quantity also the signs shown negative relations not as expected. This may be attributed to the fact that the younger farmers are more active in business than older one. This agrees with Magabe, (2016) result, he was reported that "as the age of respondents increases, the probability of participating in Sesame business decreases" [25].

6 **Conclusion:**

The study focus on various issues related to socioeconomic characteristics of Sesame value chain actors in Gaderif state. The results revealed that the key actors identified in the study area include; producers, wholesalers, exporters, processors, traders and consumers. It found that nearly half of actors in economically age range 41-60 years and the majority have secondary and university level of education that means they have abilities to take decisions on crop cultivation, marketing, finance, resources allocation, and new agricultural technologies adoption. Also the study appeared that all actors in Sesame value chain are specialized and devoted on their jobs. The results showed that Sesame covered about 28%

from total planted area and the average yield from feddan was very weak it equals to 67 kg. The results from multiple regression analysis have shown that the factors of planted area, yield, selling price, sale place and occupation of the farmers were shown positive and statistically significant relationship with the producer's profitability whereas a stored quantity was shown negative relationship.

7Recommendations:

1. Develop good varieties of Sesame with high productivity and resistance to diseases.
2. Improve post-harvest management system to reduce quantity and quality loss.
3. Improve Sesame quality
4. Rural roads should be constructed by the government to enable the farmers in the rural areas to transport their products easily to the urban markets.
5. Improve the efficiency of marketing system
6. Improve market information system with regard to prices because it helps producers to choose best marketing channels to ensure better profits

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9 Figures

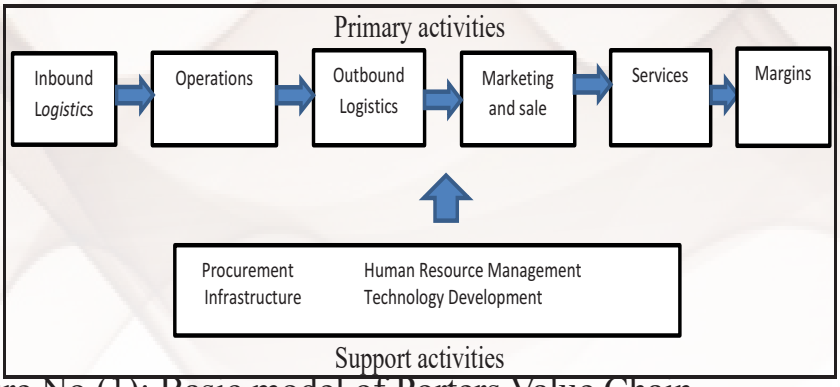
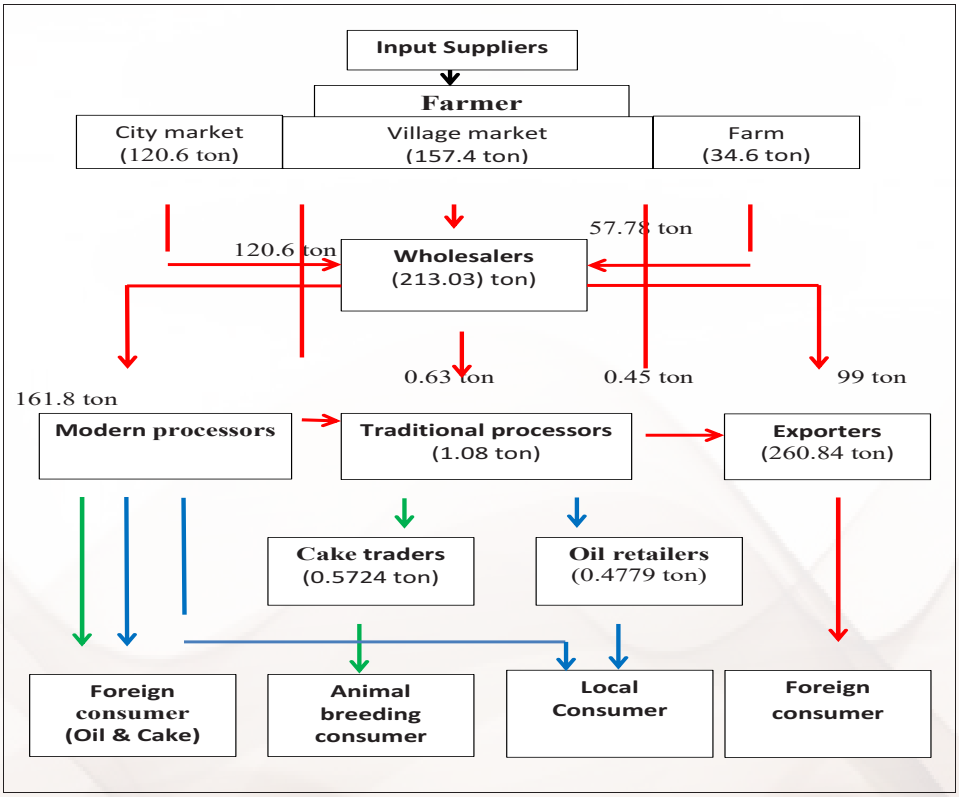


Figure No (1): Basic model of Porters Value Chain
Source: https://www.ifm.eng.cam.ac.uk/research/dstools/value-chain



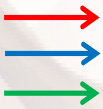


Figure (2): Flowchart of the Sesame value chain in Gaderif State, Sudan

Source: Drawn by researcher January, 2020