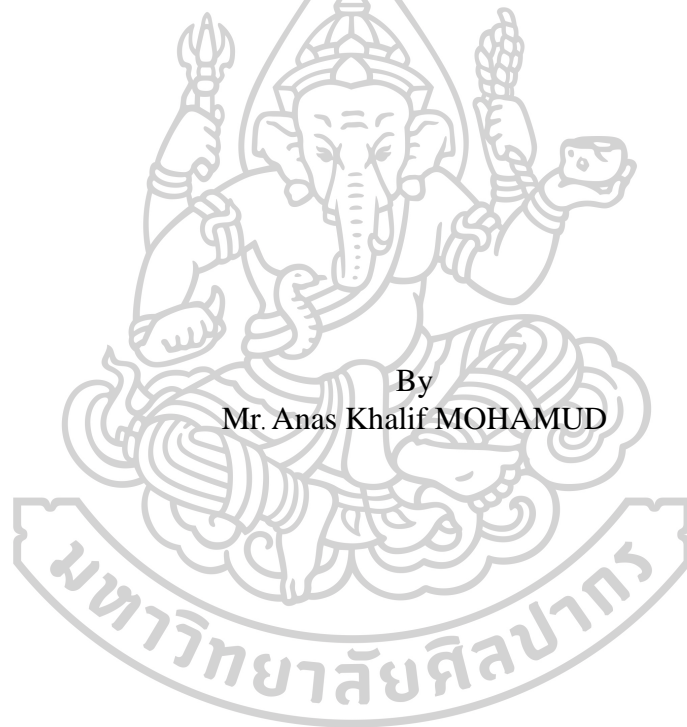




SOCIOECONOMICS, FACTORS INFLUENCING THE SESAME PRODUCTION,  
AND SMALL-FARMER HOLDERS' NEEDS IN INCREASING SESAME  
PRODUCTION IN JOWHAR DISTRICT, MIDDLE SHABELLE, SOMALIA.



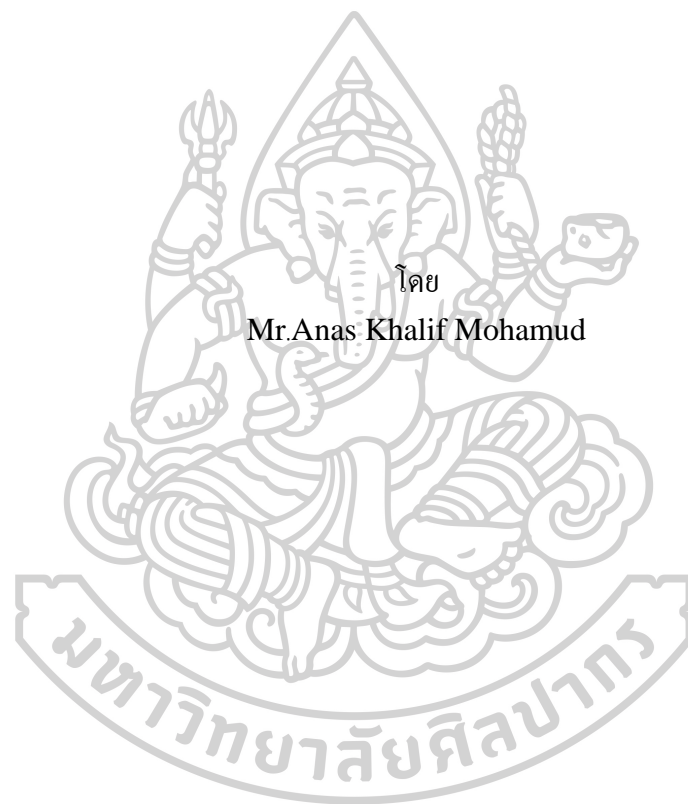
By  
Mr. Anas Khalif MOHAMUD

A Thesis Submitted in Partial Fulfillment of the Requirements  
for Master of Science BIOSCIENCE FOR SUSTAINABLE AGRICULTURE

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Socioeconomics, factors influencing the sesame production, and small-farmer holders' needs in increasing sesame production in Jowhar District, Middle Shabelle, Somalia.



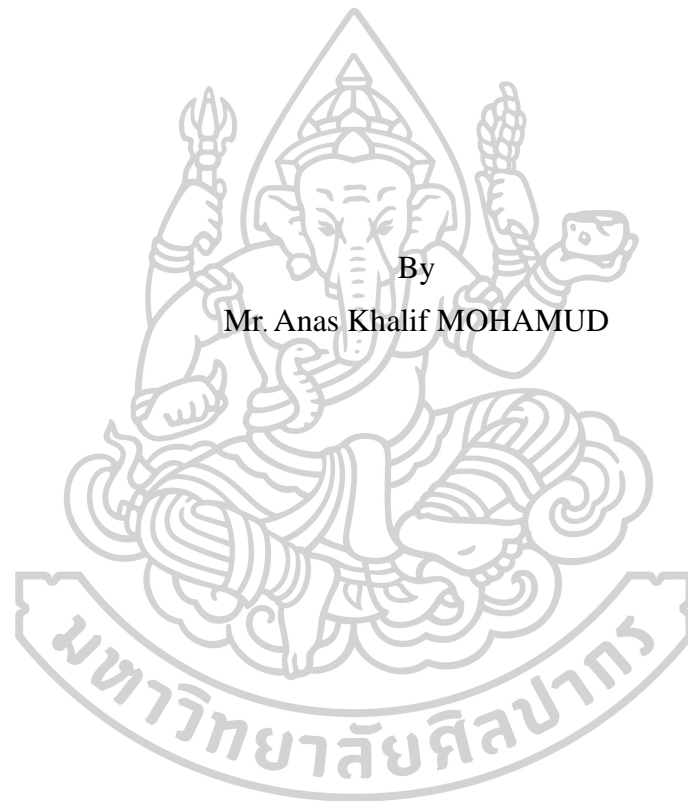
วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรวิทยาศาสตรมหาบัณฑิต  
ชีววิทยาศาสตร์เพื่อเกษตรกรรมที่ยั่งยืน แผน ก แบบ ก 2 (หลักสูตรนานาชาติ)

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ลิขสิทธิ์ของมหาวิทยาลัยศิลปากร

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Title Socioeconomics, factors influencing the sesame production, and small-farmer holders' needs in increasing sesame production in Jowhar District, Middle Shabelle, Somalia.

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Field of Study BIOSCIENCE FOR SUSTAINABLE AGRICULTURE

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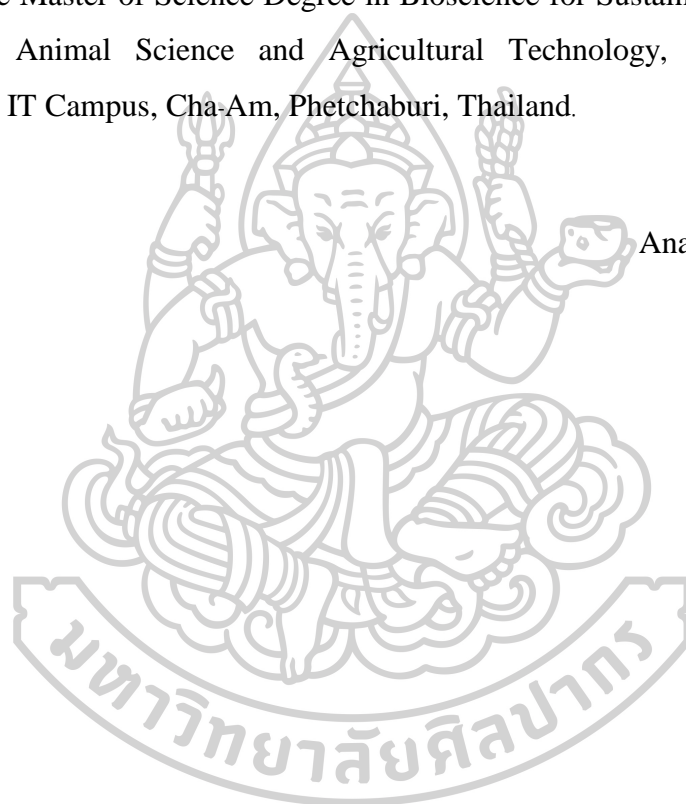
Mr. Anas Khalif MOHAMUD : Socioeconomics, factors influencing the sesame production, and small-farmer holders' needs in increasing sesame production in Jowhar District, Middle Shabelle, Somalia. Thesis advisor : Assistant Professor Dr. Panida Duangkaew

Sesame is an economically important crop to produce high-quality oil and nutritional products. In Somalia, sesame is very important for both domestic consumption and export to an international market. The Jowhar District, Middle Shabelle, Somalia, is the main sesame cultivation site along the river Shabelle. This study sought to investigate the socioeconomic details of sesame farmers, their cultivation practices in Jowhar District, and gather the farmers' perspectives on factors influencing higher sesame production. The study took place in Jowhar district, middle Shabelle Somalia, utilizing a farm-based cross-sectional approach. Data was gathered through a structured close-ended questionnaire, and participants were selected randomly. The collected data was analyzed using SPSS software. The sample size in the study consisted of 196 + no response 5% = 205. Many of the respondents 71.7% were men. The mean age of respondents is 43.46 years. One fourth (24.4%) of respondents having a high school education. Over half of the respondents (57.1%) had 5-15 years of sesame cultivation experience. Most of the respondents (91%) used traditional methods to promote plant growth and pest control in growing sesame. Most of the farmers used simple hand tools for weeding (62%) and harvesting (69%). The survey discovered that most respondents (88%) sold sesame as wholesale at the farm gate. Many respondents (43.9%) strongly agreed that improving local sesame seed varieties should play an important role in producing sesame seed and increasing the price of the produce in the market. About 35.6% strongly agreed that the promotion of sesame waste, such as sesame husks and meals as animal feed, should encourage farmers to increase sesame production. Multiple regression analysis showed the statistically significant impact of the number of laborers on sesame production, as indicated by a p-value of 0.026\*\*. The size of the cultivated area emerges as a highly influential factor, supported by a very significant p-value of 0.000\*\*\*.

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Anas Khalif MOHAMUD



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## CHAPTER 1

### INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the oldest oil seeds in the world and can be cultivated in both tropical and subtropical areas (Khidir, 1997, Weiss, 1983). It is commonly known as til (Hindi), hu ma (Chinese), sesame (French), Goma (Japanese), gergelim (Portuguese), and ajonjoli (Spanish) (Anilakumar, 2010). Although sesame has been indigenous in Ethiopia, its cultivation has been started for centuries in Burma, Pakistan, Japan, India, and other countries in Africa. In modern periods, sesame has also been cultivated in South America, Central America, and the United States of America (Lalpantluangi, 2018). Because of the growing export value of this crop, its production area in 2017 expanded to almost 10 million hectares (FAOSTAT, 2022).

Sesame is an economically important crop. The sesame market has recently expanded because of the expanding global population, shifting consumer habits, and consumer awareness of health issues (Rahman et al., 2022). About 5.5 million tons of sesame were produced worldwide in 2017, with Africa and Asia producing much of that total. By 2040, sesame production is expected to increase from 5.53 million tons in 2017 to 9.26 million ton (Rahman et al., 2022). According to FAOSTAT, Africa produced more than 40% of the world's sesame seeds, with Sudan serving as the continent's top producer (FAOSTAT, 2022).

Somalia potentially played a role in the international sesame trade, ranking as the 12th largest sesame producer in the world in 2012 (SATG, 2016). According to the Somali Agriculture Technical Group (SATG), the annual revenue from sesame in 2012 was \$300 million US, or 5.25% of the nation's gross domestic product (GDP) (SATG, 2016). In 2019, Somalia exported sesame seed 28,672 tons to the overseas market, earning US\$43.03 million for the country. At the regional trade events, Istanbul and Dubai are the two main markets where sesame from Somalia has been sold to foreign clients (GEEL, 2020). Despite the COVID-19 pandemic, there was a 29% increase in exporting processed sesame in 2020 compared to 2018, with shipments of 14 metric tons of the product worth \$20 million (GEEL, 2020). This increase resulted in the good prospect of sesame production (both raw seeds and processed products) and subsequently benefitted Somalia's economy (GEEL, 2020). Hence, the improvement of sesame productivity in Somalia should have a direct impact on Somalia's GDP.

Even though there was an increase in production, but world sesame ranking producer of Somalia fell to 24<sup>th</sup> in 2020. The major challenges of sesame cultivation

are input and production knowledge gaps. The farmers encompass issues like poor seed quality, persistent threats from pests and diseases, lack of investment, civil strife, lack of policy, and limited research and data (SATG, 2016).

Geographically, many crops have been cultivated in in Jowhar District because of the soil fertility and the river Shabelle which provides water for irrigation. The land along the riverbank is very fertile for agriculture and this area is one of the major crop productions in the country. The farmers along the river Shabelle generally grow sesame using their traditional methods. However, information on socioeconomics, agronomic practice methods, productivity, and sesame farmers' knowledge needs is still rare for sesame production. Thus, the survey of this information is beneficial for the improvement of sesame production.

Based on these gaps of knowledge, the objectives of this research were (1) to examine the socioeconomic information of sesame farmers and sesame production practices in the Jowhar District, (2) to study the factors that influence sesame productivity, and (3) to survey the farmer's needs to increase sesame production. The data obtained was worthwhile for both improving sesame production and increasing farmers' income.

### **1.1 Statement of the problem**

Somalia is one of the potential producers of sesame in the world. Somalia ranked as 12<sup>th</sup> for the largest sesame producer in the world in 2012; however, 24<sup>th</sup> in 2020 despite the increase in the total production and export values. The major challenge is to enhance the higher productivity of sesame since the farmers have encountered several difficulties, including low productivity, a lack of crucial market knowledge, a lack of technical expertise among farmers, and a lack of processing capacity to produce high-quality seeds, particularly to the standards required in export markets. Also, information on socioeconomics, agronomic practice methods, productivity, and sesame farmers' knowledge needs, and ideas is still rare for sesame production. The survey of this information will be beneficial for the improvement of sesame production in Somalia.

### **1.2 Research objectives**

- 1) To examine the socioeconomic information of sesame farmers and sesame production practices in the Jowhar District, Somalia
- 2) To study the factors that influence sesame productivity in the Jowhar District, Somalia

- 3) To survey the farmer's needs to increase sesame production in the Jowhar District, Somalia



## CHAPTER 2

### LITERATURE REVIEWS

#### 2.1 Sesame

##### 2.1.1 General characteristics

Sesame is a member of the Pedaliaceae family in the genus *Sesamum*. Sesame may be divided into three categories based on the color of the germplasm: white sesame, black sesame, and yellow sesame (Figure 1). Black and white sesame are the more prevalent and extensively farmed dominating species. White sesame is the most popular and has the highest oil content, whereas black sesame has the most robust growth, lodging resistance, and drought tolerance (Hegde, 2012). In general, as the color of the germplasm intensifies, the oil content steadily diminishes.



**Figure 1** Sesame seeds of different colors.

**Source:** <https://images.app.goo.gl/3QvJ4XsRxuqnqiAn8>.

*Sesamum indicum* plants, flowers, capsules, and seeds are shown in Figure 2. Sesame is a warm-season annual crop that may grow up to 1.5-2 meters, depending on the varieties and growing environment. It varies greatly in size, form/shape, growth habit, blossom color, and seed size. The stem is upright, with distinct longitudinal furrows. The stem color ranges from light green to purple, with a preference for

darkish green. Sesame has a long-shallow thin taproot with a well-distributed secondary root system for optimal soil moisture utilization (Mili et al., 2021).

The leaf size ranges from 3-17.5 cm in length, 1-1.7 cm in breadth, and 1-5 cm in petiole length. Most of the leaves are dull, darkish-green, or light green with a yellowish tint. The leaves are hairy and mucilaginous. They are borne singly or 2-3 together in the leaf axils. The leaves are whole, lanceolate, and occasionally somewhat serrate. To allow optimum sunlight penetration, upper leaves are smaller and lanceolate. The arrangement of the leaf changes depending on the variety, alternating or opposite (Mili et al., 2021).

The calyx lobes of sesame are 5-8 mm long and 1.6-3.5 mm wide, lanceolate in shape, and have a pilose appearance. The corolla of sesame is 2.5-3 cm long in a tube shape about 1 - 1.5 cm in diameter. It is white, often with a purplish-red or yellow halo. The four stamens are hidden inside the flower. The ovary is superior with 4 locules and pilose outside. Flowers occur in late summer and early autumn. Sesame has bell-shaped white to pale-rose flowers that appear in the leaf axils. Flowering begins 35 - 45 days after planting and lasts 75 - 85 days for early cultivars, with some kinds taking up to 150 days to mature. Flowers have five-lobed corollas that range in color from white to light pink to practically purple and are born on extremely short peduncles (Mili et al., 2021).

Sesame is mostly self-pollinated, while insect pollination occurs. Insect pollination has been found to cause up to 50% outcrossing. Flowers bloom in the early morning and die in the evening. Anthers open and release pollen quickly after the flower opens, and it is only viable for 24 hours. The stigma stays receptive from one day before the flower opens until one day after the blossom opens. The fruiting structure is a capsule or pod that begins to form approximately 20 - 30 cm above the ground surface. The sesame capsule is rectangular, 2 - 3 cm in length, and 6 - 12 mm in diameter, with longitudinal ribs on the surface and microscopic hairs. Capsules are connected to the stem at an upright angle, are generally hairy, and contain 50-90 tiny seeds.

After fertilization occurs, sesame seeds are developed in the pods until ripening dried state. Physiological maturity occurs 95 - 110 days following planting for early varieties and up to 150 days for late varieties. When 75% of the capsules on the main stem have developed seeds or three-fourths of the stem turn yellow, the sesame plant has reached physiological maturity.

Sesame seeds are very tiny ovate seeds that are slightly flattened and thinner at the hilum than at the opposite end. Depending on the variety, the weight of

1000 sesame seeds is between 2 – 4 g on average. The seed color varies according to the varietal: white, yellow, reddish brown or grey, dark grey, olive green, extremely dark brown, and black. The tough seed coat may be readily removed with dry decortication (Mili et al., 2021).



**Figure 2** *Sesamum indicum* plant (A.), flower (B.), capsules with seeds (C.)

**Source:** <https://images.app.goo.gl/bjnwZj2gJTJPhqg87>,  
<https://images.app.goo.gl/Ye2rzTHSZp4M7ePW7>,  
<https://images.app.goo.gl/S4xc3vj2axsMbAqf7>.

### 2.1.2 Cultivation

Sesame is a warm-season annual crop. The environmental circumstances influence sesame's growth, development, and flowering. It grows robustly in areas where temperatures remain high throughout the growing season. The soil temperature

is a good indicator of when to sow sesame seeds. For good seed germination, the temperature of the topsoil should not be lower than 20°C for 10 days, and plant growth is retarded by cool temperatures even after the stand is established. Sesame requires excellent soil moisture for the establishment and high production, but it cannot tolerate standing water. Irrigation water produces substantially yields much more than rain-fed crops (Gharby, 2017).

Sesame is mostly self-pollinated, while insect pollination occurs. Insect pollination has been found to cause up to 50% outcrossing. Growth and fruiting are favored with average daily temperatures of 30 to 33 °C. Capsule set is usually poor during periods of extremely hot weather when maximum temperatures exceed 40°C. However, sesame will shed blooms if it is stressed for moisture. Some varieties will shed blooms for several days if it has been stressed for moisture and are irrigated late. Sesame varieties require 90 - 110 days after planting to reach physiological maturity. Another 20 - 40 days are needed to allow the plant to dry down for harvest.

#### 2.1.2.1 *Soil type*

Sesame plants are very tolerant of different soil conditions, but good drainage is a necessity. A sandy, loamy soil is a good option. Sesame cannot handle standing water, wet soils, or heavy clay soils, nor will it tolerate salty soil or salt air. The optimum pH range is 5.5 to 8.0, acidic or alkaline soils are not suitable (ALOI, 2023). Sesame requires a fine tilth for good germination and crop establishment similar to many other crops. Land preparation is done in the dry season to allow sunlight to act on weeds and insect pests in the soil before the rains start. Land preparation for sesame planting involved plowing by disk plow and then harrowing with a disk harrow. Ridging, leveling, and furrowing were done manually (CEFA, 2016).

#### 2.1.2.2 *Water*

Sesame is usually planted in arid and semi-arid regions of the world. The plant is very responsive to environmental conditions and abiotic factors such as temperature, humidity, precipitation, and soil moisture. All of which can affect its yield and quality. Since the water requirements of sesame crops have not been investigated so far, we know sesame for its ability to tolerate dry conditions. It requires less water compared to many other crops, making it suitable for cultivation in regions with limited water resources or during drought periods (Ucan, 2007). However,

sesame planting should be considered while planning crop irrigation projects in each cultivation region.

Usually, the crop is grown under rainfed conditions. When facilities are available, the crop may be irrigated to field capacity after thinning operation and thereafter at 15 TO 20-day intervals. Researchers recommend stopping irrigation just before the pods begin to mature. Surface irrigation at 3 cm depth during the critical stages, i.e., 4 – 5 leaves or branching, flowering, and pod formation will increase the yield by 35 – 52 percent. Two irrigations of 3 cm depth each in the vegetative phase (4 – 5 leaf stage or branching) and in the reproductive phase (at flowering or pod formation) are the best, registering maximum yield and water use efficiency. In the case of single irrigation, it can be best given in the reproductive phase. In the tail-end fields in the command area, the best use of the sparingly available water can be made for augmenting sesame production (Ucan, 2007).

#### *2.1.2.3 Temperature*

The sesame plant needs fairly high temperatures during its life cycle. Normally the optimum temperature required during its life cycle is between 25 – 35 °C. If the temperature is more than 40 °C with hot winds, the oil content reduces. If the temperature goes beyond 45 °C or less than 15 °C, there is a severe reduction in yield (Mogilda., 2022).

Sesame originated in tropical areas thus sesame grows robustly in areas where temperatures remain high throughout the growing season. The soil temperature is a good indicator of when to sow sesame seeds. For good germination, the temperature of the topsoil should be over 20 °C for 10 days (Gharby, 2017). Seeds do not germinate well when soil temperatures are below 20 °C, and plant growth is retarded by cool temperatures even after the stand is established. Growth and fruiting are favored with average daily temperatures of 30 – 33 °C. Early literature indicated that capsule sets are usually poor during periods of extremely hot weather when maximum temperatures exceed 40 °C (Baath et al., 2022).

#### *2.1.2.4 Pest and weed management*

Pest and weed management in sesame cultivation is crucial to ensure optimal yield and quality of the crop. Crop rotation and intercropping can help reduce pests and weed pressure. Sesame is often rotated with other crops to break pest cycles and reduce weed growth. Intercropping with legumes or other plants that

naturally repel pests can also be beneficial. Hand weeding and mechanical cultivation are traditional methods used to control weeds in sesame fields. However, these methods can be labor-intensive and time-consuming, especially for large-scale operations (Gebregergis, 2016).

Herbicides are commonly used to control weeds in sesame fields. Pre-emergent herbicides are applied before weeds germinate, while post-emergent herbicides are applied after weeds have emerged. It's important to use herbicides judiciously and according to label instructions to minimize environmental impact and resistance development. In addition, some natural enemies of sesame pests, such as predatory insects or microbial agents, can be used as biological control agents. These can help reduce pest populations without the need for synthetic chemicals. However, their efficacy can vary depending on environmental conditions and pest species. Integrated Pest Management (IPM) combines multiple pest management strategies, including cultural, mechanical, chemical, and biological control methods, to minimize pest damage while reducing reliance on synthetic pesticides. This holistic approach aims to maintain pest populations below economically damaging levels while minimizing environmental impact (Dungarwal, 2003).

#### 2.1.2.5 *Harvesting methods*

In Somalia, sesame harvesting involves manual labor and simple tools. Farmers would wait until the sesame pods matured and turned brown. Then, they would cut the plants close to the ground and tie them into bundles to dry in the sun. Once dried, they would thresh the plants to separate the seeds from the pods. This method is still practiced in most Somali regions because modern equipment is not readily available. Furthermore, in modern sesame harvesting, machinery has largely replaced manual labor, especially in large-scale commercial operations. Combines equipped with special headers are commonly used to cut the sesame plants and separate the seeds from the rest of the plant. These machines streamline the process, making it faster and more efficient. Additionally, some farmers may prefer traditional methods for reasons such as maintaining seed quality or adhering to cultural practices (Georgiev, 2008).

#### 2.1.3 Nutritional and phytochemical components

Sesame seeds are known for their high nutritional content. The nutritional component of sesame is shown (Table 1). Fat, protein, vitamins, minerals, and dietary

fiber are all abundant in sesame seeds. Sesame seeds are high in minerals, such as Fe and Ca, and are rich in protein and fat (Table 1). Sesame oil, which is produced using conventional processes, is a good source of unsaturated fatty acids, fat-soluble vitamins, amino acids, and other nutrients. (Haixia & Lu, 2015).

Sesame contains high vitamin E (Mili et al., 2021). Black sesame seeds (100 g) contain vitamin E about 50.4 mg. According to (Hegde, 2012),  $\gamma$ -tocopherol is the predominant type of vitamin E in sesame seeds, while  $\alpha$ -tocopherol is present in comparatively smaller amounts.  $\gamma$ -tocopherol has a higher antioxidant capacity than  $\alpha$ -tocopherol (Hegde, 2012). Apart from vitamin E, sesame seeds also contain vitamin A, thiamine, riboflavin, folic acid, pantothenic acid,  $\alpha$ -tocopherol,  $\beta$ -tocopherol,  $\gamma$ -tocopherol,  $\delta$ -tocopherol, and tocotrienol (Fasuan, 2018).

Other mineral elements in sesame seeds also include K (468 mg/100 g), P (605 mg/100 g), Mg (324 mg/100 g), Na (2.31 mg/100 g), Fe (14.6mg/100 g), Zn (5.74 mg/100 g), and Mn (1.24 mg/100 g) (Elleuch et al., 2007).

Sesame oil contains linoleic and linolenic acids, as well as large concentrations of physiologically active compounds such as lignans, natural vitamin E, and phytosterols. Linoleic acid (46.9% of the total unsaturated fatty acids in sesame oil) and oleic acid (37.4%) are the two most prevalent. These fatty acids are classified as essential fatty acids. Additionally,  $\gamma$ -tocopherol, a key component of vitamin E is abundant in sesame oil (Hama, 2017) (Gharby, 2017).

**Table 1** Key nutritional composition of sesame seeds.

Component	value	min	max
Protein (g/100g)	17.6	17	18
Crude protein, N x 6.25 (g/100g)	20.8	3.2	21.3
Carbohydrate (g/100g)	9.85		
Sugars (g/100g)	3	0.29	0.31
Starch (g/100g)	4		
Fiber (g/100g)	14.9	11.8	18
Fat (g/100g)	49.7		
Saturated Fatty Acids (SFA) (g/100g)	7.09	6.7	7.6
Monounsaturated Fatty Acids (MUFA) (g/100g)	18.8		18.9
Polyunsaturated Fatty Acids (PUFA) (g/100g)	21.8		21.9
Oleic acid (C18:1 n-9 cis) (g/100g)	18.7	18.6	
Linoleic acid (C18:2 9c,12c (n-6)) (g/100g)	21.2	20.9	21.5
Linolenic acid (C 18:3 9c, 12c, 15c (n-3)) (g/100 g)	0.26	0.14	0.38

Ash (g/100g)	4.48	4.45	4.5
<b>Minerals</b>			
Calcium (mg/100g)	962	714	1150
Copper (mg/100 g)	1.58	1.5	4.08
Iron (mg/100 g)	14.6		
Magnesium (mg/100 g)	324	318	351
Manganese (mg/100 g)	1.24	1.17	2.46
Phosphorus (mg/100 g)	605	453	694
Potassium (mg/100 g)	468		
Selenium (µg/100 g)	26.5	2.2	51.9
Sodium (mg/100 g)	2.31	0.88	11
Zinc (mg/100 g)	5.74	5.3	7.75
<b>Vitamins</b>			
Vitamin B1 (Thiamin) (mg/100g)	0.79		
Vitamin B2 (Riboflavin) (mg/100g)	0.25		
Vitamin B3 (Niacin) (mg/100g)	4.52		
Vitamin B5 (Pantothenic acid) (mg/100g)	0.05		
Vitamin B6 (mg/100g)	0.79		
Vitamin B9 (Folate) (µg/100g)	97		
Vitamin E (mg/100 g)	25		

**Source:** <https://ciqual.anses.fr/>, accessed on 30 April 2024.

#### 2.1.4 Production and economic importance

Worldwide sesame seed consumption was USD 6559.0 million in 2018, and it will reach USD 7244.9 million by 2024, with a CAGR (compound annual growth rate) of 1.7% (Intelligence., 2019). Global sesame consumption is steadily increasing mainly due to changing consumer consumption patterns and increasing health awareness. Nowadays, consumers mostly prefer high nutritive value products. Consequently, the demand for sesame seeds is higher since it has several nutritional characteristics such as vitamins, minerals, fiber, healthy fat, and protein. About 70% of the world's sesame seed is used to produce oil and meal. Total annual oil and food consumption is about 65% and 35%, respectively (Morris & Janick, 2002). Tanzania is the highest sesame seed consuming country (21% based on tonnes), followed by China (19%), Sudan (9%), Myanmar, India, Ethiopia, and Nigeria (6% each) with almost 74% of the global consumption. The consumption of Tanzania, Sudan, and Myanmar was 30.8, 17.6, and 10.1 kg per year respectively in 2016 (Agritech., 2019).

The world sesame production is about 5,532,000 metric tons (MT) behind soybean, groundnut, cottonseed, sunflower, linseed, and rapeseed, in the quantity of world oilseed production. The average sesame productivity of the world's top-producing countries within 20 years (1999-2018) is given in. However, the data for Sudan and South Sudan was officially recorded in 2012 by Food and Agriculture Organization Statistical Databases. India, Myanmar, and China are the highest producers among the countries. The average sesame yield is found to be highest in China (1223 kg/ha) followed by Nigeria (729 kg/ha) and Tanzania (720 kg/ha) (FAOSTAT, 2022)

More than 6.5 million tons (t) of sesame seeds were produced globally in 2020. (1,525,104 t), Myanmar (740,000 t), Tanzania (710,000 t), India (658,000 t), and Nigeria (490,000 t) are the top five producers of sesame in the world (Table 2) (FAOSTAT, 2022).

**Table 2** The top nations that produce sesame in 2022.

Country	Production (t)	Area (ha)
Sudan	1,525,104	5,173,521
Myanmar	740,000	1,500,000
Tanzania	710,000	960,000
India	658,000	1,520,000
Nigeria	490,000	621, 413

**Source:** FAOSTAT (2022).

Africa accounts for more than 40% of the world's sesame seed production with Sudan as the leading producer country on the continent. Sudan was Africa's top producer of sesame seeds as of 2022 (Table 2). Sudan generated more than 1.5 million metric tons of seeds. Tanzania and Nigeria come third and fifth with output totals of 710,000 and 490,000 tons, respectively. Africa generated more than 4.2 million metric tons of sesame seeds in the year (FAOSTAT, 2022).

### 2.1.5 Sesame product development

The paragraph discusses the versatile use of sesame seeds in various food products, including baking, confectionery, and snacks, as well as their importance in Middle Eastern tahini and Asian sesame oil. The demand for sesame seeds in the food industry is driven by consumer preferences for diverse and healthier food options,

alongside the popularity of ethnic cuisines like Middle Eastern and Asian dishes. Sesame seeds are prized for their nutritional benefits, including high protein, fiber, healthy fats, vitamins (B and E), and minerals (magnesium, calcium, and iron), making them a popular choice for health-conscious consumers. However, market expansion is hindered by price volatility caused by weather conditions affecting crop output, as well as fluctuations in input costs, such as seeds, fertilizers, and labor, which can impact sesame seed prices and ultimately affect consumers (Pulidindi & Mohanan, 2023).

The sesame seeds market is segmented based on product type, category, end-use, and distribution channels. Hulled sesame seeds, valued at USD 4.84 Billion in 2022, are rich in protein, fats, fiber, and minerals, making them popular for healthy and restrictive diets, as well as in pharmaceuticals and personal care products. Conventional sesame seeds dominate the market, accounting for around 73.2% in 2022, due to lower costs and wider availability, although they may contain residues of herbicides and fertilizers. In the food industry, sesame seeds are in high demand for their nutritional benefits and versatility, particularly in bakery goods, snack bars, and dressings, catering to the increasing demand for healthier and natural ingredients. Supermarkets and hypermarkets hold the largest market share of USD 3.34 Billion in 2022, reflecting the growing preference for convenient shopping experiences (Pulidindi & Mohanan, 2023).

Besides being used in many foods, sesame meals can be applied for animal feeds and fertilizer raw material. Seeds and oil have significant pharmacological benefits and are being applied in pharmaceuticals and cosmetics (Shahrajabian, 2023). Stalks and some used sesame oil can also be processed as alternative fuel.

## **2.2 Sesame production in Somalia**

Somalia has emerged as the 12th largest global producer of sesame seeds since 2012, playing a significant role in international trade despite facing challenges such as civil unrest and limited investment. Sesame production has increased seven-fold since 1991, thriving in Somalia's resilient climate characterized by short rainy seasons followed by longer dry periods. Sesame revenue annually amounts to approximately \$300 million, contributing 5.25% to the country's GDP (SATG, 2016). However, the sesame value chain faces numerous challenges, including low education levels among producers, poor seed quality, pest threats, and underdeveloped segments like processing and marketing. Addressing these constraints requires knowledge-based initiatives and investment in modern processing technology. Furthermore, the sesame

value chain offers opportunities for financial services and government regulation to ensure quality control and authenticity. Investing in sesame presents potential for economic growth, employment opportunities, particularly for women and youth, and sustainable development in Somalia (SATG, 2016).

Sesame production in Somalia benefits from the country's favorable climate and soil conditions, with a long history dating back centuries. Cultivated primarily by smallholder farmers, sesame, locally known as "shumaam," is grown across various regions, including river valleys, coastal areas, and inland regions. Traditional farming methods are employed, with minimal mechanization and reliance on rainfall for irrigation. While productivity levels vary due to factors like rainfall variability and limited access to modern inputs, sesame remains a key agricultural export for Somalia, contributing to the economy and trade balance (CEFA, 2016).

Sesame is exported to the Middle East and Europe predominantly for use in cooking and confectionery. European markets typically pay the highest prices but have more stringent quality standards. Exports to the Far East are predominantly used for making oil. These markets are less stringent in terms of quality and quality importation procedures; however, prices are significantly lower.

Important factors affecting export quality include cleanliness, color, and the absence of foreign matter. White sesame is preferred for culinary and confectionary purposes and is currently preferred among Somali exporters but for other uses, including oil and halva. Oil content and boldness are more important. Seeds are graded on purity, ranging from 98.2% to 99.98%. However, the premium paid for this extra purity is modest at a little over one percent. Organic sesame is currently attracting a premium price on international markets, although this requires specific certification (Agritech, 2020).

Approximately 80% of Somali sesame grain is exported to the Middle East, India, and China, though some also go to the Netherlands and Turkey. Prices have rocketed from \$350 per Mt in 2005 for unprocessed sesame to \$1,700/ton in 2014 for de-hulled sesame. However, prices plummeted to around \$550 per Mt in 2015. In part, sesame is locally consumed after being processed into oil, which sells for \$4 per liter while sesame grain is also made locally into flour for baking (GEEL, 2020).

With a limited global output of sesame, international demand is on the rise, as is the product's price. Somalia is one of the few countries in the world, where sesame is grown as a traditional crop. The traditional sesame crop rotation with maize benefits both crops. Unfortunately, local sesame landraces are contaminated and genetically exhausted. Due to the poor genetic value, yields are low (350–420 kg/ha) and the seed

quality is poor. Consequently, Somalis are not benefiting from sesame, as they should be due to these bottlenecks (CEFA, 2016).

## **2.3 Socioeconomic factors related to crop production**

### **2.3.1 Age**

Age can influence crop production in various ways. Younger farmers may have access to more modern techniques and technologies, as well as greater adaptability to changing new practices or market conditions. Older farmers, on the other hand, may have more experience and traditional knowledge but may be less inclined to adopt new practices. Succession planning is important in agriculture to ensure the transfer of knowledge and skills from older to younger generations.

The age of sesame traders emerges as a significant socio-economic determinant influencing the volume of sesame trade. In traditional Nigerian societies, roles are often assigned based on age, as highlighted by (Muhammed, 2022). Research conducted in Nigeria suggests that sesame traders typically fall within an active age range, capable of effectively conducting trading activities. Additionally, individuals under the age of 25 assist their parents or mentors in sesame trading, undergoing training until they achieve independence. Market transactions for sesame are predominantly conducted by middle-aged individuals, who are perceived as mature and adept at making market-related decisions (Katanga, 2021).

### **2.3.2 Education**

Education levels impact crop production through their influence on farmers' ability to adopt modern agricultural practices, access information, and make informed decisions. Higher levels of education are often associated with greater adoption of technology, better understanding of market dynamics, and improved risk management strategies.

Farmers having completed primary school and undergoing agricultural training are positively and significantly associated with adoption rates at 5% and 10% levels, respectively. Consequently, within the context of adopting modern agricultural technologies, the education of farmers significantly influences farm productivity. This finding is consistent with research by (Alene et al. 2007) and (Asfaw et al. 2004). Farmers with at least a primary school education or who have received agricultural

training are more inclined to adopt improved sesame seeds, leading to increased productivity.

A study in Burkina Faso indicates that farmers who attended primary school, received agricultural training, and adopted the improved variety achieved productivity levels 140 kg/ha and 160 kg/ha higher, respectively (Kafando, 2023), compared to those who adopted without attending primary school or receiving agricultural training. This outcome further reinforces Schultz's assertion that formal education contributes significantly to farm production only in the context of modern technology.

### 2.3.3 Gender



Gender disparities in agriculture impact women's access to resources, education, and decision-making, hindering their productivity and livelihoods. Traditional gender roles allocate tasks, with men typically engaged in primary agricultural activities while women handle secondary tasks, reinforcing resource disparities. Limited access to education and extension services further impedes women's adoption of modern farming practices. Gender norms grant men greater decision-making power within households, exacerbating inequalities. Women also face time constraints due to caregiving responsibilities, reducing their engagement in agriculture. Challenges in accessing markets and obtaining fair prices further hinder women's economic empowerment. Addressing these gender disparities is essential for promoting equality and enhancing crop production efficiency (FAO, 2011).

Numerous studies in Sub-Saharan Africa show lower agricultural yields among female farmers compared to males, attributed to constraints like limited land access, weaker tenure security, and reduced access to resources and information. Women also face challenges acquiring inputs and managing plots due to education levels and dual roles (Peterman et al. 2011). While some studies confirm lower productivity for women, others find no significant differences or suggest gaps disappear with normalized input access, neglecting differences in input returns. Empirical challenges arise from relying on household head gender, potentially masking plot-level gender disparities. Research using plot-level data reveals nuanced insights, indicating the importance of considering specific decision-making units. Studies like (Kilic et al. 2013) underscore significant productivity gaps between female- and male-managed plots, urging for more nuanced analyses to understand gender dynamics fully in agricultural productivity (World Bank, 2012).

### 2.3.4 Land

Land factors play a crucial role in determining sesame production. Soil quality including composition, texture, pH level, and fertility of the soil significantly impacts sesame growth. Soil should have adequate nutrients, good drainage, and appropriate water-holding capacity (Rengasamy, 2010). Climate temperature, rainfall patterns, humidity, and sunlight availability influence sesame growth. Different crops thrive in different climatic conditions. Access to water for irrigation is essential, especially in regions with irregular rainfall patterns. Adequate water sources or efficient irrigation systems are necessary for sustained crop production. The size and shape of the land impact the efficiency of farming operations, including planting, irrigation, and harvesting. Larger, regularly shaped plots are often more manageable (Cornia, 1985.).

Land access, ownership rights, land tenure systems, and accessibility to land influence farmers' ability to invest in long-term improvements and adopt sustainable farming practices (Spiertz, 2013). Soil erosion, desertification, salinization, and pollution can degrade land quality and reduce its productivity over time. Sustainable land management practices are essential to mitigate these issues (Sharma, 2015). The distribution of land ownership among smallholder farmers, large-scale agribusinesses, or communal land systems can impact investment in land improvements and agricultural productivity.

### 2.3.5 Income

Income factors are crucially linked to crop production, both for individual farmers and for the agricultural sector. Farmers' income levels directly affect their ability to invest in agricultural inputs such as seeds, fertilizers, pesticides, machinery, and irrigation systems. Higher-income enables farmers to adopt modern technologies and practices that can enhance sesame yields and quality (Chauke, 2014). Income determines farmers' access to essential resources like land, water, and labor. Wealthier farmers may be able to afford larger landholdings, access better-quality land, and hire more labor for farming operations, leading to increased production (Pender, 2008).

In addition, higher income levels provide farmers with better financial resilience against crop failures, market price fluctuations, and other risks associated with agriculture. They can afford insurance policies, diversify their crops, or invest in

risk-mitigation strategies to safeguard their income and production. Income influences farmers' participation in agricultural markets. Wealthier farmers may have the resources to transport their produce to distant markets, invest in storage facilities, or participate in value-added activities such as processing and packaging, thereby increasing their income potential. Furthermore, Income levels can affect farmers' willingness and ability to adopt sustainable agricultural practices. While some sustainable methods may require higher initial investments, they can lead to long-term benefits such as improved soil health, water conservation, and resilience to climate change, ultimately enhancing income stability (Deressa, 2009).

Income levels may influence farmers' access to education and training opportunities. Wealthier farmers can invest in acquiring knowledge and skills related to modern farming techniques, pest management, market trends, and value chain integration, leading to higher productivity and profitability. Income levels can determine eligibility for government support programs and agricultural subsidies. Governments often provide financial assistance, subsidies, or incentives to low-income farmers to promote crop production, improve food security, and alleviate rural poverty. Overall, in Somalia, income factors play a significant role in shaping farmers' decisions, capabilities, and outcomes in crop production, influencing not only their livelihoods but also the overall productivity and sustainability of the agricultural sector (Immink, 1993).

#### 2.3.6 Knowledge and Training

Knowledge and training are essential factors in crop production as they empower farmers to make informed decisions, adopt best practices, and improve agricultural productivity. Knowledge about crop biology, agronomy, and physiology enables farmers to understand the specific requirements of different crops, including soil, water, and nutrient needs, as well as optimal planting times and spacing. Training provides farmers with information on selecting appropriate crop varieties based on local agro-climatic conditions, market demand, and disease resistance. It also educates them about the importance of crop rotation to maintain soil fertility and prevent pest and disease buildup (Rasanjali, 2021).

Farmers learn about soil conservation techniques, such as minimum tillage, cover cropping, and organic matter addition, to improve soil structure, fertility, and water retention, leading to enhanced crop yields and sustainability. Training programs teach farmers efficient irrigation methods, water-saving technologies, and scheduling techniques to optimize water use efficiency, mitigate drought risks, and ensure adequate moisture for crop growth. Knowledge about pest and disease identification,

monitoring, and control measures helps farmers implement IPM strategies, reducing reliance on chemical pesticides and minimizing crop losses while safeguarding human health and the environment (Musemwa, 2013).

Farmers learn proper post-harvest handling, storage, and processing techniques to minimize post-harvest losses, maintain crop quality, and maximize market value, thereby enhancing income opportunities. Training equips farmers with knowledge of market trends, value chain dynamics, quality standards, and marketing strategies, enabling them to access profitable markets, negotiate better prices, and add value to their produce through processing and branding (Chetthamrongchaia, 2019). By investing in knowledge and training initiatives, farmers can enhance their productivity, profitability, and resilience while promoting sustainable agriculture and food security.

### 2.3.7 Market Access

Market access is crucial for farmers to sell their crops at fair prices and maximize their income. Adequate transportation infrastructure, including roads, bridges, and storage facilities, is essential for farmers to transport their crops to markets efficiently and maintain their quality during transit (Daud, 2018). Access to timely and accurate market information regarding prices, demand trends, and consumer preferences enables farmers to make informed decisions about crop selection, timing of sales, and negotiation with buyers. The availability of marketplaces, wholesale markets, agri-business hubs, and farmer markets facilitates direct interaction between farmers and buyers, reducing transaction costs and ensuring transparent pricing mechanisms. Clear and transparent market regulations, including licensing, grading standards, quality certification, and contract enforcement, create a conducive environment for fair trade and protect farmers from exploitation by middlemen or buyers. Establishing linkages between farmers, agribusinesses, food processors, exporters, retailers, and consumers through value chain partnerships, cooperative networks, and contract farming arrangements enhances market access and creates value-added opportunities for farmers (Bagamba, 2007).

Access to diverse domestic and international markets reduces farmers' dependence on a single market outlet, mitigating risks associated with price volatility, seasonal fluctuations, and market shocks. Integration into regional, national, and global markets through trade agreements, market access initiatives, and export promotion programs expands farmers' market reach, increases market competitiveness, and enhances income opportunities (Zeller, 1998).

Specialized support programs, such as market access grants, market information services, market-oriented extension programs, and farmer cooperatives, help smallholder farmers overcome barriers to market entry and compete effectively in agricultural value chains. Meeting quality standards, food safety regulations, and certification requirements demanded by domestic and international markets enhances farmers' market access, ensures product competitiveness, and opens up premium market segments (Kamara, 2004). By addressing these market access factors, policymakers, development agencies, and agricultural stakeholders can empower farmers to effectively participate in markets, improve their livelihoods, and contribute to economic growth and food security.

## **2.4 Factors affecting sesame farmers in Jowhar District Middle Shabelle, Somalia**

Agricultural production in Somalia faces a myriad of challenges, stemming from both natural and human factors. Somalia is prone to erratic weather patterns, including recurrent droughts and irregular rainfall, which significantly affect agricultural productivity. Droughts can lead to crop failures and food shortages, exacerbating food insecurity and poverty among farmers. Access to reliable water sources for irrigation is limited in many parts of Somalia, particularly in the Jowhar district.

Inadequate infrastructure, including roads, impedes the efficient transportation of agricultural inputs and produce. Poor infrastructure also restricts farmers' access to markets, limiting their ability to sell their products at fair prices and hindering economic growth in the agricultural sector. Additionally, Many Somali farmers lack access to quality seeds, fertilizers, pesticides, and modern agricultural machinery and equipment. This limits their ability to adopt improved farming techniques, increase productivity, and adapt to changing environmental conditions.

Furthermore, extension services and agricultural education are often lacking in Somalia, depriving farmers of valuable information and training on modern farming practices, crop management, and post-harvest handling techniques. Somali farmers face challenges in accessing markets due to trade barriers, and a lack of market information. Additionally, informal taxation and extortion at checkpoints can increase the cost of transporting agricultural produce to markets (Abdi-Soojeede, 2018).

Decades ago, Somalia held a prominent position as a major sesame exporter globally. Nonetheless, three decades of civil unrest have significantly impacted the industry's profitability. With the loss of their competitive advantage, Somali sesame farmers now cultivate low-quality seeds and lack sufficient training (GEEL, 2020).

This, coupled with periodic droughts and outdated farming techniques, has led to decreased yields. The challenges faced by sesame farmers in Jowhar District, Middle Shabelle, Somalia, are multi-faceted and can significantly impact their livelihoods. Sesame farming in the region may suffer from low productivity due to various factors such as inadequate access to quality seeds, limited availability of irrigation water, poor soil fertility, and susceptibility to pests and diseases (Ismaan, 2020). Additionally, traditional farming practices and a lack of modern agricultural techniques can also contribute to low yields.

Many sesame farmers in the region may lack information about market demand, pricing trends, and export requirements. This lack of market knowledge can result in difficulties in identifying profitable market opportunities, negotiating fair prices for their produce, and effectively positioning their products in domestic and international markets. The absence of technical expertise among farmers can hinder their ability to adopt advanced agricultural practices that could enhance productivity and quality. This includes knowledge about optimal planting techniques, proper pest and disease management strategies, efficient water and resource management practices, and post-harvest handling methods. Inadequate infrastructure and processing facilities pose challenges for sesame farmers in meeting the quality standards required by export markets. Without access to modern processing equipment and facilities, farmers may struggle to clean, sort, and package their sesame seeds to meet the hygiene, safety, and quality specifications demanded by international buyers (SATG, 2016).



## CHAPTER 3

### RESEARCH METHODOLOGY

#### 3.1 Study site

The study was carried out in Jowhar District in the Middle Shabelle region, south-central Somalia (Figure 3). Jowhar is located 90 km from Mogadishu, the capital city of Somalia. The Jowhar district was purposely selected. This district area has the river Shabelle that provides water for cultivation and is the cultivation area for many crops including sesame (UN-HABITAT, 2020). In 2014, the district population was 269,851 (UNICEF, 2017).



**Figure 3** Map of Somalia showing the study site, Jowhar district.

**Source:** Available from *Malaria Journal*. UNFPA Population Estimation Survey 2014, <https://images.app.goo.gl/K4zWdELLkuF1Ee4BA>.

#### 3.2 Target population and sample size

The target population in this study was the small-holder sesame farmers in the Jowhar district area. According to the Agribusiness Solution Report, there were approximately 220,000 sesame farmers across Somalia (<https://agribusinesssolutionshub.com/sesame-opportunities/>). However, there was no information about the number of sesame farmers based in the Jowhar District. Therefore, the sample size was estimated using Cochran Formula.

$$n = \frac{z^2 (pq)}{e^2} = \frac{1.96^2 \times 0.5 \times 0.5}{0.07^2} = 196$$

N = sample size

z = the selected certified value of deserted confidant level = 1.96

p = the (estimated) proportion of the population that has the attribute in question  
= 0.5

q = 1 - p = 0.5

e = the desired level of precision = 0.07

There were 196 + no response 5% = 205 respondents who were the small-holder sesame farmers in this study.

### 3.3 Sampling and data collection

A farm-based cross-sectional study was conducted using a prepared questionnaire (Appendix 1) to obtain information for the analysis. All Jowhar sesame farmers were given an equal chance to participate. Snowball sampling, in which the subjects were approached for interview based on a recommendation from their acquaintances, was employed because it facilitates access to members of the purposively designated sample categories. In case the respondents are illiterate, a research assistant will facilitate the interview by answering the questionnaires via a dialogue with the respondents.

### 3.4 Questionnaire validation and pilot study

The questionnaire was developed in English and this English version was used to collect data by verbally translating the questions during data collecting if someone needed to translate. The questionnaire was validated using the Item Objective Congruence (IOC) method (Turner & Carlson, 2003), done by 3 external experts.

Each item in the questionnaire was given either 1 (clearly measuring) -1 (clearly not measuring) or 0 (the content area is unclear) by each expert. The scores received were calculated for the IOC Index using the below formula. The questions scored below 0.5 were removed, between 0.50-0.70 was revised according to the expert's comment, and above 0.7 was used.

$$IOC = \Sigma R/N$$

where  $\Sigma R$  = The sum of expert opinion scores per item

$N$  = Number of experts

Consequently, a pilot study consisting of 30 respondents was conducted in the study area and check the reliability of the questionnaire using the Cronbach alpha coefficient as shown in the following formula:

$$\alpha = \frac{\bar{c}}{\bar{c} + (n - 1)\bar{v}}$$

where  $\bar{c}$  = the average inter-item covariance

$\bar{v}$  = the average variance

From the pilot study, the overall Cronbach's alpha of 0.766 was received which was acceptable.

### 3.5 Data cleaning and analysis

Data was cleaned, coded, and entered on the Excel spreadsheet imported into the SPSS version 20 (SPSS, Chicago, IL License) for analysis. Descriptive statistics were analyzed and presented frequency with percentage for all categorical characteristics and mean with standard deviation (SD) for continuous variables.

Multiple linear regression was used to identify a possible correlation between an outcome variable and independent variables at a significance p-value of <0.05. The outcome variable (DV) is sesame production which is a continuous variable, and the independent variables were mixed continuous and categorical variables.

Variables that showed negative coefficients were recognized as negatively related to the outcome while those that showed positive coefficients were recognized to be positively related to the outcome. To avoid the standard error in the regression model and ensure multicollinearity does not exist in the strength of the correlation and influence between the independent variables, Variance Inflation Factor (VIF) analysis is used with the VIF formula (Akinwande et al, 2015).

$$VIF = 1/1 - R^2.$$

Where VIF = variance inflation factor analysis

$R$  = coefficient number

VIF value of less than 10 is recognized as an acceptable multicollinearity level and included in the model while VIF values greater than 10 are recognized as an unacceptable multicollinearity level and excluded from the model.



## CHAPTER 4

### RESULTS

#### 4.1 The socioeconomic information of sesame farmers and sesame production practices in the Jowhar District, Somalia

##### 4.1.1 Socioeconomic characteristics

A total of 205 farmers participated in the survey, the majority (71.7%) were men, and the farmer's mean age of 43.46 years old. The high school attendance rate was 24.4%. Many respondents (46.3%) had families with an average size of 6 to 10 members. Many of the respondents (79.0%) claimed that they have 1-3 people who worked as agricultural workers. Over half of the respondents (57.1%) had 5-15 years of sesame cultivation experience, with a mean difference of 15.24. Half of the participants (51.7%) were landowners. (61.5%) of respondents said they received financial funding from private sources. Also, the majority (53.7%) of respondents reported having an annual income of between 6001 and 8000 USD, while the mean yearly income is 6045.13 USD (Table 3).

##### 4.1.2 Sesame production in the Jowhar district

According to Table 3, 64.9% of the sesame growers in the research region cultivate an average of 4 - 6 hectares of land, while the mean average of respondents cultivated 3.95 hectares of land. Over half (52.2%) of the sample farms claimed to produce between 791 and 1290 kg throughout the survey period, with a mean production average is 1181.40. According to the farmer's response, 33.7% made between 2401 to 3900 USD per year from sesame sales, and the mean annual revenue from sesame cultivation is \$3105.01. Many sesame farmers (66.3%) are aware that sesame output has stopped being exported. As seen in Table 3, over half of farmers (59.0%) in the region said that local businesses were their primary source of seeds. However, 44.4% of the farmers said they had no idea whether the seeds were certified or not.

Most of the respondents (97.1%) stated that they use pesticides on their farms and (91.2%) of the farmers they provided used chemical pesticides to produce sesame. Many of the interviewed people (68.8%) claimed the technique of harvesting was mostly the use of basic hand tools. The results of this study revealed that none of

the study participants graded sesame seeds after harvest. However, 78.0% of respondents to the survey said they cleaned sesame seeds before selling them, and 61% said they cleaned their product using the dried method. This survey discovered that 87.8% of the study subjects sold their goods at the farm gate.

**Table 3** Socio-demographic characteristics.

Characteristics		N=205	%
<b>Gender</b>	Male	147	71.7
	Female	58	28.3
<b>Age (year)</b>	21-39	90	43.9
	40-59	92	44.9
	□ 60	23	11.2
	Mean=43.46, Maximum=78, Minimum=21, and SD=11.96		
<b>Educational level</b>	Illiterate	25	12.2
	Read or write.	40	19.5
	Primary school	22	10.7
	High school	50	24.4
	Diploma	39	19.0
	Bachelor's degree	29	14.1
<b>Family members</b>	1-5 Members	79	38.5
	6-10 Members	95	46.3
	□ 11 Members	31	15.1
	Mean=6.86, Maximum=22, Minimum=1, and SD=3.43		
<b>Laborers</b>	1-3 Members	162	79.0
	4-6 Members	43	21.0
	Mean=3.02, Maximum=6, Minimum=1, and SD=1.10		
<b>Farm experiences</b>	5-15 years	117	57.1
	16-26 years	79	38.5
	□ 26	9	4.4
	Mean=15.24, Maximum=40, Minimum=5, and SD=5.47		
<b>Landowner</b>	Owner	106	51.7
	Rent	75	36.6
	Farmworks	24	11.7
<b>Financial support</b>	Government project	25	12.2
	Bank	28	13.7
	NGO	26	12.7
	Private funds	126	61.5

<b>Annual Income</b>	1980-3980	39	19.0
	3981-5980	24	11.7
	5981-7980	110	53.7
	7981-9600	32	15.6
Mean=6045.13, Maximum=9600, Minimum=2000, and SD=2100.68			

**Table 4** Sesame Production in the Jowhar District.

<b>Characteristics</b>		<b>N=205</b>	<b>%</b>
<b>Cultivated area</b>	1-3 Hectare	72	35.1
	4-6 Hectare	133	64.9
	Mean=3.95, Maximum=6, Minimum=1, and SD=1.04		
<b>Productivity</b>	290-790 kg	18	8.8
	791-1290 kg	107	52.2
	□ 1291	80	39.0
	Mean=1181.40, Maximum=2000, Minimum=290, and SD=328.04		
<b>Income from sesame sales per year</b>	900-2400\$	41	20.0
	2401-3900\$	69	33.7
	3901-5400\$	63	30.7
	5401-6500\$	8	3.9
	Mean=3105.01, Maximum=6000, Minimum=792, and SD=1312.07		
<b>Aware of product cut-off</b>	Yes	136	66.3
	No	69	33.7
<b>Source of seed planting</b>	Government sections	28	13.7
	NGOs	22	10.7
	Buy from local shops	121	59.0
	Own collection	34	16.6
<b>Seeds for planting are certified</b>	Yes	80	39.0
	No	34	16.6
	I don't know	91	44.4
<b>Method of sesame cultivation</b>	Traditional method	187	91.2
	GAP standard method	11	5.4
	Organic standard	7	3.4
<b>Use of fertilizer</b>	Yes	199	97.1
	No	6	2.9
<b>The type of</b>	Organic compost	3	1.5

<b>fertilizer normally applies</b>	Inorganic chemical fertilizer	135	65.9
	Biofertilizer	9	4.4
	Mixed fertilizer	58	28.3
<b>Water supply for sesame cultivation</b>	Irrigation water	33	16.1
	Rainfed	18	8.8
	Mixed	154	75.1
<b>Type of irrigation</b>	Sprinklers	0	0
	Pump-set	187	91.2
	Dripping	0	0
<b>Wedding method</b>	Manual removal by hand	64	31.2
	Use simple hand tools	126	61.5
	Chemical herbicides	15	7.3
<b>Use of pesticides</b>	Yes	205	100
	No	0	0

*Table 4 Sesame Production in Jowhar District (cont.).*

<b>Characteristics</b>	<b>N=205</b>	<b>%</b>	
<b>Type of pesticide</b>	Chemical pesticides	205	100.0
	Biopesticides	0	0
<b>Harvesting method</b>	Manually by hands	52	25.4
	Use simple hand tools	141	68.8
	Use a harvesting machine	12	5.9
<b>Sesame seed grading</b>	Yes	0	0
	No	205	100
<b>Seed cleaning before the sale</b>	Yes	160	78.0
	No	45	22.0
<b>Seed cleaning before the sale</b>	Dried method	125	61.0
	Wet method	35	17.1
<b>Selling method</b>	Wholesale	180	87.8
	Retail	25	12.2

## 4.2 Factors that influence sesame productivity in the Jowhar District, Somalia

### 4.2.1 Multiple regression analysis for the influence of socioeconomic factors and cultivation practice factors on sesame productivity

The statistical analysis of various factors influencing sesame production provides valuable insights into the complex dynamics of agricultural practices. The study reveals significant relationships between several key variables

and sesame yield, shedding light on the factors that play a crucial role in determining the success of sesame cultivation.

One of the noteworthy findings is the statistically significant impact of the number of laborers on sesame production, as indicated by a p-value of 0.026\*\*. This suggests that the Labor force has a tangible effect on the overall output, emphasizing the importance of workforce management and efficiency in sesame farming.

Farming experience, although not reaching conventional significance levels, shows a marginal significance with a p-value of 0.070. This implies a potential relationship between the level of experience and sesame yield, prompting further exploration into how cumulative knowledge and skills acquired over time may contribute to improved production outcomes.

The size of the cultivated area emerges as a highly influential factor, supported by a very significant p-value of 0.000. This underscores the critical role of land management and allocation in sesame farming, with larger cultivated areas leading to a more substantial impact on yield.

Knowledge of the sesame production office is a statistically significant factor with a p-value of 0.019. This highlights the importance of access to information and resources provided by relevant agricultural authorities, suggesting that well-informed practices contribute significantly to enhancing sesame production.

The source of seeds emerges as a highly significant factor with a p-value of 0.000, indicating a substantial impact on sesame production. This underscores the importance of seed quality and origin in influencing the overall yield, emphasizing the need for farmers to pay attention to sourcing their seeds.

Cultivation techniques also demonstrate a statistically significant effect on output, with a p-value of 0.043. This underscores the importance of effective and optimized cultivation methods to maximize sesame production.

A marginally significant p-value of 0.064 suggests a potential impact between water supply and sesame production. While not reaching conventional significance levels, this finding warrants further investigation into the relationship between water availability and crop yield, recognizing the crucial role of adequate water supply in agricultural success.

The analysis shows that the weeding method has a statistically significant impact on sesame productivity, as indicated by its t-value of -2.639 and a significant level of 0.009\*, which is below the threshold of 0.05. This suggests that the weeding method used significantly affects the productivity of sesame crops. Specifically, a negative coefficient of -80.976 implies that certain weeding methods

are associated with lower sesame productivity compared to others. Further investigation into the specific weeding techniques employed could provide insights into optimizing weed control practices to enhance sesame yields.

The encouraging aspect of the study is the positive influence of the availability of sesame products with added value. Although not quantified with a p-value, this observation suggests that diversification and value addition in sesame products contribute positively to the agricultural landscape, potentially offering new avenues for farmers to enhance their income and overall productivity.



**Table 5** Multiple regression analysis of factors associated with sesame productivity.

<b>Explanatory variables</b>	<b>Coefficient</b>	<b>SE</b>	<b>t</b>	<b>Sig</b>	<b>VIF</b>
Gender	-10.557	26.755	-0.380	0.750	1.341
Age	-0.256	1.289	-0.199	0.843	1.994
Education	-4.874	9.752	-0.500	0.618	2.166
Family members	-1.318	4.442	-0.297	0.767	2.137
Number of laborers	31.515	14.004	2.250	0.026*	1.901
Farming experience	5.130	2.806	1.828	0.070	2.145
Landowner	-18.094	29.144	-0.621	0.536	1.838
Financial support	-24.763	16.663	-1.486	0.140	3.128
Income per year	0.001	0.006	0.240	0.811	1.310
Cultivation area	263.885	12.907	20.445	0.000*	1.196
Income from sesame sales/year	0.016	0.010	1.638	0.104	1.483
Aware of the product cut-off	-64.044	27.084	-2.365	0.019*	2.938
Seed source	77.984	20.724	3.763	0.000*	1.614
Quality of seeds certified	-23.497	14.466	-1.624	0.107	1.815
Cultivation method	62.178	30.363	2.048	0.043*	2.127
Use of fertilizer	76.981	88.527	0.870	0.386	1.265
Type of fertilizer	13.412	12.611	1.064	0.289	1.534
Water supply	-39.578	21.211	-1.866	0.064	2.598
Weeding method	-80.976	30.683	-2.639	0.009*	2.758
Harvest method	15.791	32.302	0.489	0.626	2.598
Cleaning of sesame	-17.237	29.300	-5.88	0.557	1.426
Type of selling	-45.220	43.505	-1.039	0.300	1.779

\* represents the significant level at  $p < 0.05$ .

#### 4.2.2 Farmer's opinions on factors influencing sesame productivity in the Jowhar district.

##### 4.2.2.1 *Factors that influence increasing productivity*

Table 6 and Figure 4 presented the rankings of factors affecting sesame production based on responses from participants who were asked about the factors that increase their sesame production the most. The researcher asked the participants to select 5 factors that increase their sesame production the most and ranked them from the most important (5) to the least important factors (1).

Water and irrigation emerge as increasingly crucial factors in higher ranks, with most respondents (188 respondents) ranking it as the most important factor in increasing sesame production (39.10%). Knowledge training on agricultural practices comes as the second factor (20.37%) with many respondents (82 respondents) ranking it as the most important factor. Knowledge of the value addition of sesame products received mixed responses; however, it held a considerable level of importance running as the third-ranking factor (11.74%). Thirty respondents chose post-harvest management as the most important factor, making it the fifth ranking after seed quality. Seed quality, fertilizer, and disease and pest management were in the farmer's consideration. Even though not many people chose it as the most important, many respondents selected and scored them in the list.

##### 4.2.2.2 *Factors that influence decreasing productivity*

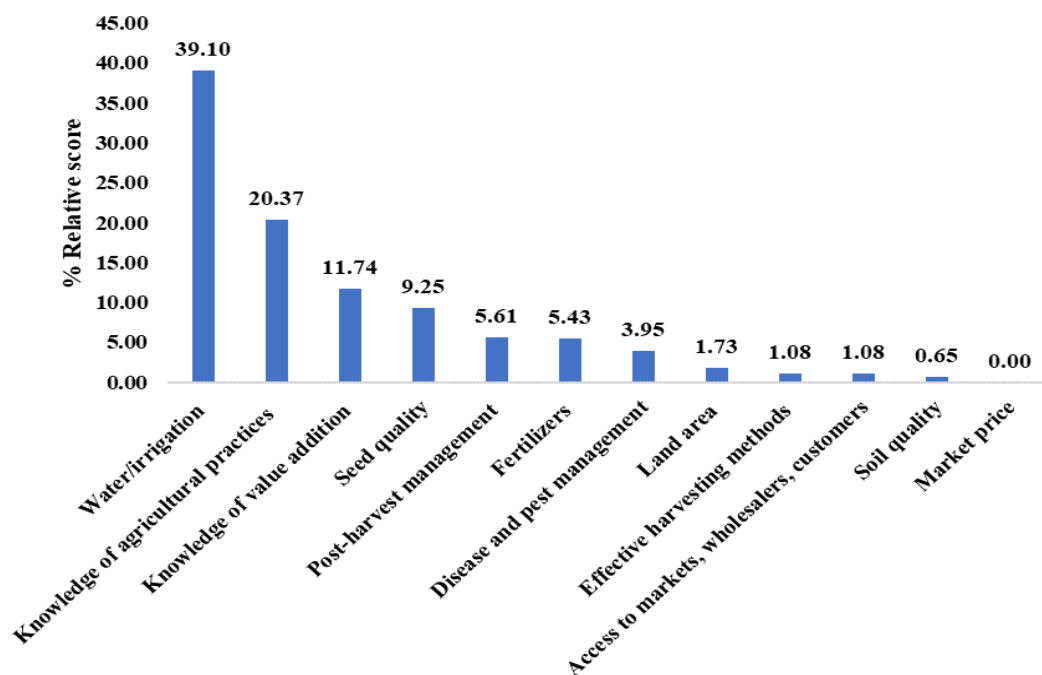
The factors identified by participants as having the greatest impact on diminishing sesame production, ranked from most to least important are shown in Table 7 and Figure 5. The researcher asked the participants to select and rank 5 factors that diminish their sesame production, with 5 being the most important and 1 being the least. The percentages in parentheses indicate the proportion of respondents who ranked each factor.

The factor that farmers considered the most important factor that retard sesame productivity is a lack of knowledge of agricultural practices (23.92%). The second most considered factor was drought (20.79%). Drought showed a significant importance with over a quarter of respondents ranking it as the most important factor affecting production. Knowledge of value addition of sesame products was consistently ranked moderately high (13.57%), indicating that participants recognized the importance of value addition in sesame production. The disease and pest problems rank fourth (10.87%) with 24 respondents choosing them as the most important factor. Flooding was also considered an important factor in diminishing

sesame production (7.32%). Seventeen respondents chose flooding as one of the most significant factors. Fertilizer and seed quality, despite being chosen as less important many respondents considered them as one of the crucial factors for sesame production.

**Table 6** Factors that influence increasing productivity.

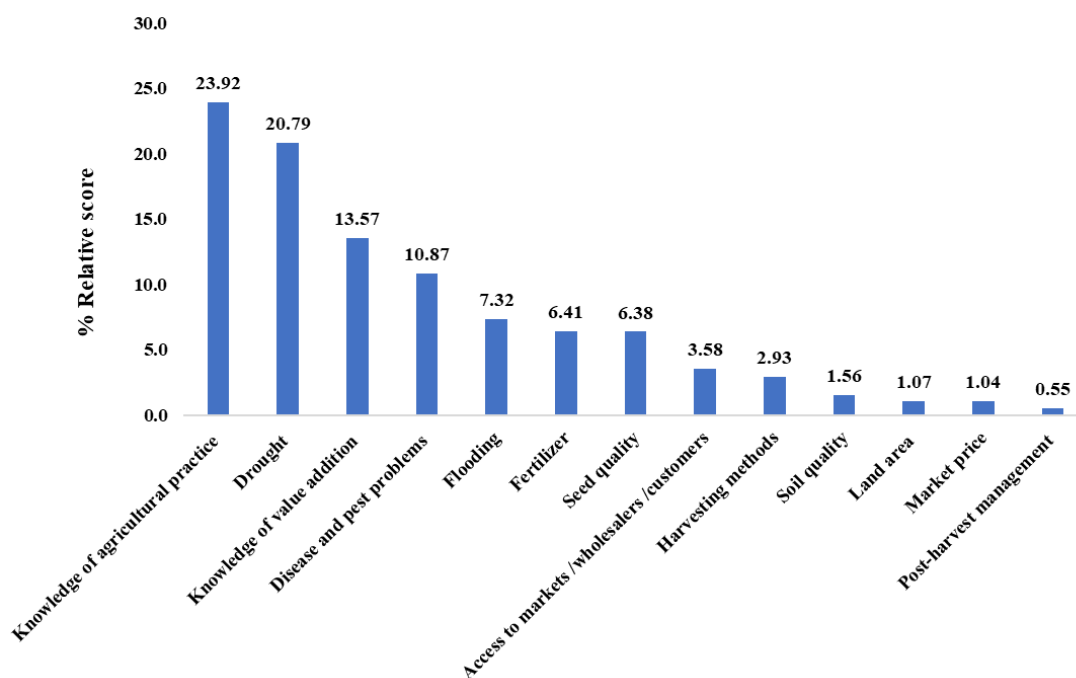
Factors	Farmer's score ranking from less (1) to most (5) important				
	(1)	(2)	(3)	(4)	(5)
Seed quality	34 (16.6%)	54 (26.3%)	59 (28.8%)	11 (5.4%)	1 (0.5%)
Soil quality	3 (1.5%)	4 (2.0%)	2 (1.0%)	1 (0.5%)	1 (0.5%)
Land area	1 (0.5%)	1 (0.5%)	7 (3.4%)	5 (2.4%)	5 (2.4%)
Water/irrigation	5 (2.4%)	27 (13.2%)	68 (33.2%)	88 (42.9%)	188 (91.7%)
Effective fertilizers	58 (28.3%)	34 (16.6%)	16 (7.8%)	8 (3.9%)	2 (1.0%)
Knowledge of agricultural practices	6 (2.9%)	12 (5.9%)	26 (12.7%)	73 (35.6%)	82 (40.0%)
Disease and pest management	38 (18.5%)	14 (6.8%)	14 (6.8%)	6 (2.9%)	5 (2.4%)
Effective harvesting methods	4 (2.0%)	2 (1.0%)	4 (2.0%)	2 (1.0%)	3 (1.5%)
Post-harvest management	5 (2.4%)	10 (4.9%)	12 (5.9%)	3 (1.5%)	30 (14.6%)
Knowledge of value addition	37 (18.0%)	64 (31.2%)	35 (17.1%)	28 (13.7%)	17 (8.3%)
Access to markets, wholesalers, customers	18 (8.8%)	6 (2.9%)	3 (1.5%)	1 (0.5%)	0 (0.0%)
Market price	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)



**Figure 4** Ranking of the farmer's opinions on factors that increase sesame production.

**Table 7** Factors that influence diminishing productivity.

Factors	Farmer's score ranking from less (1) to most (5) important				
	(1)	(2)	(3)	(4)	(5)
Seed quality	35 (17.1%)	39 (19.0%)	17 (8.9%)	8 (3.9%)	0 (0.0%)
Soil quality	6 (2.9%)	14 (6.8%)	2 (1.0%)	2 (10%)	0 (0.0%)
Land area	10 (4.9%)	8 (3.9%)	1 (0.5%)	1 (0.5%)	0 (0.0%)
Drought	3 (1.5%)	12 (5.9%)	40 (19.5%)	53 (25.9%)	56 (27.3%)
Flooding	8 (3.9%)	14 (6.8%)	12 (5.9%)	17 (8.9%)	17 (8.3%)
Fertilizer	46 (22.4%)	29 (14.1%)	10 (4.9%)	7 (3.4%)	7 (3.4%)
Knowledge of agricultural practice	14 (6.8%)	13 (6.3%)	28 (13.7%)	69 (33.7%)	67 (32.7%)
Disease and pest problems	16 (7.8%)	23 (11.2%)	32 (15.6%)	14 (6.8%)	24 (11.7%)
Harvesting methods	17 (8.3%)	7 (3.4%)	15 (7.3%)	1 (0.5%)	2 (1.0%)
Post-harvest management	9 (4.4%)	1 (0.5%)	2 (1.0%)	0 (0.0%)	0 (0.0%)
Knowledge of value addition	21 (10.2%)	24 (11.7%)	30 (14.6%)	27 (13.2%)	30 (14.6%)
Access to markets /wholesalers /customers	14 (7.8%)	15 (7.3%)	12 (5.9%)	5 (2.4%)	2 (1.0%)
Market price	4 (2.0%)	6 (2.9%)	4 (2.0%)	1 (0.5%)	0 (0.0%)



*Figure 5* Ranking of the farmer's opinions on factors that diminish sesame production.

#### 4.3 Farmer's opinion to increase sesame production in the Jowhar District, Somalia

A prepared close-ended question was asked to the farmers in the Jowhar district to examine their opinions or need to boost sesame productivity. The statement questions were about cultivation training, market access, and value-added sesame products.

##### 4.3.1 Knowledge of cultivation training

In general, approximately 40% of respondents were confident to a high extent that sesame production training would boost sesame production (Table 8.). Some selected statements about cultivation training were then asked to examine farmers' needs to boost sesame productivity.

As shown in Table 9. and Figure 6. More than half of respondents agree (27.8%) and strongly agree (28.8%) that training sesame farmers on the proper time of weeding, preventing, and curing effects of insects and diseases plays an important role

in sesame seed production. 22.9% and 20% of respondents agree or strongly agree that training in the correct pattern of sesame sowing will boost the yield, while 22.4% disagree with minor doubt and 24.9% neither agree nor disagree. Only 17.6% and 19% of respondents agree to the use of farm equipment to facilitate managing large land areas and producing sesame seeds of higher quality than without equipment use. More than half of the respondents neither disagree nor are not sure that utilizing farm equipment properly will boost productivity. Approximately 40% of respondents agreed and strongly agreed that training on the proper use of local organic manures and crop rotation contributes to sesame seeds' quantitative and qualitative improvement. About one-third of the respondents agree that training farmers' skills in proper harvesting and storing increases sesame prices in the domestic market. In summary, from 5 training aspects, the training on weeding preventing, and curing effects of insects and diseases was the most agreed upon and interesting by the farmers.

#### 4.3.2 Knowledge of market access and marketing

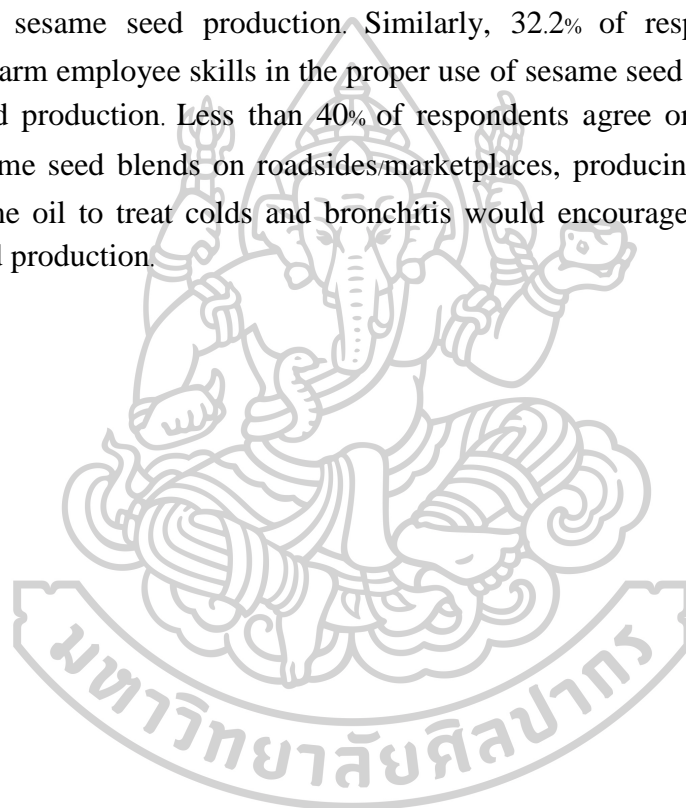
Over half of respondents believed that access to the wholesalers would increase sesame output in the district. However, most of them did not believe that marketing knowledge would increase sesame production (Table 8.).

Some selected statements about market access and marketing were then asked to examine farmers' needs to boost sesame productivity (Table 10 and Figure 7.). The result showed that 43.9% of respondents agree with no doubt at all and 20% also agree that improving local sesame seed types is crucial for increasing sesame production and market prices. Almost two-thirds of the respondents (34.1% and 26.8% strongly agree and agree, respectively) believed that improving market security and reducing tax rates on sesame seeds encourages sesame seed production. Less than half of the respondents (20% and 14.6%) either agree or strongly agree that access to marketplaces without charges would encourage farmers to produce more sesame seeds. Similarly, less than half of farmers agree that improving market prices and planning production would increase the number of competent farmers to produce sesame seeds. However, 26.3% of farmers agree with minor doubt and 19.5% strongly agree that exporting sesame seeds in exchange for payments in hard currency to farmers leads to high sesame seed production.

#### 4.3.3 Knowledge of sesame product value addition

The farmers were asked for their opinion on sesame product value addition. The results showed that 88.3% of the farmers believed that value-added sesame products would encourage farmers to produce more sesame. Among these respondents, most of them highly agree. Most (78.0%) of respondents were interested in roasting and blending sesame seeds with sugar components to increase value. Additionally, sesame oil manufacturing would add value to sesame seeds, according to 93.2% of study respondents.

According to Table 11 and Figure 8, 35.6% of respondents agree with no doubt at all that using sesame husks and meals as animal feed encourages farmers to increase sesame seed production. Similarly, 32.2% of respondents agree that improving farm employee skills in the proper use of sesame seed processing increases sesame seed production. Less than 40% of respondents agree or strongly agree that selling sesame seed blends on roadsides/marketplaces, producing nutritive foods, or using sesame oil to treat colds and bronchitis would encourage farmers to increase sesame seed production.



**Table 8** Farmer's opinion on increased sesame production in the Jowhar District, Somalia.

Items	N	%
<b>In your opinion, to what extent has training sesame growers in sesame production boosted sesame production in your district?</b>		
Very low extent	32	30.5
Low extent	1	0.9
Not sure	13	12.4
High extent	43	40.9
Very high extent	16	15.2
<b>In your opinion, to what extent will access to the market/wholesaler boost sesame production in your district?</b>		
Very low extent	34	27.6
Low extent	1	0.8
Not sure	20	16.3
High extent	62	50.4
Very high extent	6	4.9
<b>In your opinion, to what extent has proper marketing knowledge boosted sesame production in your district?</b>		
Very low extent	44	34.4
Low extent	19	14.8
Not sure	46	35.9
High extent	19	14.8
Very high extent	0	0
<b>Do you think value-added sesame products will encourage farmers to produce more sesame seeds in your district?</b>		
Yes	181	88.3
No	24	11.7
<b>In your opinion, to what extent will value-added sesame products will boost sesame production in your district?</b>		
Very low extent	36	20.1
Low extent	0	0
Not sure	6	3.3
High extent	72	40.2
Very high extent	65	36.3
<b>Are you interested in sesame seed value addition through roasting sesame seeds blended with sugar ingredients for sale at roadsides and markets?</b>		
Yes	160	78.0
No	45	22.0

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<b>Are you interested in sesame seed value addition through sesame oil production?</b>		
Yes	191	93.2
No	14	6.8

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**Table 9** Farmers' knowledge needs on sesame cultivation training.

<b>Sesame cultivation training</b>	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Improving farm employee skills on the proper pattern of sesame sowing increases sesame seed production.	25 (12.2%)	41 (20.0%)	51 (24.9%)	47 (22.9%)	41 (20.0%)
Training sesame farmers on the proper use of farm equipment facilitates managing large land areas and producing sesame seeds of higher quality than without equipment use.	42 (20.5%)	46 (22.4%)	42 (20.5%)	36 (17.6%)	39 (19.0%)
Training sesame growers on the proper use of local organic manures and crop rotation contributes to sesame seeds' quantitative and qualitative improvement.	18 (8.8%)	48 (23.4%)	52 (25.4%)	53 (25.9%)	34 (16.6%)
Training sesame farmers on the proper time of weeding, preventing, and curing effects of insects and diseases plays an important role in sesame seed production.	16 (7.8%)	38 (18.5%)	35 (17.1%)	59 (28.8%)	57 (27.8%)
Increasing sesame farmer skills in proper harvesting and storing increases sesame prices in the domestic.	44 (21.5%)	40 (19.5%)	47 (22.9%)	36 (17.6%)	38 (18.5%)

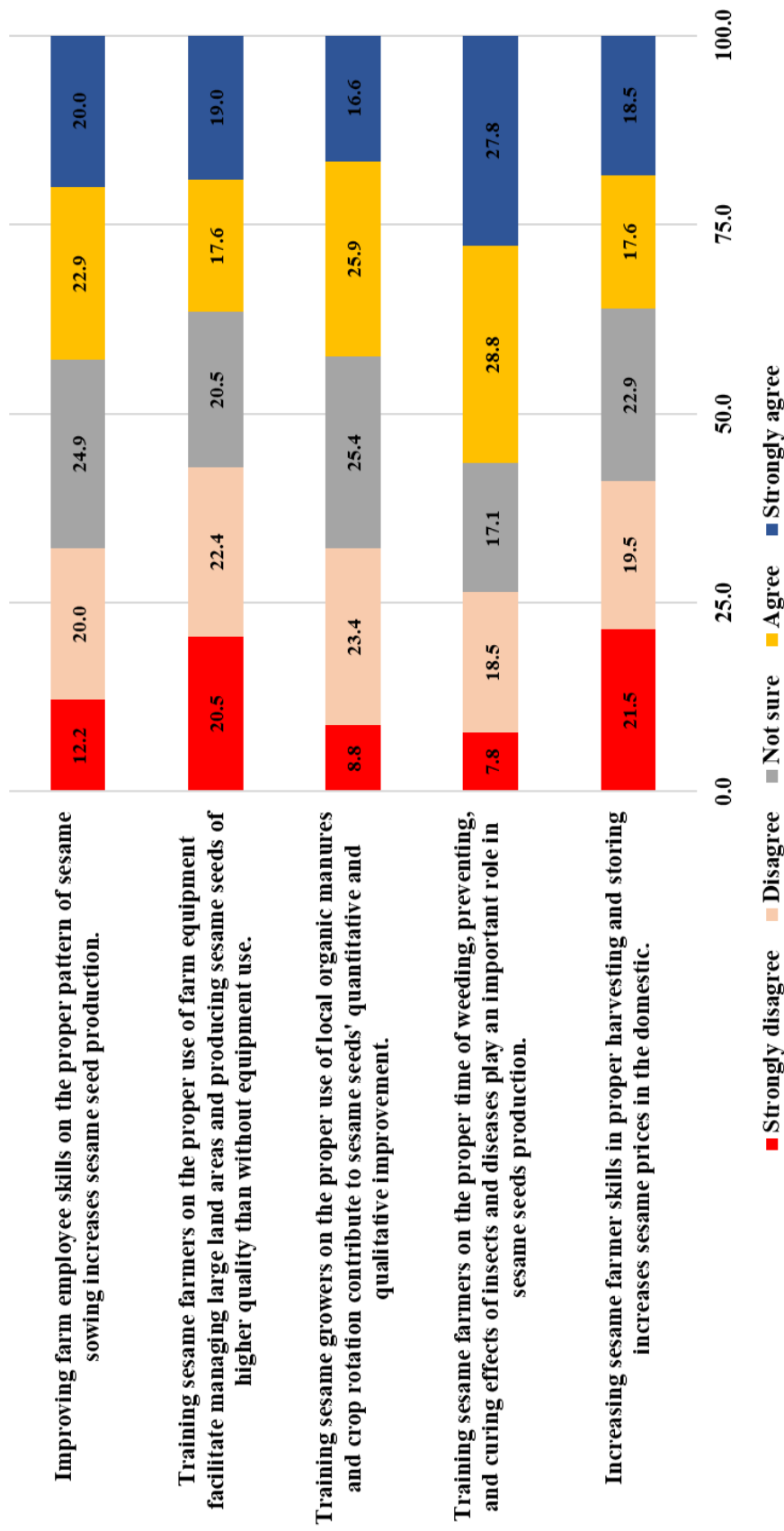


Figure 6 Farmers' knowledge needs on sesame cultivation training.

**Table 10** Farmers' need for market access and marketing knowledge.

<b>Market access and marketing knowledge</b>	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Not sure</b>	<b>Agree</b>	<b>Strongly agree</b>
Ease of access to marketplaces by sesame seed growers and offering goods in the market without charges encourage farmers to produce more quintals of sesame seeds.	41 (20.0%)	49 (23.9%)	44 (21.5%)	41 (20.0%)	30 (14.6%)
Improving market prices and planning production increases the number of competent farmers to produce sesame seeds.	35 (17.1%)	35 (17.1%)	51 (24.9%)	50 (24.4%)	34 (16.6%)
Improving local sesame seed varieties plays an important role in sesame production and price increases in the market.	28 (13.7%)	22 (10.7%)	24 (11.7%)	41 (20.0%)	90 (43.9%)
Exporting sesame seeds with returns of hard currency to the farmers creates high sesame seed production.	42 (20.5%)	35 (17.1%)	34 (16.6%)	54 (26.3%)	40 (19.5%)
Improving market security and reducing tax rates on sesame seeds encourages sesame seed production	21 (10.2%)	23 (11.2%)	36 (17.6%)	55 (26.8%)	70 (34.1%)

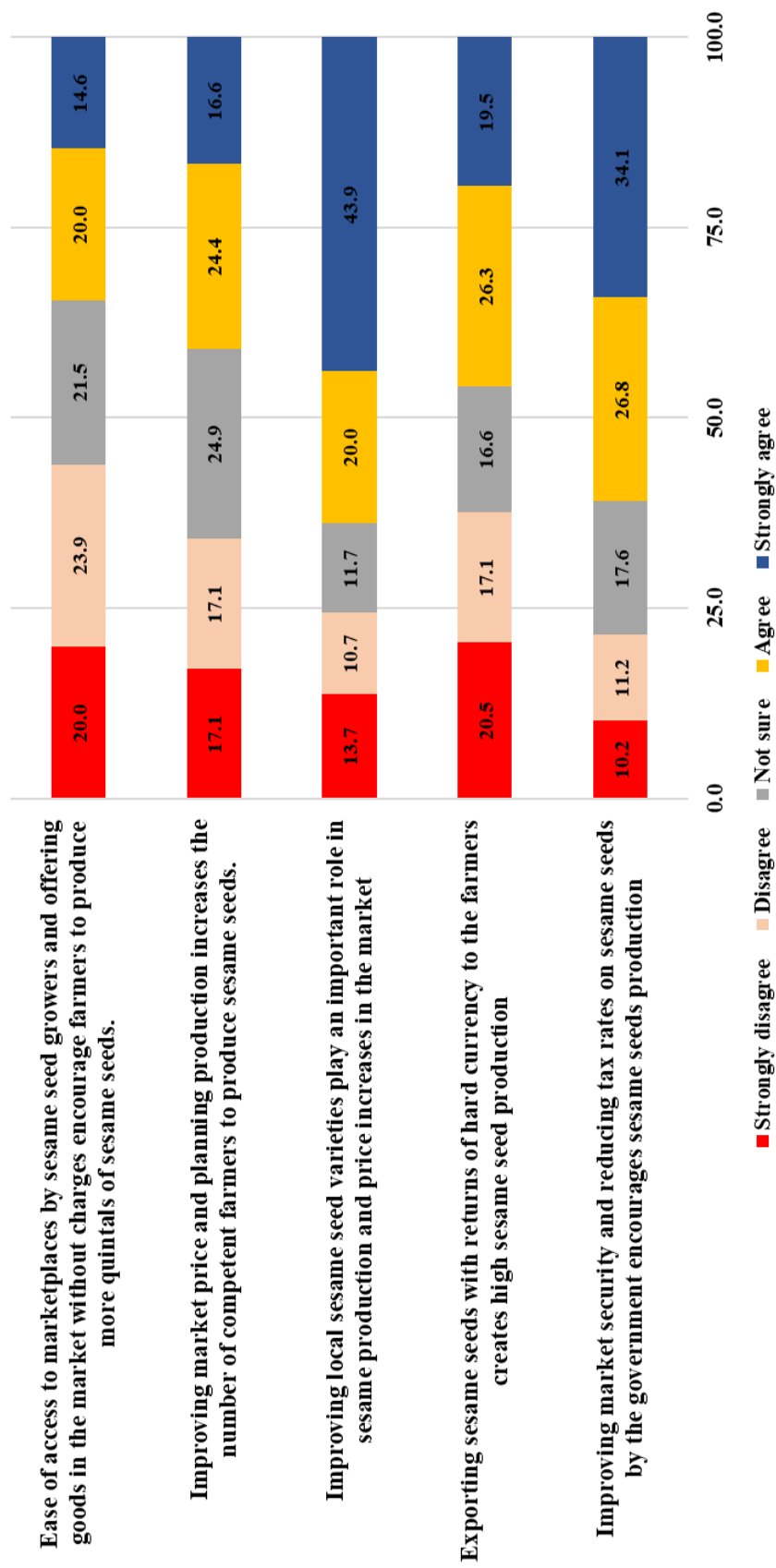


Figure 7 Farmers' needs of market access and marketing.

**Table 11** Farmers' needs on sesame product value addition.

<b>Value addition on sesame products</b>	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Not sure</b>	<b>Agree</b>	<b>Strongly agree</b>
Improving farm employee skills in the proper use of sesame seed processing increases sesame seed production.	32 (15.6%)	41 (20.0%)	36 (17.6%)	66 (32.2%)	30 (14.6%)
Using sesame husks and meals as animal feed encourages farmers to increase sesame seed production.	31 (15.1%)	23 (11.2%)	50 (24.4%)	28 (13.7%)	73 (35.6%)
Roasted sesame seeds blended with sugar ingredients sold at roadsides and marketplaces encourage farmers to produce more sesame seeds.	48 (23.4%)	36 (17.6%)	40 (19.5%)	37 (18.0%)	44 (21.5%)
Using ground sesame seed with grain flour as a nutritive food for human consumption enables farmers to produce more sesame production.	31 (15.1%)	39 (19.0%)	60 (29.3%)	48 (23.4%)	27 (13.2%)
The community uses sesame oil in the treatment of colds and bronchitis and encourages farmers to increase sesame seed production.	42 (20.5%)	39 (19.0%)	40 (19.5%)	47 (22.9%)	37 (18.0%)

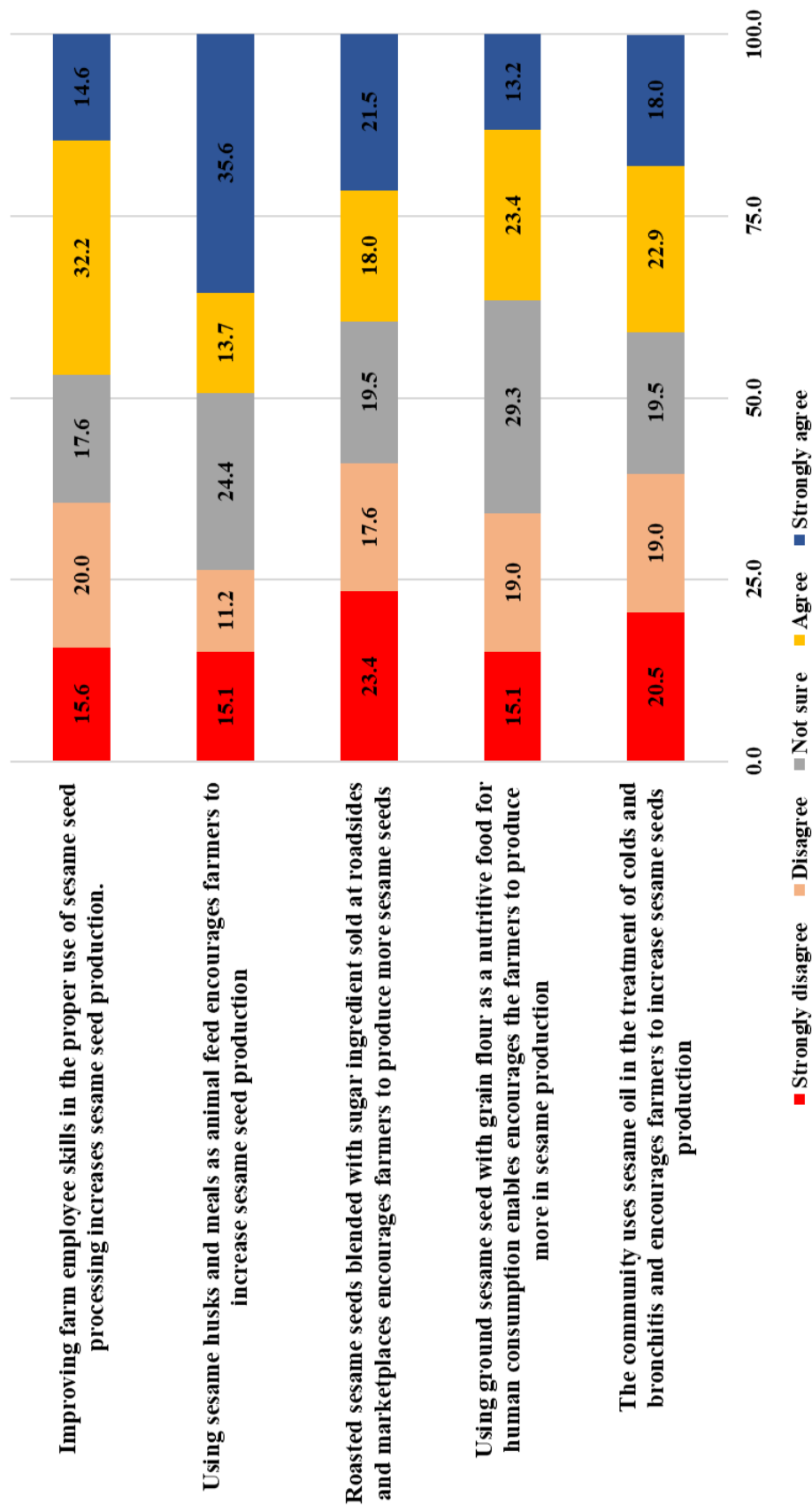


Figure 8 Farmers' needs on sesame product value addition.

## CHAPTER 5

### DISCUSSION

#### 5.1 Socio-characteristic factors

Most of the farmers in this survey were male (71.7%). In many societies, deep-seated cultural beliefs associate farming with masculinity, historically in Somalia, commonly the male gender has been the primary provider and decision-maker in agricultural activities. (Chauhan et al. 2018) in their study indicated that either only the male head of the family or the husband was dominating the decision-making in agriculture activities. Most women had low decision-making power in farming activities, and Men predominantly made sole decisions in paddy cultivation practices (Bora, 2023). Women's participation and decision-making in agriculture is an important factor for sustainable development and achieving gender equality. Studies have shown that there are significant differences between men and women in decision-making patterns in agriculture (Bora, 2023). Women's decision-making ability in agricultural management is influenced by factors such as information exchange, constraints, communication skills, sources of farm information, land holdings, scientific orientation, and farm knowledge (Kumari et al., 2023). Overall, empowering women in agriculture and promoting joint decision-making can lead to improved outcomes in terms of productivity, empowerment, and well-being.

The farmer's mean age is 43.46 years old. Middle-aged males often possess valuable skills, traditional knowledge, and experience in agricultural practices. By actively participating in farming activities, middle-aged males can contribute to obtaining increased household income and economic stability, also middle-aged males engaged in agriculture can help ensure food security within their communities. Middle-aged males in agriculture can have a significant impact on farm income. A study on Japanese found middle-aged male farmers have better income compared to other occupations (Iijima, 2018). Finally, another study focused on the development of small-scale agriculture in Nigeria, male sesame farmers contributed more labor than women to the farming of sesame, and the value of the marginal physical and marginal value outputs of male labor was higher than that of female labor (Luka, 2010).

The result indicates that only 24.4% of sesame farmers have completed high school. Research conducted by (Muhammad et al., 2022) underscores the significant impact of education on sesame production. Studies, such as those by (Yahaya et al.,

2022), reveal that farmers with higher education levels are more inclined to adopt advanced sesame production techniques. Education plays a crucial role in enhancing farmers' proficiency in crop management and technology adoption, enabling them to learn about improved cultivation methods, land preparation, irrigation, pest and disease control, and efficient harvesting practices (Jonah, 2020). Furthermore, education correlates with increased access to extension services, credit facilities, and market information, all of which contribute to enhanced production efficiency. Thus, advocating for formal and informal education initiatives for sesame farmers is essential for improving their productivity and livelihoods. Governments and NGOs should prioritize providing educational and training opportunities, as well as strengthening extension services, to foster sustainable growth in the sesame industry. Research in Ethiopia and neighboring regions, as highlighted by (Gela et al., 2019), confirms that both formal and informal education enhance farmers' access to financial resources and advanced technologies.

Nearly half (46.3%) of respondents came from families averaging 6 to 10 members. A majority (79.0%) stated having 1-3 family members engaged in agricultural work. Family size significantly impacts agricultural revenue, with larger families often experiencing lower productivity and income (Muhammad, 2022). Research indicates that as family size increases, agricultural output declines due to resource constraints and increased consumption of farm-produced food (Andrew, 1997), contributing to heightened poverty in rural areas (Omideyi, 1988). Conversely, smaller families tend to yield higher agricultural productivity and income (Kartikasari et al., 2016), with farms featuring smaller family sizes demonstrating greater output per hectare and income per active family member involved in agriculture. Hence, policies promoting smaller family sizes and discouraging high fertility rates are recommended to enhance agricultural productivity and income in farming households. A study in northern Benin also revealed family size's substantial impact on farms' net revenue from sesame cultivation (Dossa, 2023). In summary, family size's influence on revenue is complex. While larger families in agricultural settings may leverage free labor to expand farming activities, increased costs and resource limitations can counterbalance revenue gains. Non-agricultural settings, meanwhile, are more influenced by factors like education and employment opportunities, which play a pivotal role in determining household income. Thus, while family size shapes revenue, its effects are intricately intertwined with socioeconomic dynamics (Mekonnen, 2015).

Over half of the respondents (57.1%) had 5-15 years of sesame cultivation experience, with a mean difference of 15.24. Farmers with more experience are better able to comprehend the needs of sesame farming, while Farmers may maximize crop

productivity and quality by using knowledge (Gedefa, 2010). They are aware of the appropriate seeding timing, seeding rate, and plant spacing, all of which may greatly increase productivity, using integrated pest management techniques, crop rotation, and organic or chemical pesticides, and the farmer's knowledge, suitable pest control measures may be used to reduce crop losses (Ahirwar et al., 2009). Farmers with experience are aware of the best harvesting practices to reduce seed loss and damage. Additionally, they are familiar with post-harvest techniques including drying, threshing, cleaning, and storing. Sesame farming plays a crucial role in enhancing farmers' livelihoods. Implementing advanced techniques like utilizing genetically enhanced varieties, maintaining nutrient balance, treating seeds, and employing plant protection methods has been proven to elevate sesame productivity and profitability (Choudhary et al., 2022). In Nigeria, sesame cultivation has positively impacted farmers' livelihoods, contributing significantly to their income and facilitating improvements in various assets such as education, housing, transportation, communication, and livestock (Junaidu et al., 2022). Similarly, in Ethiopia, farmers have reported increased net profits from sesame cultivation, despite the higher production costs associated with employing enhanced production methods (Gebre & Kahsay, 2023).

Half of the participants (51.7%) were identified as landowners, a status that confers numerous benefits for farmers. The ownership of farmland offers financial security and managerial autonomy for farmers (Feder & Onchan, 1987). Freed from the specter of property loss, farmers can establish long-term objectives, embrace sustainable practices, and invest in infrastructure enhancements. Moreover, owning farmland facilitates the creation of a legacy and potential inheritance for future generations (Arora et al., 2015). Farmland ownership presents various advantages for farmers. In China, the formal recognition of farmland rights has been demonstrated to enhance farmers' welfare, influencing factors such as family income, access to medical care, and the stability of land management rights (Guan et al., 2022). In the United States, the appreciation of farmland values alleviates financial strain for farms owning less than one-quarter of their land (Burns et al., 2018). Conversely, in China, the conversion of farmland results in increased income and improved living conditions but also imposes economic and personal burdens on landless farmers (Chen et al., 2013).

## **5.2 Sesame production**

If farmers are aware that their output has stopped being exported, it's a good sign and there are several potential benefits. Relying heavily on exports can make farmers vulnerable to fluctuations in international trade, tariffs, and other market disruptions. By focusing on the local market, farmers can reduce their exposure to these risks and achieve more stability in their operations, and shifting the focus to the local market can make farmers more resilient to global economic shocks. In addition, Farmers can explore alternative domestic markets for their products. focus on local consumers, they can establish direct relationships with buyers, reduce transportation costs, and explore value-added products that cater to local demand, leading to increased profitability. A stronger emphasis on local consumption can contribute to improved food security within the country. The study in east Chad reported that more has farmers access to knowledge of markets which guarantees higher food security (Corsi, 2017).

Farmers who have used local seeds can lead to the development of locally adapted varieties that are better suited to the specific growing conditions of the region. This can result in improved crop yields, resilience to pests and diseases, and increased food security. Farmers can reduce their dependence on commercial seed companies, this is particularly beneficial for smallholder farmers who may have limited financial resources. The smallholder farmers in the Eastern and Central African countries also do not buy sesame seed but mainly rely on their stocks or obtain seed from other farmers (David, 1999).

Most of the sesame farmers (68.8%), who have used basic hand tools to harvest sesame production, had both positive and negative responses (Table 4). The basic hand tools are generally inexpensive compared to mechanized equipment (Myint et al., 2020). This can benefit smallholder farmers or those with limited financial resources. These basic tools allow farmers to access and work in narrow rows or areas with limited space that may be difficult for machinery to reach. Basic hand tools used for harvesting sesame may allow farmers to selectively harvest mature sesame pods, ensuring higher-quality yield. Furthermore, these tools require a significant amount of physical labor for harvesting sesame and thus this can be a challenge for farmers with limited labor availability, leading to delays in harvesting. A similar study claimed that in seed harvest, workers should spend a lot of time on the manual sesame seed harvest in the physical works.

Almost all the respondents (97.1%) stated that they use pesticides on their farms and most of them (91.2%) preferred using chemical pesticides to produce sesame (Table 4). Farmers opt for chemical pesticides on sesame crops due to their efficacy in pest control (Fakeer & Gaeel, 2022) a common practice believed to boost productivity by

mitigating pest damage (Mohammad, 2018). However, excessive use of these pesticides can pose risks to human health and the environment (Tudi et al., 2022). In Iran, farmers prioritize performance and effectiveness when choosing and applying pesticides (Tran, 2022). Promoting awareness among farmers about balanced pesticide usage and offering alternative methods like integrated pest management (IPM) and biopesticides is essential. Despite their effectiveness, advocating for sustainable and eco-friendly pest management practices is crucial in sesame cultivation (Thakur et al., 2023). found that many African smallholder sesame farmers who used synthetic pesticides suffered illnesses from chemical exposure (Lekamoi, 2022).

A significant majority of sesame farmers (87.8%) indicated a preference for wholesale selling of sesame directly at the farm gate (Table 4). This approach bypasses intermediaries like brokers or traders, potentially leading to higher profits for farmers by eliminating their significant share. However, wholesale selling at the farm gate presents challenges. In Uganda, smallholders encounter obstacles such as a lack of equipment for land preparation, pest, and disease-related crop losses, seed availability issues, and labor shortages for weeding (Munyua., 2013). In Ethiopia's sesame market, outlet choice is influenced by factors like household education, proximity to markets, sesame production volume, and market prices (Temesgen et al., 2017). Similarly, in Gimbi Woredas, Oromia Region, factors affecting outlet decisions include sesame market prices, cooperative membership, access to credit, and transportation ownership (Temesgen et al., 2017). In Benue State, Nigeria, market participation among sesame farmers is influenced by education, output, information accessibility, seasonality, inadequate storage, transportation costs, taxes, distance to markets, and road conditions (Aworh., 2015). Addressing these challenges and considering local factors affecting market choices is crucial for successful wholesale sesame selling at the farm gate.

### **5.3 Factors that influence sesame productivity**

#### **5.3.1 Multiple regression analysis of factors influencing sesame productivity**

The statistical analysis of various factors influencing sesame production provides valuable insights into the complex dynamics of agricultural practices. The study reveals significant relationships between several key variables and sesame yield, shedding light on the factors that play a crucial role in determining the success of sesame cultivation (Table 5).

One of the noteworthy findings is the statistically significant impact of the number of laborers on sesame production. This suggests that the labor force has a tangible effect on the overall output, emphasizing the importance of workforce management and efficiency in sesame farming. A study in Ethiopia reported that labor and seed were the variables that positively affected the production of sesame (Mekonnen, 2015). Farming experience showed marginal significance with the sesame productivity. This implies a potential relationship between the level of experience and sesame yield, prompting further exploration into how cumulative knowledge and skills acquired over time may contribute to improved production outcomes (Mekonnen, 2015).

The size of the cultivated area emerges as a highly influential factor. This underscores the critical role of land management and allocation in sesame farming, with larger cultivated areas leading to a more substantial impact on yield (FAO, 2006).

In addition, awareness of product cut-off is a statistically significant factor. This highlights the importance of access to information and resources provided by relevant agricultural authorities, suggesting that well-informed practices contribute significantly to enhancing sesame production (Murungweni et al., 2016).

The source of seeds emerges as a highly significant factor indicating a substantial impact on sesame production. This underscores the importance of seed quality and origin in influencing the overall yield, emphasizing the need for farmers to pay attention to sourcing their seeds (Wittkop et al., 2009). Cultivation techniques and weeding methods also demonstrate a statistically significant effect on output. This underscores the importance of effective and optimized cultivation methods to maximize sesame production.

My opinion, comparisons between Ethiopia and Somalia regarding their agricultural practices and impacts on sesame production. While similarities exist, such as both countries relying on small-scale farming with traditional methods, it's crucial to acknowledge their distinct contexts. Somalia's potential trajectory in sesame production could mirror Ethiopia's if it follows a similar path of predominantly traditional farming methods without embracing modern agricultural techniques. However, significant differences between the two nations, including geography, climate, and socio-economic conditions, could lead to divergent outcomes. Somalia's challenges, including conflict, instability, and environmental degradation, may affect agricultural productivity differently than in Ethiopia. Additionally, regional variations within Somalia, such as differences in access to resources and market dynamics, further complicate the comparison.

### 5.3.2 Farmers' opinion on factors influencing sesame production.

More than half of respondents agree (27.8%) and strongly agree (28.8%) that training sesame farmers on the proper time of weeding, preventing, and curing effects of insects and diseases plays an important role in sesame seed production. Training sesame farmers on proper weeding timing, prevention, and management of insect pests and diseases is essential for enhancing sesame seed production (Chavhan., 2023). In Ethiopia, a country where sesame holds significant value, farmers encounter challenges such as low yields and limited access to improved seeds. Research conducted in India also underscores the importance of effective pest management strategies, including the use of botanicals and chemical treatments, in controlling pests like shoot webber and leafhopper, which ultimately leads to improved seed yield (Thakur et al, 2023). The implementation of Integrated Pest Management (IPM) modules, which include insecticide treatments and intercropping, has been found to significantly reduce pest populations and enhance seed equivalent yield (Thakur et al, 2023). Furthermore, the application of pre-and post-emergence herbicides in sesame cultivation has shown promising results in managing weed growth and maximizing seed yield (Neeshu, 2022). Thus, training programs that emphasize weed and pest management are crucial for optimizing sesame seed production.

The findings from the participant responses in this study offer valuable insights into the factors influencing sesame production. Water and irrigation emerge as pivotal elements, consistently ranked at the top by most respondents (Table 6), underscoring their critical role in enhancing sesame yield. This aligns with the agricultural understanding that adequate water supply is fundamental for optimal crop growth and productivity (Morison et al., 2008). The increased water supply and efficient irrigation system will improve sesame. production and productivity (Ucan, 2007).

The importance of seed quality in bolstering sesame production highlights the need for attention to seed sourcing and quality assurance measures (Table 6). There was a report that seed quality is one of the main factors that affect crop production (Bishaw et al., 2007).

Training on agricultural practices regarding sesame production received a high score, suggesting its perceived importance in optimizing the production sesame process. While effective fertilizers are acknowledged as important contributors to yield enhancement, they are ranked relatively lower compared to other factors, signaling a complex interplay of various agricultural inputs (Dimkpa et al., 2020).

In my opinion, using fertilizer efficiently will enhance the yield of sesame in several ways, Fertilizers containing nitrogen, phosphorus, and potassium are vital for

sesame growth, applied at appropriate stages to ensure optimal nutrient availability and maximize yield. Adequate nutrient supply enhances plant health, making sesame more resilient to pests, diseases, and environmental stresses, resulting in higher yields. Balanced fertilization supports robust flowering and seed formation, critical for sesame productivity, by providing essential nutrients like nitrogen, phosphorus, and potassium.

### 5.3.3 Farmers' opinions on support and knowledge needs.

Almost all the sesame farmers (94.6%) thought that improving local sesame seed varieties would be a stimulant for increased sesame production and productivity. This highlights the importance of investing in research and development to enhance the quality and yield of sesame seeds. There's a study that reported the lack of access to improved seeds is the most important production (Teklu et al., 2021). Enhancing sesame production and productivity relies significantly on improving the existing local varieties of sesame seeds. Currently, cultivated local landraces yield low amounts and have lower oil content (Lukurugu, 2023). To tackle this issue, breeding initiatives should concentrate on creating sesame varieties that yield more while also enhancing their quality traits, including resistance to pests and diseases, early maturation, and tolerance to drought (Teklu, 2021). Through genomic studies, particular genes and variations responsible for differences in agronomic traits have been pinpointed, providing valuable insights for applications in molecular breeding (Kefale, 2022). Combining traditional breeding techniques with genetic and genomic methods such as mutation breeding and genomics-assisted breeding can result in the creation of sesame varieties that exhibit improved yield, oil content, and other favorable agronomic characteristics (Sirisha, 2022). By integrating traits like local adaptation, compatibility with machine harvesting, and characteristics preferred by the market, enhanced varieties of sesame can greatly increase production and productivity within the sesame industry.

The study also highlights the potential for value addition in sesame products to incentivize farmers. Most respondents expressed interest in value-added processes such as roasting and blending sesame seeds and sesame oil manufacturing. Moreover, a significant proportion believe that value-added sesame products would encourage farmers to cultivate more sesame seeds. These findings underscore the importance of promoting value-addition initiatives and providing training to farmers in processing techniques. Promoting the utilization of lesser-known indigenous fruits and vegetables and other food plants through value-added processing will increase their cultivation

(Aworh, 2015). Microwave roasting of sesame seeds is preferred for healthier oil content, as it can significantly influence the oil content, fatty acid profiles, and physicochemical properties of the extracted oil (El-Beltagi, 2022). Moreover, a technique for manufacturing sesame oil includes roasting procedures to improve the oil's flavor and reduce the presence of harmful compounds like benzopyrene, leading to higher yield (Nagar et al., 2023). These discoveries emphasize the significance of roasting methods in improving the quality and attractiveness of sesame seeds and oils.



## CHAPTER 6

### CONCLUSIONS AND RECOMMENDATIONS

#### 6.1 Summary of Findings

The study surveyed 205 farmers in Jowhar District, Middle Shabelle, Somalia, focusing on sesame production and small-holder farmers' knowledge needs. The majority were men, with a mean age of 43.46 and a high school attendance rate of 24.4%. Most had 5-15 years of sesame cultivation experience, and most received financial assistance from private sources.

The study reveals that most sesame growers in the research Area cultivate 4-6 hectares of land, with 52.2% producing between 791 and 1290 kg. Most farmers use pesticides, with 59.0% relying on local businesses as their primary source of seeds. Moreover, a significant number of respondents are interested in roasting and blending sesame seeds with sugar components and sesame oil manufacturing to increase value. Providing farmers with high-extent value-added sesame products could increase sesame output and encourage farmers to grow more seeds.

The study found that training farm workers in the correct pattern of sesame sowing can boost sesame seed yield. Proper management of land and using farm equipment also contribute to higher-quality seeds. Improving harvesting and storage skills also increases sesame prices in the domestic market. Additionally, training on weeding, insect prevention, and disease curing is crucial for sesame seed production.

The study found that improving farm employee skills in sesame seed processing doesn't increase production. However, 35.6% agree that using sesame husks and meals as animal feed encourages more production. Roasted sesame seeds blended with sugar, ground sesame seed, and grain flour for nutritious food, and sesame oil for colds and bronchitis also encourage more production.

The study found that ease of market access and free goods for sesame seed growers encourages more production. However, 24.9 percent doubt raising market prices and organizing production will increase skilled farmers. 43.9% agree that improving local seed types is crucial for increased production and market prices. Exporting seeds in hard currency also leads to high production.

The study ranked factors affecting sesame production, with 22.4% identifying the lack of good fertilizers as the worst. Low seed quality was ranked second, followed by

water deficiency/drought as third. Poor knowledge of agricultural practices was ranked fourth and fifth. These factors contribute to the decline of sesame production.

The study reveals that 28.3% of participants ranked effective fertilizers as the least important factor for increasing sesame production, followed by good seed quality (26.3%) and water availability and irrigation (3, 2) and 3 (best) factors.

The study also examined, factors influencing sesame production provides valuable insights into agricultural practices. Labor force, farming experience, cultivated area size, knowledge of the sesame production office, seed source, and cultivation techniques all significantly impact sesame yield. Notably, labor force, cultivated area size, and seed source show particularly strong correlations. These findings underscore the importance of efficient workforce management, effective land allocation, seed quality, and informed agricultural practices in maximizing sesame productivity. Additionally, water supply demonstrates a potential influence on yield.

## 6.2 Conclusion

In conclusion, the study sheds light on various aspects influencing sesame production among small-holder farmers in Jowhar District, Middle Shabelle, Somalia. Through surveying 205 farmers, key insights have been gained regarding farming practices, knowledge needs, and factors affecting yield.

The study also found that it is evident that factors such as land cultivation size, seed quality, access to knowledge training, and market opportunities significantly impact sesame production. Farmers recognize the importance of improving local seed varieties, accessing proper training, and enhancing value-added products to boost output and market competitiveness. Moreover, effective workforce management, land allocation, and cultivation techniques play crucial roles in maximizing yield.

Challenges such as inadequate fertilizers, low seed quality, water scarcity, and limited agricultural knowledge pose barriers to achieving higher sesame productivity. Addressing these challenges through targeted interventions, including improved access to quality inputs, training in best practices, and enhancing market opportunities, can contribute to overcoming barriers and fostering increased sesame production.

Furthermore, the study underscores the importance of continued research and development efforts to optimize sesame farming practices, enhance productivity, and promote sustainable agricultural growth in the region. By addressing the identified factors and leveraging opportunities for improvement, stakeholders can work towards realizing the full potential of sesame cultivation, ultimately benefiting farmers, communities, and the agricultural sector in the Jowhar district.

### 6.3 Recommendation

Based on my findings drawn from the study, several recommendations can be made to support and enhance sesame production among small-holder farmers in the Jowhar District, Middle Shabelle, Somalia.

First, I would highly recommend Investment in Seed Quality Improvement, Government and agricultural organizations should prioritize initiatives aimed at improving the quality of local sesame seed varieties. This can be achieved through research, breeding programs, and dissemination of improved seed varieties to farmers. Also enhancing, Knowledge and Training Programs Continued efforts should be made to provide comprehensive training and extension services to farmers, covering various aspects of sesame cultivation, including proper land management, cultivation techniques, pest and disease management, and post-harvest practices. These programs should be tailored to the specific needs and challenges faced by farmers in the region.

Additionally, enhancing access to inputs and addressing challenges related to inadequate fertilizers and water scarcity requires improved access to quality inputs such as fertilizers, irrigation systems, and drought-resistant seed varieties. Government subsidies or support programs can help make these inputs more affordable and accessible to small-holder farmers. Promoting Value-Added Products, there is an opportunity to increase sesame production by promoting value-added products such as roasted sesame seeds, sesame oil, and blended sesame products. Government and industry stakeholders should support initiatives aimed at value addition, including providing training and access to processing equipment.

Furthermore, market access and infrastructure development will improve market access for sesame farmers, including access to wholesalers and export markets, which is essential for increasing production and profitability. Investments in market infrastructure, transportation networks, and market information systems can help facilitate better market access for farmers. Research and Development I also highly recommend, and development is crucial for optimizing sesame farming practices, addressing emerging challenges, and identifying new opportunities for improvement. Collaborative research initiatives involving government agencies, academic institutions, and the private sector can help drive innovation and sustainability in sesame production. By implementing these recommendations, stakeholders can work towards realizing the full potential of sesame cultivation in the Jowhar district, ultimately improving livelihoods, enhancing food security, and promoting sustainable agricultural growth in the Jowhar district and Somalia.

#### 6.4 Areas for further research

- 1) Exploring Sustainable Value Addition Strategies for Sesame Farming Communities in Middle Shabelle, Somalia
- 2) Enhancing Agricultural Resilience: Addressing Knowledge Gaps and Market Integration for Small-holder Sesame Farmers in Jowhar District, Somalia.
- 3) Sesame production, challenges, and opportunities in Ethiopia.



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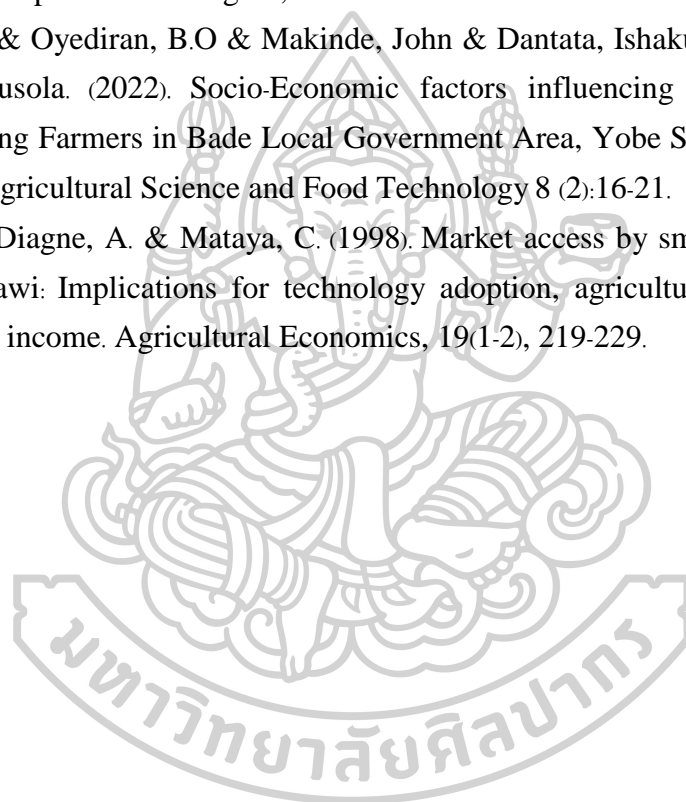
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## Appendix 1

### Questionnaire

Dear Sir/Madam,

I am currently studying **Sesame Production and Small-holder Farmer's Knowledge Need about Production Training, Access to the Market, and Value-Added Product of Sesame in Jowhar District, Middle Shabelle, Somalia**. I humbly request you to be one of the participants in this study and your cooperation will be of great importance to this study. Your answers will be kept with the utmost confidentiality. Thank you very much for your time and cooperation.

#### INSTRUCTION: PLEASE TICK WHERE APPROPRIATE

##### Section A: Biographical Data

To help us to classify your responses, please supply the following facts by marking the right option as appropriate.

1. **Gender:**
  - Male
  - Female
2. **Age (year).**  
{.....}
3. **Educational level:**
  - Below high school
  - High school
  - Diploma
  - Bachelor degree
  - Master degree
  - Other .....
4. **The number of family members:**  
{.....}
5. **The number of laborers:**  
{.....}
6. **Your farming experience:**  
{.....}
7. **Landowner:**
  - Owner
  - Rent
8. **Financial support:**
  - Government project.
  - Bank
  - NGO
  - Private funds
9. **How much income have you got per year?**  
{.....}

### Section B: Sesame Cultivation

10. Sesame cultivated area:

{.....}

11. How much sesame do you produce?

{.....}

12. How much income have you got from sesame sales per year (5 years average):

{.....}

13. Are you aware of the sesame product cut-off?

Yes

No

14. Where do you get the seed for planting?

Government sections

NGOs

Buy from local shops

Own collection

15. Is the quality of the seeds certified?

Yes

No

I don't know.

16. What methods do you use to cultivate sesame?

Traditional method

GAP standard method

Organic standard

17. Do you use fertilizer?

Yes

No.

18. What kind of fertilizer do you normally apply?

Organic compost

Inorganic chemical fertilizer

Biofertilizer

Mixed fertilizer

19. Water supply for sesame cultivation:

Irrigation water

Rainfed

Mixed.

20. If you use irrigation which type of irrigation, do you use?

Sprinklers

Pump-set

Dripping.

21. What kind of weeding method do you normally use?

Manual removal by hands

Use simple hand-tools

Chemical herbicides

22. Do you use pesticides?

Yes ( Chemical pesticides       Biopesticides)

No

- 23. If yes, which type of pesticide do you use?**
- Chemical pesticides
  - Biopesticides
- 24. What methods do you use to harvest sesame?**
- Manually by hands
  - Use simple hand-tools
  - Use a harvesting machine
- 25. Do you grade your sesame seeds after harvesting?**
- Yes
  - No
- (Please tell us why.....)
- 26. Do you clean sesame seeds before the sale?**
- Yes ( Dried method                       Wet method)
  - No
- (Please tell us why.....)
- 27. How do you sell your produce?**
- Wholesale
  - Retail
- 28. Do you think improving local sesame seed varieties will enhance sesame production in your district?**
- Yes
  - No
- 29. Do you think that the government has done enough to ensure that sesame farmers in your district have proper knowledge training for sesame production?**
- Yes
  - No
- 30. If yes, in your opinion, to what extent has training sesame growers in sesame production will boost sesame production in your district?**
- Very high extent
  - High extent
  - Not sure
  - Low extent
  - Very low extent
- 31. Do you think the government has done enough to ensure that sesame farmers in your district can access the market/wholesaler to sell their produces?**
- Yes
  - No
- 32. If yes, in your opinion, to what extent will access to the market/wholesaler boost sesame production in your district?**
- Very high extent
  - High extent
  - Not sure
  - Low extent
  - Very low extent

33. Do you think that the government has done enough to ensure that sesame farmers in your district have proper marketing knowledge about sesame sales?
- Yes
  - No
34. If yes, in your opinion, to what extent has proper marketing knowledge boosted sesame production in your district?
- Very high extent
  - High extent
  - Not sure
  - Low extent
  - Very low extent
35. Are you interested in sesame seed value addition through roasting sesame seeds blended with sugar ingredients for sale at roadsides and markets?
- Yes
  - No
36. Are you interested in sesame seed value addition through sesame oil production?
- Yes
  - No
37. Do you think value-added sesame products will encourage farmers to produce more sesame seeds in your district?
- Yes
  - No
38. If yes, in your opinion, to what extent has value-added sesame product will boost sesame production in your district?
- Very high extent
  - High extent
  - Not sure
  - Low extent
  - Very low extent

**39. From your experience, which factor(s) diminish your sesame production the most?**

Please select 5 factors and rank them from the most important (5) to less important factors (1).

<b>FACTORS</b>	<b>RANK</b>
a) Low-seed quality	
b) Low soil quality	
c) Small land area	
d) Water deficiency/ drought	
e) Flooding	
f) Lack of good fertilizers	
g) Poor knowledge of the agricultural practice	
h) Disease and pest problems	
i) Poor harvesting methods	
j) Poor post-harvest management	
k) Poor knowledge of value addition of sesame product	
l) Access to markets/wholesalers/customers	
m) Market price	

**40. From your experience, which factor(s) increase your sesame production the most?**

Please select 5 factors and rank them from the most important (5) to less important factors (1).

<b>FACTORS</b>	<b>RANK</b>
a) Good seed quality	
b) Good soil quality	
c) Land area	
d) Water/irrigation	
e) Effective fertilizers	
f) Knowledge training on agricultural practices	
g) Good disease and pest management	
h) Effective harvesting methods	
i) Good post-harvest management	
j) Knowledge of value addition of sesame product	
k) Easy access to markets/wholesalers/customers	
l) High market price	

**Section C: Sesame Small-holder Farmer's Knowledge Need about Training, Access to Market, and Value-Added Product**

Please indicate your response mode by writing only the score in the blank provided for each item or statement stated below.

**KEY**

<b>Response mode</b>	<b>Score</b>
Strongly agree (agree with no doubt at all)	<b>5</b>
Agree (agree with minor doubt)	<b>4</b>
Not sure (Neither agree nor disagree)	<b>3</b>
Disagree (disagree with minor doubt)	<b>2</b>
Strongly disagree (disagree with no doubt at all)	<b>1</b>

<b>Construct</b>	<b>Effect of Training on sesame production</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
1	Improving farm employee skills on the proper pattern of sesame sowing increases sesame seed production					
2	Training sesame farmers on the proper use of farm equipment facilitate managing large areas of land and producing sesame seeds of higher quality than without equipment use					
3	Training sesame growers on the proper use of local organic manures and crop rotation contribute to the quantitative and qualitative improvement of sesame seeds					
4	Training sesame farmers on the proper time of weeding, preventing, and curing effects of insects and diseases play an important role in sesame seeds production					
5	Increasing sesame farmer skills in proper harvesting and storing increases sesame prices in the domestic					

<b>Construct</b>	<b>Effect of the Market on sesame production</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
1	Ease of access to marketplaces by sesame seed growers and offering goods in the market without charges encourage farmers to produce more quintals of sesame seeds					
2	Improving market price and planning production increases the number of competent farmers to produce sesame seeds					
3	Improving local sesame seed varieties play important role in sesame production and price increases in the market					
4	Exporting sesame seeds with returns of hard currency to the farmers creates high sesame seed production					
5	Improving market security and reducing tax rates on sesame seeds by the government encourages sesame seeds production					

Construct	Effect of value addition on sesame production	1	2	3	4	5
1	Improving farm employee skills in the proper use of sesame seed processing increases sesame seed production.					
2	Using sesame husks and meals as animal feed encourages farmers to increase sesame seed production					
3	Roasted sesame seeds blended with sugar ingredient sold at roadsides and marketplaces encourages farmers to produce more sesame seeds					
4	Using ground sesame seed with grain flour as a nutritive food for human consumption enables encourages the farmers to produce more in sesame production					
5	The community uses sesame oil in the treatment of colds and bronchitis and encourages farmers to increase sesame seeds production					

**Thank you for your responses.**

**END**



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