Australian Journal of Crop Science AJCS

Aust J Crop Sci. 19(07):816-829 (2025) | ISSN:1835-2707
https://doi.org/10.21475/ajcs.25.19.07.p357

Production of minor tropical oil crops in Africa: Case of sesame (*Sesamum indicum* L.)

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Submitted:* *01/05/2025

Revised:* *09/06/2025

Accepted:* *10/06/2025

Abstract: Sesame (*Sesamum indicum* L.), also called simsim, benne, or gingelly, is one of the oldest cultivated oilseed crops grown for the extraction of edible oil. Although its origin is contested, it most likely originates in Asia (probably India) or eastern Africa. Sesame tolerates hot and dry conditions and grows when other crops fail. Sesame seeds have one of the highest oil contents of any seed; 37% to 63% depending on the cultivar and growing season. There has been an increase in the demand for sesame in international markets, largely due to its nutritious properties and its inclusion in a variety of foods. Despite its nutritional and high-value attributes, as well as increased demand in international markets, sesame is still an orphan crop. There is no international agricultural research center with a research mandate for sesame; consequently, the crop has attracted limited scientific research. Sesame is widely grown in warmer regions of the world, with the largest production occurring in Africa and Asia; the major producing countries include Sudan, India, Myanmar, Tanzania, Nigeria and China. In Africa, sesame is mainly grown in the northern and western regions. The crop receives little support from researchers, industry, or policymakers; as a result, it lags behind other oilseed crops in terms of genetic advancement. Its production in Africa is mainly carried out by small-scale farmers; there is minimal use of inputs, such as fertilizers and other agrochemicals. Farmers plant low-yielding local varieties and obtain seeds from informal sources, especially own-saved seeds. There are also huge pre- and post-harvest losses, especially from uneven shattering of capsules. This review looks into sesame production systems in Africa and the constraints encountered by various producers in different countries. The identified constraints might provide a basis for implementing practical and profitable interventions to enhance sesame production in Africa. Deliberate efforts should be made to improve sesame production; the crop needs policy and research attention if high production is to be achieved.

Keywords: Africa; Constraints; Production; Sesame

Introduction

Sesame (*Sesamum indicum* L), also called simsim, benne, or gingelly, belongs to the genus *Sesamum* and the family *Pedaliaceae*. Sesame is one of the oldest cultivated oilseed crops grown for edible oils and is used in food (Ashri, 1989). It was domesticated well over 3,000 years ago; evidence of early sesame production has been found dating back to 1600 B.C in the Tigris and Euphrates valleys (AGMRC, 2022). Sesame likely originated in Asia (probably India) or Eastern Africa; ancient Egyptians are known to have used ground seeds as grain flour. The Chinese have used sesame seeds for more than 5000 years (Bedigian, 2010). Sesame has been cultivated for centuries, particularly in Asia and Africa, for its seeds, which are rich in edible oils and proteins (Anilakumar et al., 2010). Ethiopia is considered a center of diversity for sesame (Zerihun, 2012) given the rich genetic diversity of the crop there (Girmay, 2018). Numerous wild relatives of sesame occur in sub-Saharan Africa with a smaller number in India (Sani et al., 2014; AGMRC, 2022). The genus *Sesamum* has many species, most of which are wild and native to sub-Saharan Africa (Bedigian, 2010). *Sesamum indicum* is the cultivated type. Sesame is widely grown and naturalized in most tropical, subtropical, and southern temperate areas of the world, particularly in India, China, Malaysia, South America, and Africa, where it is primarily grown by small farmers (Anilakumar et al., 2010). This review looks into sesame production systems in Africa and the constraints encountered by various producers in different countries. The identified constraints might provide a basis for implementing practical and profitable interventions to enhance sesame production in Africa.

Sesame

Sesame is a tropical crop that requires fairly hot conditions for optimum growth (Meena and Rao, 2013). ; It is adapted to both tropical and subtropical climates (Wacal et al., 2021). It has the ability to grow in areas where other crops fail, particularly under hot and dry conditions; consequently, it has been called a 'survivor' crop (Langham, 2007). It can be grown from the warm temperate zones to the tropics so long there is a growing season of at least 5 months; in the subtropics, sesame is a short-day crop (Wei et al., 2022). The plant grows best in hot tropical climates with moderate rainfall in sandy, well-drained soils. It grows best where annual daytime temperatures are within the range of 20 to 30^0C but can tolerate 10-40^0C. Under rainfed conditions, it can tolerate mean annual rainfall of 300–1500 mm (Langham, 2007). Sesame is propagated by seeds and takes approximately four months from planting to seed ripening (Anilakumar et al., 2010). The plant is an erect annual herb that grows 60–150cm in height. There are two main types of sesame under cultivation, depending on branching characteristics. One is the monopole type, which is usually unbranched with short internodes. It bears two to three capsules per node, has a hard stem, and generally matures late. The other type is the branched type, which generally matures earlier. It is branched, has long internodes, and bears mostly one capsule per node (Patel et al., 2018). Sesame is a remarkable oilseed with numerous health benefits, economic significance, and versatility in the kitchen and industries (Archipelago Farms Kenya. 2023). Sesame is chiefly cultivated for its edible seeds, which grow in pods/capsules (Dossa et al., 2017). The seeds were either eaten raw or roasted. Dry, roasted seeds are used in breads, cakes, and other pastries or to garnish and flavour vegetables. Ground seeds are made into paste, which is used to thicken soups and sauces, whereas sesame oil, extracted from the seeds, is widely used in cooking, cosmetics, and traditional medicine (Archipelago Farms Kenya, 2023). Sesame seed coat colour ranges from black to white through different intermediates such as dark brown, brown, light brown, beige, and cream (Pandey et al., 2013); black and white seeded sesame are the most common and widely grown (Wei et al., 2022). Black sesame seeds have strong growth ability, lodging resistance, and drought resistance, while white sesame seeds have higher oil, protein, and moisture contents than black sesame seeds and are the most widely cultivated globally (Wei et al., 2022). Preference for a particular seed coat colour in sesame differs from region to region (Pathak and Dixit, 1992); Japanese prefer black seeded sesame, while Sudanese favours white-seeded sesame (Hossain et al., 2010). In particular, a larger seed size, coupled with a light-coloured seed coat such as white, often commands price premiums in a market-dependent manner (Graham et al., 2001). In other instances, black sesame fetches higher prices than white sesame in certain international markets. This price difference is due to the higher production costs of black sesame, along with the additional demand created by its perceived health benefits. White sesame is used solely as a food condiment, whereas black sesame is in demand as a food oil, cosmetic, and pharmaceutical ingredient (Namibian Agronomic Board (NAB) 2021). In Myanmar, black sesame is a high-value ingredient exported to Japan and other neighbouring countries (Myint et al., 2020). High-yielding white-seeded sesame varieties with high oil content are limited in India (Pandey et al., 2013). Sesame seeds have one of the highest oil contents of any seed, 37–63%, depending on the cultivar and growing season (Hegde, 2012). White-seeded sesame has a high oil content, which decreases gradually as the colour of the seeds deepens towards black (Wei et al., 2022). Sesame oil is rich in unsaturated fatty acids and contains 14% saturated, 39% mono-unsaturated, and 46% poly unsaturated fatty acids (Toma and Tabekhia, 1979). It is high in linoleic acid (37–47%) and oleic acid (35–43%), and low in saturated fatty acids, palmitic acid (8–11%), and stearic acid (5–10%). The seeds also contain proteins (14.1–29.5%), carbohydrates (4.3–20.5%), ash (4.2–6.9%), fiber (2.7–6.7%), minerals, and high amounts of biologically active substances such as lignans (sesamolin and sesamin), natural vitamin E (tocopherols), and phytosterols (Fukuda et al., 1985; Bhat et al., 2014; Wei et al., 2022). The seeds are an excellent source of copper and calcium; they contain three times more calcium than a comparable measure of milk (Anilakumar et al., 2010). The seeds are also rich in phosphorous, iron, magnesium, manganese, zinc, protein, thiamine, and vitamins B_6 and B_1 (Anilakumar et al., 2010). Sesame oil has a long shelf life, is highly stable, and is resistant to oxidative deterioration. This is due to the high amounts of tocopherols (vitamin E), which are dominated by gamma-tocopherol (90.5%) (Wei et al., 2022). The bioavailability of vitamin E can be increased by the presence of natural antioxidants, such as sesamin and sesamolin, as well as their derivatives (sesamol and sesaminol) (Sirany and Tadele, 2022; Wu, 2007). These antioxidants also improve the flavour and taste of foods prepared using sesame seed oil (Anilakumar et al., 2010). The lignan content of sesame seeds is strongly related to seed coat colour, with black sesame seeds having the highest sesamin, sesamol, and total lignan contents, whereas white sesame seeds have a relatively low sesamin content (Wei et al., 2022). Lignans (sesamin and sesamolin) are known to have cholesterol-lowering effects in humans (Ogawa et al., 1995), which prevent high blood pressure and increase vitamin E supplies in animals (Kamal-Eldin et al., 1995). Sesamin represents approximately 50% of sesame lignans, with sesamolin, sesamol, and sesaminol accounting for a small proportion of the weight (Wei et al., 2022). It has been reported that sesamin has good antioxidant properties, cholesterol-lowering, lipid metabolism regulation, blood pressure stabilization, and anti-tumor effects (Wei et al., 2022). It increases the fat burning process and decreases fat storage in the human body (Penalvo et al., 2006). In addition, sesamin has been proven to decrease lipogenesis; consequently, less fat is esterified in the liver, and therefore, less fat is synthesized (Ide et al., 2003). Sesamin has also been shown to increase the production of ketone bodies (Anilakumar et al., 2010). The total phytosterol content in sesame seeds is approximately 400mg/100g (Phillips et al., 2005); Phytosterols are believed to reduce cholesterol levels in the blood, enhance the immune response, and decrease the risk of certain cancers (Anilakumar et al., 2010). Sesame oil is also known to maintain high density lipoprotein cholesterol (HDL) and reduce low density lipoprotein cholesterol (LDL) (Sirato-Yasumoto et al., 2001). The primary marketable products from sesame are whole seeds, seed oil, and seed cake (meal) (Anilakumar et al., 2010); In many countries, the seeds are used to add flavour and variety to local dishes rather than as a primary source of cooking oil. Whole sesame seeds are extensively used in cuisines in the Middle East and Asia. They are the main ingredients in

'tahini' (sesame seed paste) and the Middle Eastern sweets called 'halvah' (Anilakumar et al., 2010). In Europe and North America, sesame seeds are used to flavour and garnish various foods, particularly bread and other baked products, such as cakes and buns. Sesame seed oil is a popular cooking oil in Chinese, Japanese, and Middle Eastern cuisines (Sirany and Tadele, 2022). In India, sesame seed oil is commonly used as the cooking medium (Anilakumar et al., 2010). In many African countries, sesame seeds are used as spices, eaten raw or fried as snacks, or used in confections such as candy and baking. They are also the main ingredients of the soups. Seed oil is used to fry vegetables and meat (Anilakumar et al., 2010). Nearly 70% of sesame seeds produced globally are processed into edible oil (Myint et al., 2020) while the seedcake left after oil processing is used as livestock meal (Bhat et al., 2014). Sesame oil is mostly used in cooking, shortening, and margarine and is also used in the manufacturing of soaps, paints, lubricants, fragrances, cosmetics, medicines, and pesticides.

Sesame production and trade globally

Sesame is grown widely in the warmer regions of the world, with the largest production occurring in Sudan, India, Myanmar, China, and Tanzania (Wei et al., 2022). Asia is the largest producer of sesame globally, followed closely by Africa; approximately 95.9% of the world's total sesame output is produced on these continents (Food and Agriculture Organization of the United Nations Corporate Statistical Database (FAOSTAT), 2022). Since 2012, however, Africa has been the top producer (Figure 1). In 2022, African production accounted for 59.3% of the global output (FAOSTAT, 2024). In terms of production area, sesame was produced on approximately 14.8 million hectares globally in 2020; Sudan contributed 5.2 million hectares, India 1.52, Myanmar 1.5, Tanzania 0.96, Nigeria 0.62, Ethiopia 0.45 million hectares, respectively (FAOSTAT, 2022). The area under sesame cultivation has expanded rapidly in Africa in recent times, which could explain the increased sesame production by the continent (Figure 2). In 2022, the highest sesame producing countries were Sudan, India, Myanmar, Tanzania, Nigeria, China, Burkina Faso, Chad, Central Africa Republic and Ethiopia (FAOSTAT, 2024). Sesame is widely traded in local, regional, and international markets; the global sesame seed market was estimated to be worth 7.5 billion USD in 2023 and is expected to grow to 8.5 billion USD by 2028 (Mordor Intelligence, 2023). The demand for sesame is largely due to its nutritious properties and inclusion in a variety of foods (Wei et al., 2022). The global demand for sesame is growing, driven by rising demand from China and India. China has more than doubled its sesame imports in recent years and is now importing more than one-third of the world's sesame output (Commercial Agriculture for Smallholders and Agribusiness (CASA), 2020). China is the world's leading importer of sesame, importing about 50% of the world's output, followed by Turkey and Japan (Feed the Future, 2023). The high demand for sesame in most parts of the world has led to an increase in its prices in international markets. Consequently, sesame is becoming an increasingly important cash crop for many small-scale farmers across Africa.

Despite its nutritional and high-value attributes, sesame is an orphan crop. No international agricultural research center has a research mandate for sesame; thus, it has attracted limited scientific research (Boureima and Hamissou, 2019). It receives little support from researchers, industry, or policymakers; as a result, it lags behind other main oilseed crops in terms of genetic advancement (Dossa et al., 2017). Research on sesame is limited worldwide; consequently, the crop is produced under traditional management practices. Researchers in many countries, such as Wacal et al. (2021) in Uganda, Lukurugu et al. (2023) in Tanzania, Yakubu, and Yusuf (2020) in Nigeria, Teklu et al. (2021), and Teklu et al. (2022) in Ethiopia, and Myint et al. (2020) in Myanmar, have identified insect pests, diseases, weeds, low soil fertility, prolonged drought, poor agronomic practices, lack of high-yielding improved varieties, lack of wide adapting cultivars, non-synchronous maturity and seed shattering of available varieties, and lack of financial assistance as the most critical barriers to sesame production. In many countries where sesame is produced, it is often grown as a minor crop mainly by small-scale farmers (Dossa et al., 2017). The storage practices employed and the lack of effective containers lead to post-harvest losses from insect pests and reduced seed quality (Dossou et al., 2023). In addition, sesame marketing channels are fragmented and there is a lack of transparency among chain actors. In most cases, sesame growers have no access to market information and are exploited by brokers/middlemen/agents who buy seeds locally and then sell them to exporters or processors (Okadonye et al., 2023). Furthermore, there is high volatility in sesame prices in the international markets. Price instability is partially because almost all sesame is grown for export; the export of basic commodities is typically characterized by high price variations (Kleijn et al., 2013).

Sesame production in Africa

Sesame is considered one of the most suitable crops for the arid and semi-arid parts of Africa because it guarantees a high yield even under harsh environmental conditions and has the potential to leverage the income of farmers (Dossa et al., 2017). Sesame production has been on the rise in northern and western Africa (Figure 3). In several African countries, sesame has shifted from being a marginal crop to one of the major export commodities, although its production is still carried out by small scale farmers on small farms (Gildemacher et al. 2015). In 2022, the major producers of sesame in Africa were Sudan, Tanzania, and Nigeria (Table 1). Sesame seeds represent an important export commodity for some sub-Saharan African countries (SSA); sesame is a major cash crop in West and East African countries (FAO, 2019). The major producers and exporters of sesame seeds in SSA are Tanzania, Sudan, Ethiopia, Nigeria, and Burkina Faso, with their combined production representing 57% of global output (Kafando et al., 2020).

Sesame in West and Central Africa

Sesame is a significant crop cultivated in almost all countries in West and Central Africa, with Nigeria and Burkina Faso being the top producers. Sesame serves as an alternative cash crop that generates income for smallholders, particularly women (Dossa et al., 2017). In countries such as Burkina Faso, Senegal, and Mali, the governments allocate huge amounts

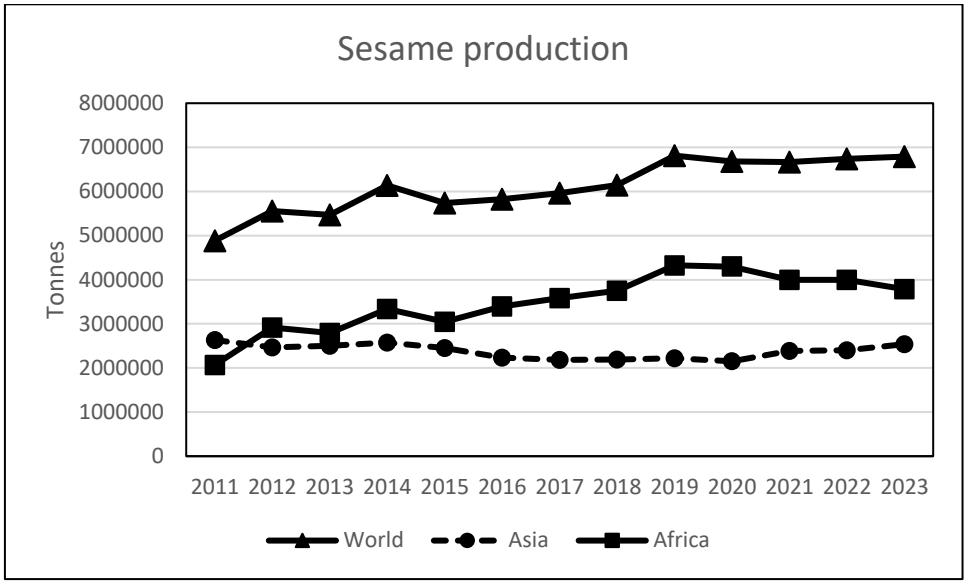

Figure 1. Sesame production in recent times. Source: FAOSTAT, 2024.

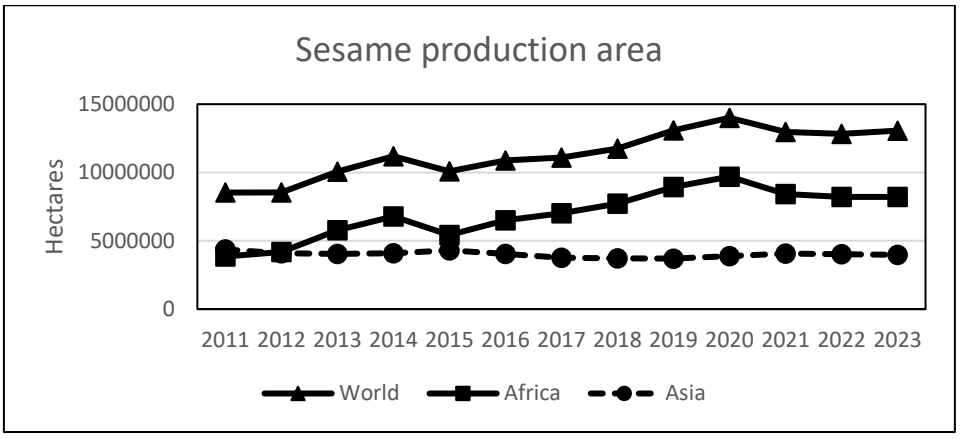

Figure 2. Sesame production area. Source: FAOSTAT, 2024.

of financial resources to stimulate sesame production (Azon et al., 2023). In West Africa, sesame is cultivated on approximately 1,417,115 hectares with an annual production of 941,021 tonnes in pure stands or in association with cereals (e.g. millet and sorghum) (Lawali et al., 2024). The West African sesame seeds are particularly appreciated in the international markets because they are largely produced in the absence of chemicals (Dossa et al., 2017). Countries such as Senegal, Nigeria, Burkina-Faso, Niger, and Mali have experienced considerable increases in sesame production (Sanni et al, 2022). In the Sahel region of West Africa, sesame is essentially a cash crop, mainly for export market (Dossa et al., 2017; Kafando, 2023). Sesame is rivalling cotton production as a cash crop (Dossa et al., 2017). In this region, the quantity of sesame traded has more than doubled over the last decade. Sesame is generally grown under rainfed conditions in traditional farming systems, with little or no use of machinery or modern inputs; it is cultivated on marginal lands (Ayana, 2015). The use of external inputs, such as fertilizers, is very modest (Dossa et al., 2017). Dossa et al. (2017) found that most sesame farmers in Mali and Senegal were men; possibly because it is a cash crop. Furthermore, they found that sesame yields were low in both countries, ranging from 50 kg/ha to 1500 kg/ha, with an average yield of 298 kg/ha. In both Mali and Senegal, sesame is a small-scale farmer commodity grown with minimal pesticides and fertilizers; in addition, local processing of sesame seeds into oil is rudimentary and limited (Dossa et al., 2017). However, in recent times, sesame cultivation in these areas is gradually becoming modernized; the crop is nowadays grown in monoculture and is planted in rows using a sowing device. In the Diourbel region of eastern Senegal, sesame has emerged as a water-efficient alternative crop to ground nuts and other traditional crops (Syngenta Foundation for Sustainable Agriculture, 2023). Although sesame farming in this region initially started on a very modest scale, covering only 10 hectares in 2021, the area under sesame expanded exponentially in the next three years, surpassing 2,000 hectares in 2023. This rapid growth was due to a fruitful collaboration between farmers and SEDAB (Sahelienne d'Entreprise de Distribution et d'Agro-Business), a local seed company that provided the necessary seeds and expertise to the farmers (Syngenta Foundation for Sustainable Agriculture, 2023). In 2022, a sesame production cooperative was established; the cooperative successfully connected with COPEOL, an oil production company interested in purchasing sesame from local producers. This partnership not only provided a reliable market for the farmers' sesame but also contributed to the economic growth of the region. Additionally, the cooperative introduced a new sesame variety called Niangballo, which exhibited excellent yields and met the requirements of processors (Syngenta Foundation for Sustainable Agriculture, 2023).

In Burkina Faso, sesame is the second major cash crop for export after cotton; sesame is grown throughout the country for export markets (Kafando, 2023). In recent times, the country's sesame sector has recorded tremendous growth both in quantity produced and value of exports to become one of the world's largest exporters of sesame seeds. This growth has been driven by the increasing world demand, mainly from the sesame-oil and confectionary industries (Kafando et al., 2020). However, the average sesame yield is relatively lower in Burkina Faso (550 kg/ha) compared to other leading producers, such as northern Uganda (673 kg/ha) (Munyua et al., 2013), Ethiopia (1,000 kg/ha), Nigeria (950 kg/ha), Tanzania (800 kg/ha), and China (1,600 kg/ha) (Kafando et al., 2020). The improved sesame variety grown in Burkina Faso "S42," has a potential yield of 1,500 kg/ha (Kafando, 2023). It is by far the best genotype in terms of seed quality and is widely grown in neighbouring countries such as Mali, Niger, and Chad (Dossa et al. 2017). This variety was developed to shorten the growing cycle (to 90 days), account for irregular rainfall patterns, and increase productivity (Kafando, 2023).

In Niger, variability in rainfall has led rural populations to integrate sesame into their cropping systems because of its low water and fertilizer requirements (Lawali et al., 2024). Consequently, sesame is increasingly becoming a significant source of income for farmers, contributing to food and nutritional security (Lawali et al., 2024). Traditionally, sesame was produced exclusively by women for domestic use, often in the form of condiments. However, in recent decades, the demand for sesame seeds has risen sharply in the international market, transforming the plant from a neglected crop to a high-value commercial crop; this has attracted more men into sesame cultivation. In Niger, sesame production has predominantly become the work of men, while women, who were once the main producers, have been relegated to local processing and marketing of processed products locally (Lawali et al., 2024). Men produce sesame and sell it to women in local markets or they export to the neighbouring countries (Lawali et al., 2024). Sesame is nowadays widely grown across the country as a sole crop or intercropped with pearl millet or sorghum. There has been an increase in production areas (30%) and output (38%), but yields are still low, at approximately 449 kg/ha (Boureima and Hamissou, 2019). There are a few sesame processing factories in the country and sesame seeds are mainly exported to Nigeria and China (Boureima and Hamissou, 2019). Roasted sesame seeds are generally used for home consumption. In the rural commune of Kankandi in the Dosso region of Niger, the most popular local sesame variety 'Lamti Bi' is preferred because of its outstanding taste and aroma. It yields between 400 and 500 kg/ha with good rainfall and 300 kg/ha with poor rainfall; yields can reach 600 and 800 kg/ha when production is high. It is more tolerant to water stress, infertile soil, and the effects of climate change than the improved varieties brought in by some development projects. Farmers use their own saved seeds with little support from the state and its partners (AFSA 2023). A previous study showed that white seed coat coloured sesame is specifically preferred by the market because of its high oil content (Boureima et al., 2017).

In Benin, sesame sector is poorly developed (Sanni et al., 2022; Azon et al., 2023). Sesame has always been produced by smallholder farmers for domestic consumption, local trade or processing. The average productivity has increased from 150 kg/ha in 2005 to 318 kg/ha in 2020, with a maximum yield of 2,000 kg/ha (Dossa et al., 2023). The crop is produced in several agro-ecological zones in the country, mostly on degraded soils that have little organic matter. The northern region of the country produces the highest volumes of sesame. In this region, sesame is mainly produced in sole cropping system and in rotation with other crops (Dossa et al., 2023). A study in northern Benin showed that sesame production was dominated by men (88.3%), and most of the respondents (77.5%) were married (Dossa et al., 2023). Majority (80.8%) of producers grow local varieties and almost all respondents (99.2%) grow sesame as a sole crop. Another study carried out in different sesame-growing areas of northern Benin showed that over 80% of sesame growers are men; over 60% of farmers grow sesame because of its profitability as a cash crop (Azon et al., 2023). Sanni et al. (2022) found that most sesame producers in north-Western Benin were men (77%) and 45.5% of them prioritize good financial returns as a principal criterion for the adoption of sesame (Sanni et al., 2022). As in most African countries, sesame is not a priority crop for research in Benin (Sanni et al., 2022). Fertilizer usage is minimal (Azon et al., 2023; Sanni et al., 2022) in sesame production and most growers have limited access to extension services and credit facilities (Dossa et al., 2023). Most growers plant their own seeds from the previous harvest; Sanni et al. (2022) reported that 91.36% of farmers in north-Western Benin planted seeds from their previous harvest. The unavailability of improved varieties has caused some farmers to completely abandon sesame production or reduce production areas in northern Benin (Dossa et al., 2023). Sesame yields are generally low and range from 401 kg/ha to 531 kg/ha (Azon et al., 2023). Most farmers rent the land to cultivate sesame; some sesame farmers are from Niger, Burkina Faso, and Togo, and do not have easy access to land (Sanni et al., 2022; Dossa et al., 2023). In most households, the area devoted to sesame production range from 0.25 to 3 hectares (Azon et al., 2023; Sanni et al., 2022). Industrial processing of sesame in Benin is low; however, 92.32% of farmers reported using the seeds to make sauce or roasted it as a snack (Sanni et al., 2022).

Nigeria is a major producer of sesame seeds, about 90% of sesame produced in the country is exported (Jonah et al., 2020). Before the lucrative interest in sesame seeds as a cash crop, it was a minor crop grown in the northern and central parts of the country. Currently, sesame is one of the major cash earner in many northern states such as Benue, Gombe, Yobe, Kano, Jigawa, Katsina, Kogi, Plateau, Kaduna, Borno, Nasarawa, and Niger states, as well as in the Federal Capital Territory (Haruna, 2011; Yakubu and Yusuf, 2020; Haruna and Usman, 2005; NEPC, 2014). Sesame seeds now rank second after cocoa among Nigerian export crops (Okadonye et al., 2023). The export market for Nigerian sesame includes Japan, China, India, Korea, and Mediterranean and Middle Eastern countries (Saleh, 2020). Japan imports about 40% of its sesame seed requirements from Nigeria, and the trade volume between the two countries reached 1 billion USD in 2022 (The Borgen Project, 2023). Nigeria generates 700 million USD from sesame exports annually (The Borgen Project, 2023). Apart from foreign exchange earnings, sesame seeds are locally processed and used in diverse forms such as local snacks and pap known as "kantun ridi" and "kunun ridi", respectively. Additionally, oil is extracted from the seed and the cake is made into "kulikuli'', which together with sesame leaves are used to prepare a local soup known as "miyar taushe". Oil is used for

cooking and medicinal purposes such as the treatment of ulcers and burns. The major sesame-producing states in Nigeria in order of volume are the Nasarawa, Jigawa, and Benue states; sesame is a popular cash crop among smallholder farmers in these states (Okadonye et al., 2023). White-seeded varieties are mostly produced in Nassarawa and Benue States, while the brown coloured ones are mostly grown in Kano, Jigawa, and Katsina states (Yakubu and Yusuf, 2020). However, sesame yields in Nigeria are low; Manyong et al. (2005) reported sesame yields of 550 kg/ha against a potential yield of 2 ton/ha in north-central Nigeria. Sesame production in Nigeria is dominated by men, most of whom are married and aged between 21 and 60 years (Jonah et al., 2020; Yakubu and Yusuf, 2020). The crop is produced by small-scale farmers on relatively poor soils and limited inputs, resulting in low yields, with an average farm size is 0-3 hectares (Jonah et al., 2020; Yakubu and Yusuf, 2020). Most growers cultivate low-yielding local varieties and use manual labour. In most cases, sesame is grown under rain-fed conditions. Major constraints faced by sesame farmers include lack of access to credit, inadequate extension services, and pests and diseases (Yakubu and Yusuf, 2020; Jonah et al., 2020), among others.

Sesame production in Eastern Africa

Historically, sesame has been an important export crop for the predominantly agrarian economies of Sudan and Ethiopia (Soliman and Demissie, 2024); both countries have been ranked among the top producers and exporters of sesame over the decade. One of the key areas of sesame production is the eastern Sudanese states of Gedaref and Kassala and the Amhara and Tigray regional states of north-western Ethiopia (Soliman and Demissie, 2024). The white sesame produced in Gedaref (Sudan) and Humera (Ethiopia) and known as 'white gold' due to its colour, has high demand due to its high quality and the relatively limited area in which it is produced (Soliman and Demisie, 2024).

Sesame is cultivated as a wild crop in Ethiopia. The three main oilseed crops produced in Ethiopia are sesame, soybean, and niger seeds, they account for approximately 20% of the country's total agricultural export profits, second only to coffee (Sirany and Tedele, 2022; Soliman and Demisie, 2024; Girma et al., 2022), with the majority of this share coming from sesame. Sesame is the largest exported oilseed; in 2019, sesame exports from Ethiopia were worth 307 million USD, making it the second-largest agricultural export commodity after coffee. Sesame is primarily an export crop, and only approximately 5% of it is consumed locally (Aysheshm, 2007; Kumera et al., 2020). Sesame accounts for 30% of the total oilseed output in Ethiopia. Ethiopian sesame seed is highly preferred by high-value end markets due to its colour, size, sweet taste, natural aroma and organic production system (Girma et al., 2022); in the international markets, Ethiopian sesame is branded and marketed as "white Humera-Gondar" and "Wollega type'' (Zerihun, 2012). The three main export types (Humera, Gondar, and Wollega) have their own characteristics such as colour, oil content, and taste. The Humera type is appreciated worldwide for its sweet taste and aroma. It has white, large, uniform seeds, and is very suitable for bakery products. The Gondar type is also suitable for the bakery market. In contrast, the Wollega-type has a high oil content and is suitable for the production of edible oil (Abebe, 2016). The white Humera/Gondar type has a higher demand in international markets than the Wollega type and serves as a reference price for Ethiopian sesame in the international market (Girma et al., 2022). Most of Ethiopia's commercial sesame production has historically occurred in its northern and north-western regions, notably in the Welkait, Metema, and Humera *woredas*, close to the borders with Sudan and Eritrea (Sirany and Tedele, 2022). The Amhara regional state accounts for 44% of the national sesame seed output, followed by Tigray (31%) and Oromia (13%) (Soliman and Demisie, 2024); the Benishangul-Gumuz State, Southern Nations, Nationalities, and Peoples (SNNP) region, and Gambela areas account for 9%, 2%, and 1% of the total output, respectively (Sirany and Tedele, 2022). Sesame cultivation in Ethiopia is largely carried out by smallholder farmers (Kostka and Scharrer, 2011); large-scale private investors account for approximately 18% of the country's production (Girma et al., 2022). Sesame production is generally rainfed. Kumera et al. (2020) found that 99% of farmers from the East Wollega and Horro Guduru Wollega zones in the Oromia region grow sesame for sale. Most of Ethiopia's sesame (>98%) is exported raw with little or no processing; cleaning and packaging are the only value additions to keep purity to the international market standards (Sirany and Tedele, 2022; Girma et al., 2022). Most exports go to Israel, China, the United Arab Emirates, and Vietnam (Sirany and Tedele, 2022). Given the commercial value of this crop, men are heavily involved in sesame production; Kumera et al. (2020) found that approximately 94% of sesame farmers from East Wollega and Horro Guduru Wollega zones in the Oromia region are men. They also found that most sesame producers (67.8%) comprised the active age group (18-49 years old). Teklu et al. (2021) found that 97.5% and 92.5% of sesame producers from Gursum and Babile districts, respectively, in the Oromia region were men, while 92.5% and 82.5% of farmers from Melokoza and Basketo districts in the SNNP region were also men. They also observed that 100% of sesame farmers in the SNNP region grew sesame as a sole crop, whereas over 70% of farmers in the Oromia region intercropped sesame with sorghum, maize, and groundnut. Despite the importance of sesame, its productivity in Ethiopia is negatively affected by a lack of access to credit and modern production technologies, lack of access to improved seeds, pests, and diseases, low yields from existing local varieties, low market prices for the produce, and lack of market information, among others (Teklu et al., 2021). These constraints result in low sesame productivity, with most farmers recording less than 600 kg/ha (Girma et al., 2022). Other constraints faced by sesame producers include weather fluctuations and volatility in international sesame prices.

Sesame is one of Sudan's main agricultural exports in the post-oil era. The secession of South Sudan in July 2011 drastically reduced earnings from the petroleum sector. This led to the loss of oil revenue which accounted for over half of government revenues and 95% of exports (Standards and Trade Development Facility (STDF), 2017). The most important oil crops grown in Sudan are sesame, groundnut, and sunflower (Shawgi et al., 2012). Sesame is one of the most exported agricultural commodities in Sudan; between 2011 and 2021, sesame accounted for nearly 30% of agricultural exports (Alhelo et al., 2023). The area planted with sesame increased from 2.16 million hectares in 2013 to over 4.15 million hectares in 2022. Sudan is considered the main global exporter of sesame seeds (Maryoud et al., 2008). Sesame from Sudan is mainly exported

to China, Saudi Arabia, India, Lebanon, and the EU (STDF, 2017). Most of the sesame is produced in southeast Sudan near the borders with South Sudan and Ethiopia, especially in the States of Kordofan North and South (Shawgi et al., 2012; STDF, 2017), in Gedaref, Blue and White Nile, Kassala, Sennar, and Darfuri (World Bank, 2020). Gedaref is considered to be part of Sudan's 'breadbasket'; it is well known for producing premium-quality sesame and contributes 30% of Sudan's production (Soliman and Demissie, 2024). In Sudan, sesame is mainly grown under rain-fed conditions by subsistence, semi-commercial, and commercial farmers. There are two farming systems; semi-mechanized rainfed farming and traditional rainfed farming. Semi-mechanized rainfed farming is practiced by large-scale farmers and companies, with huge investments from the federal government or commercial banks (STDF, 2017). On the other hand, traditional rainfed farming is practiced by family households that grow sesame for income and subsistence. Approximately half of the national sesame production in Sudan is semi-mechanized, while the other half comes from the traditional rain-fed sector (Osman et al., 2022). The production of high-grade white sesame tends to be semi-mechanized, taking place largely on commercial farms leased by well-connected traders and security officials (Gallopin et al., 2021). Sudan exports three recognized sesame grades; white-seeded sesame, brown/red sesame seed, and mixed sesame seed (Sudan Trade Point, 2024). The minimum oil content is 48% for the white seed, 50% for the mixed seed, and 52% for the brown/red seed. However, sesame production in Sudan is constrained by the lack of improved varieties suitable for the local agroecologies, lack of extension services, civil war, conflicts between farmers and livestock keepers over natural resources, scarcity of machinery at the right time to plough the land, and scarcity of labour during the harvesting season (Shawgi et al., 2012).
Sesame is one of the leading commercial crops in Somalia, contributing about 300 million USD (about 5.25% of Somalia's GDP); the crop is mainly grown for export (Abdullahi, 2023). In 2020, Somalia was the 15th largest producer of sesame in Africa, contributing 0.08% of the world's total sesame output. Farmers grow different varieties for both the domestic and international markets. Dunyar is a local sesame variety planted mainly by small-scale farmers for the local processing of sesame oil; for export markets, farmers mainly grow the Humera variety, as it has higher oil content and other characteristics that are preferred in the export market (Bubbolini et al., 2016). Approximately 80% of sesame production in Somalia is carried out in the southern states, especially the Shabelle regions, along the Shabelle and Juba rivers, owing to access to water for irrigation (Bubbolini et al., 2016; Abdullahi, 2023). Under irrigation, sesame is grown as a second crop on residual moisture. Sesame is also produced under rainfed conditions; the crop is planted during the short rainy season (Dayr) (October to December) which is followed by a longer dry season (Jiilaal) during which harvesting and seed drying take place (Abdullahi, 2023). Sesame is mostly produced by small-scale farmers; there is minimal use of machinery and yields are normally less than 1 ton/ha (Abdullahi, 2023). Farmers produce small volumes, they lack market information, and they sell their produce immediately after harvesting to the middlemen/traders (dalaal) (Abdullahi, 2023). Other constraints affecting sesame sector in Somalia are poor road infrastructure, limited access to credit facilities, lack of improved varieties and good quality planting materials and, limited attention from research and policymakers (Abdullahi, 2023).

Tanzania is a major producer of sesame; in 2020, the country produced 0.71 million tonnes, accounting for 16.6% of the total global output (FAOSTAT, 2022). Sesame farming in Tanzania is mostly carried out by smallholder farmers (99.8%) under rainfed conditions, with medium to large sesame producers contributing 0.2% of the national sesame output (Lukurugu et al., 2023). Sesame is a non-traditional cash crop for export in contemporary Tanzania (Lokina et al., 2020). It is predominantly grown as a cash crop and is also the primary oilseed crop for export (National Bureau of Statistics (NBS), 2021; Lukurugu et al., 2023). Sesame exports more than doubled from 71,696 tonnes in 2018 to 167,091 tonnes in 2020 (FAOSTAT, 2022). Most of Tanzanian sesame is exported to Japan, South Korea, Turkey, India, and Vietnam (FAOSTAT 2022; International Trade Centre (ITC), 2020). Most farmers cultivate white-seeded sesame; white seeded varieties are preferred because they are resilient and/or tolerant to adverse weather conditions and can be cultivated with minimal attention (Modor Intelligence, 2020). The main sesame-producing regions in Tanzania are Lindi (20.9%), Songwe (18.3%), Dodoma (17.1%), Ruvuma (10.3%), and Mtwara (8.1%); others are Singida (5.2%), Morogoro (5.1%), Pwani (4.5%), Katavi (2.4%), and Rukwa (1.3%) (NBS, 2021). In Lindi and Mtwara, sesame has grown to become a very popular and high-return cash crop among households, commanding relatively better producer price compared to other f crops such as maize, rice, sorghum, millet, Irish potatoes, and beans (Lokina et al., 2020). The number of smallholder farmers growing sesame has been increasing; farmers have been abandoning the production of other export crops, such as cashew nuts, in favour of sesame (Lokina et al., 2020). However, sesame yields in Tanzania are low at 740 kg/ha compared to a potential of 1.5 ton/ha from use of improved varieties (FAOSTAT, 2022; Tanzania Agricultural Research Institute (TARI), 2022). These low yields could be due to poor agronomic practices, minimal use of improved varieties, minimal use of inputs, and other socioeconomic factors (Lukurugu et al., 2023). Other factors include limited access to credit and extension services and, minimal use of fertilizers; over 90% of sesame farmers in Lindi and Mtwara regions reported not using fertilizer at planting time and as a top dressing (Lukurugu et al., 2023). To mitigate the problem of low yields, more than seven improved sesame cultivars that are more productive and resistant to biotic and abiotic stressors have been developed. They have potential to yield up to 1.5 ton/ha (Lukurugu et al., 2023). A study in the Lindi and Mtwara regions of Tanzania showed that sesame production in the southeastern parts of the country was dominated by men (almost 84.2%), and the majority of growers were married (about 91.6%) (Lukurugu et al., 2023). It is frequently noted that cash and export crops are male crops, while subsistence crops are female crops; men may take over production and marketing, even of traditional women's crops, when it becomes financially lucrative to do so (Whitehead, 2000). The standard explanation is that women are responsible for feeding the family and thus prefer to grow subsistence crops for the household, whereas men are responsible for providing cash income and, thus raise cash and export crops.

In Uganda, sesame is the second most important oilseed crop, after groundnuts (Wacal et al., 2021); the two were traditionally grown as food crops with only excess produce being sold. Sesame is mainly cultivated in the northern and eastern regions of the country (CASA, 2020); the two regions account for 93% of all sesame produced in the country (Vorley et al., 2015; Hudak, 2021). The two regions have a bimodal rainfall pattern; sesame is grown twice a year to coincide with these two rainy seasons, and hence, more output. In the Mbale area of eastern Uganda, sesame is grown mainly for food and not for oil (Vorley et al., 2015). Most sesame is produced in northern Uganda; the crop is grown in almost all households in this region as a food security and nutrition crop and has been nicknamed 'white gold'. Sesame is the principal oilseed crop in the Arua hub in the West Nile sub-region; farmers in the Lira area also produce significant volumes of sesame (Vorley et al., 2015). Sesame was traditionally grown as a food crop in northern Uganda, but for many, it has also turned into a cash crop (Vorley et al., 2015). Sesame is currently grown primarily as a cash crop; over 78% of the total volume of sesame produced by the households is sold. Sesame production has been boosted by the return of peace in northern Uganda and the increased export demand for sesame in international markets. Historically, sesame was regarded as a woman's crop in Uganda; it was grown on marginal lands or kitchen gardens for consumption at the local level. When sesame commercialization began in Uganda, it became a cash crop (Vorley et al., 2015) and men joined in its production. However, women are still heavily involved in sesame production; they are exclusively responsible for planting, weeding, harvesting, drying, threshing/sorting, and marketing of small volumes. Men are responsible for breaking virgin land (land opening) and marketing large volumes of the seeds (CASA, 2020). Sesame is locally consumed in a variety of ways, including being ground into paste, made into stew and consumed with other foods such as the popular smoked meat (CASA, 2020). Sesame seeds are also roasted, mixed with honey and sugar, and then rolled into balls or pellets to be eaten as a snack; at the household level, the most popular use of sesame is either roasted or ground into paste (Munyua et al., 2013). Domestic processing of sesame oil in Uganda is minimal (CASA 2020). Uganda is a net exporter of sesame, although its export volume is negligible compared to the global market size. The three major export outlets are the European markets (Austria, Denmark, Germany, and Switzerland), Middle East (Turkey, Egypt, and the United Arab Emirates), and Far East (Singapore, Japan, and China) (Munyua et al., 2013). Most of Ugandan sesame is exported to the United Arab Emirates and China (Munyua et al., 2013). However, there is low mechanization in sesame production and minimal use of inputs, such as fertilizers, herbicides, quality seeds and improved varieties. Most small-scale farmers source seeds informally; when improved seeds are procured, they are recycled severally before renewal. Access to improved seeds is a challenge because quality-assured seeds are not available in the market. Consequently, the average yield has been less than 200 kg/acre, which is far below the potential (Dalipagic and Elepu, 2014; FAOSTAT, 2018). Other challenges that impede sesame sector growth in Uganda include poor production and post-harvest handling methods, limited research attention, use of poor quality seeds, limited access to improved seeds, use of low-yielding unimproved varieties, pests, and diseases, declining soil fertility, climate change and drought, poorly organized sesame markets, fragmented value chain relationships, and limited access to affordable credit services for agribusiness (CASA, 2020; Wacal et al., 2021; Munyua et al., 2013). Small-scale production of sesame presents challenges in quality control, making it difficult to meet the stringent standards required to access premium markets (Munyua et al., 2013). There has been an introduction of shatter-resistant sesame variety 'Smarter Sesame' by Ag-Ploutos Company, a Ugandan agro-input dealer (Hudak, 2021). In Uganda, sesame breeding is the mandate of the National Semi-Arid Resources Research Institute (NaSARRI) which is responsible for the development of new varieties. The institute has developed new varieties such as Sesim 1, 2, and 3 (Wacal et al., 2021); Sesim 2 is the most popular variety in northern and eastern Uganda (Munyua, 2013). It is white in colour and therefore has a high market demand. It has been reported that all traders prefer white grains when buying sesame. The three traits most frequently considered by traders when selling and buying sesame are grain colour (86%), followed by grain cleanliness (71%) and then percentage of foreign matter (54%) (Munyua et al., 2013).

In Kenya, sesame is produced by small-scale farmers in the marginal agro-ecological zones of western and coastal areas (Ayiecho and Nyabundi 1997). Sesame can grow well in Kwale, Kilifi, and Lamu counties along the coast; Busia, Bungoma, and Kakamega in the western region; and Meru and Mandera in the eastern and northeastern regions, respectively (FarmBiz Africa, 2024). Sesame farming in Kenya has gained momentum because of its adaptability to various climatic conditions and its high cash returns. However, sesame yields in Kenya are low; the average seed yields are 400 kg/ha compared to the potential research yield of 2230 kg/ha (Ayiecho and Ong'injo, 2009). The low sesame yields could be due to low-yielding genotypes, including unimproved land races, use of poor quality seeds, pests and diseases, limited access to credit, and lack of knowledge of good agronomic practices including fertilizer application, among others (Koitilio et al., 2022). Lamu county is a prominent hub for sesame production because of its favourable climate and fertile soils. Most of the local farmers in Lamu county grow brown and black seeded varieties, although efforts have been made to introduce the white variety (Archipelago Farms Kenya, 2023). In Kenya, sesame oil is considered a premium cooking oil that is retained between Ksh. 700–1,000 (Archipelago Farms Kenya, 2023). In the Tana Delta along the Kenyan coast, Nature Kenya has been promoting cultivation of oilseed crops, such as sesame and sunflower, under a climate-smart agriculture initiative (Nature Kenya, 2021). According to local farmers, sesame is more profitable than the staple maize crop. A 90 kg bag of sesame can fetch up to Ksh. 10,000 whereas maize fetches less (Nature Kenya, 2021). A recent study reported that more women (60.8%) were involved in sesame production and processing in western Kenya (Koitilio et al., 2022). In addition, they found that only 3.9% of the farmers in Bungoma and Busia counties had received the right information or knowledge about sesame production; in Busia county, however, 45.1% of the farmers had received training in sesame production. Poor access to information and training remains a challenge for most farmers in developing countries (Aina, 2004). There are two local sesame accessions and one improved cultivar grown in the three counties of western Kenya: the local white, local brown, and Sudan (an improved cultivar introduced by the Adventist Relief Agency (ADRA). Local white was the most common genotype, grown

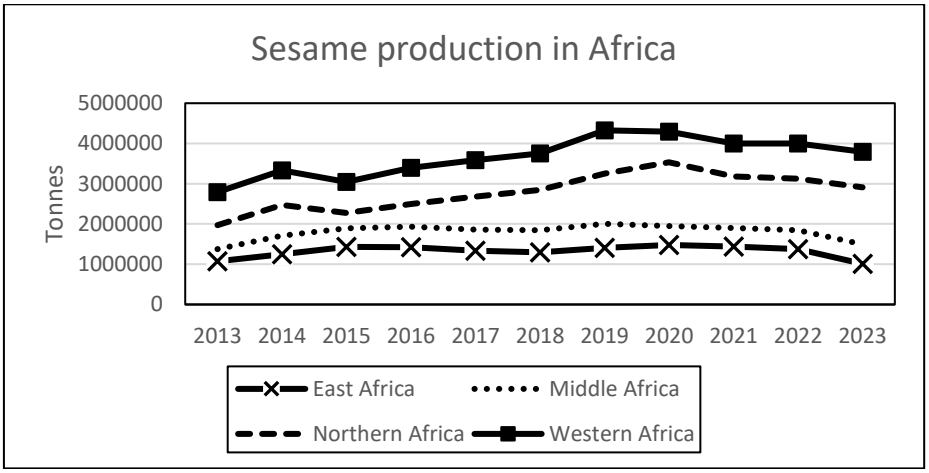

Figure 3. Sesame production in Africa. Source: FAOSTAT, 2024.

Table 1. Major sesame producing countries in Africa.

Rank	2021	Tonnes	2022	Tonnes	2023	Tonnes
1	Sudan	1,119,026	Sudan	1,230,000	Sudan	1367552
2	Tanzania	700,000	Tanzania	700,000	Nigeria	420000
3	Nigeria	440,000	Nigeria	450,000	Tanzania	266994
4	Burkina Faso	270,000	Burkina Faso	208,800	Burkina Faso	247156
5	Chad	196,904	Chad	201,900	Chad	209884
6	Ethiopia	190,000	CAR*	190,900	Ethiopia	200000
7	South Sudan	182,153	Ethiopia	180,000	CAR*	196641
8	Uganda	146,000	South Sudan	179,711	South Sudan	177596
9	Mozambique	125,000	Uganda	138,000	Mozambique	163219
10	Niger	85,062	Mozambique	120,000	Uganda	140000

CAR*=Central African Republic. Source: Statista.com. 2024; Helgilibrary.com. 2024.

by 89.5% of the farmers. The preference for white-seeded sesame genotypes could be attributed to premium prices in the market (Lukurugu et al., 2023). Generally, white-seeded sesame genotypes fetch higher prices in the market than dark-coloured ones (Pandey et al., 2013). This is because of a number of factors, including consumer preference (white sesame seeds are preferred by consumers), culinary utility (white sesame seeds are considered to have greater culinary utility than dark-coloured sesame seeds), and oil content (white sesame seeds are considered to have a higher oil content than dark-coloured sesame seeds). White sesame seeds could also be preferred because of their high quality and oil content compared to pigmented cultivars, as reported in other regions of the world (Hassan, 2012). Studies from eastern India indicated that white-seeded sesame is sold at a price at least 30% higher than that of brown-seeded or black-seeded cultivars because of consumer preference and greater culinary utility (Chakraborty et al., 1984). Koitilio et al. (2022) found that the majority of farmers (66.7%) purchased planting seeds from the local grain market, while 24.8% of the farmers saved part of their produce for planting in the next season; 2.6% of the farmers obtained seeds from commercial seed merchants. It has been observed that the reason for low sesame yields in East Africa is the lack of improved cultivars because most farmers purchase seeds of traditional sesame landraces from local markets (Were et al., 2006). For instance, in Ethiopia it has been shown that farmers have no access to improved sesame cultivars and access to quality seed of available cultivars also appears to be very limited (van der Mheen-Sluijer and Cecchi, 2011). Most sesame farmers in western Kenya (80.4%) plant sesame as a mono-crop. In addition, most of the respondents (81%) do not use any fertilizer at all when growing sesame. Most of the farmers (60.8%) practice row planting; this ranges from 76.5% in Busia to 43.1% in Siaya county. Most respondents (71.2%) produce sesame for both commercial and subsistence purposes (Koitilio et al., 2022). However, only a few farmers grow sesame in Kenya; the crop is grown by small-scale farmers mostly for family consumption, while a small surplus is sold in local markets. Consequently, large-scale edible oil producers and sesame exporters rarely receive sufficient supply from Kenyan farmers. Because of the scarcity of sesame seeds, the commodity is very expensive; for instance, Ardhi Industries in Karen, Nairobi, which presses 150 kilograms of sesame seeds a day buys one kilogram of sesame at KSh. 750–850 (FarmBiz Africa, 2024). Consequently, large-scale food manufacturers in Kenya import most of their sesame from neighbouring Somalia and Ethiopia, as local farmers cannot satisfy the demand. Additionally, sesame exporting companies in Kenya, such as Orgature Sesame Supply Limited, buy sesame seeds from Uganda and then re-export them to South Africa because Kenyan farmers cannot meet their demand (FarmBiz Africa, 2024).

Sesame in Southern Africa

In Zimbabwe, sesame is grown in the dry southeastern parts of the country that are characterized by low and erratic rainfall patterns (Muyambo and Shava, 2021). Here, people grow drought-resistant crops such as sorghum to realize food security, while others grow cash crops such as cotton and sesame and use the money to buy maize, which is their staple food. Sesame

is an indigenous crop that had almost become extinct among the Ndau people of the dry south-eastern Zimbabwe. Traditionally, local women used to intercrop sesame with other crops such as sorghum, millet, rapoko, and maize; sesame was planted on a very small basis for domestic purposes to flavour meals. After becoming almost extinct, sesame was later reintroduced into south-eastern Zimbabwe from the neighbouring Mozambique; most Ndau communities live on both sides of the Zimbabwe-Mozambique border and have relatives in both countries (Konyana, 2017; Muyambo 2019). The resurgence of sesame as a cash crop among the Ndau people of Zimbabwe has seen the involvement of men in its production; sesame is now an all-gender crop, though still grown on a small-scale level. Even youth of both sexes have been lured into farming sesame because of the prospects of obtaining foreign currency, and there has been an increase in demand for agricultural land due to the commercialization of sesame (Sipeyiye and Muyambo, 2021). As a cash crop, sesame is no longer intercropped with other crops but is cultivated on separate plots. Sesame is well-paying, being sold at 10–20 South African Rand (R) for 1 kilogram of seeds; almost 100% of sesame seed buyers come from the neigbouring Mozambique (Muyambo and Shava, 2021; Sipeyiye and Muyambo, 2021). There is little mechanization in sesame production in Zimbabwe; most farm activities are performed manually. Households that own cattle or donkeys use animal-drawn ploughs for land preparation. During planting, sesame seeds are mixed with soil before broadcasting to ensure even spacing of the crop; the seeds are then covered with light soil using a tree branch drawn either by animals or humans to ensure maximum germination rate (Muyambo and Shava, 2021). Women and their children constitute the main part of the manual labour pool. This is because of the ever-rising migration of men to neighbouring countries for greener pastures; consequently, a larger number of women than men live in rural villages (Sipeyiye and Muyambo, 2021). Women undertake all activities including land acquisition, tillage, planting, weeding, harvesting, storing, to selling the crop. Sesame is also grown in the Kaitano area of the Zambezi Valley (Nyamadzawo et al., 2019). The area has fertile alluvial soils and high temperatures that are suitable for sesame production. However, sesame is generally under-researched in Zimbabwe. Sesame farmers lack extension services and support from government agricultural research and development institutions (Muyambo and Shava, 2021). They also lack knowledge of sesame production practices and have limited access to improved varieties and certified seeds; farmers mostly plant their own retained seeds of local varieties (Nyamadzawo et al., 2019). Sesame market systems are poorly developed in Zimbabwe and are characterized by low prices in the country; consequently, most farmers sell their crops in the neighbouring Mozambique (Nyamadzawo et al., 2019).

In Mozambique, sesame has only recently been grown as a cash crop by many farmers; previously, it was produced only on a very small-scale level. The crop is mainly produced by smallholder farmers, primarily in Sofala, Zambezia, Nampula, and Cabo Delgado Provinces. The total production in 2021 was estimated to be 157,000 tonnes, with an average yield of 541 kg/ha (Feed the Future, 2023). In Nampula region, sesame is produced on small farms (often less than one hectare); individual farmers usually produce not more than 100 kg. Sesame producers sell the seeds directly to companies or they sell through associations (Kleijn et al., 2013). Most of the sesame (98%) produced in the country is exported; Mozambique exports most (83%) of its sesame to China (Feed the Future, 2023), other export destinations are Middle Eastern region, Europe, the US, and Japan (Kleijn et al., 2013; Feed the Future, 2023). Sesame is rapidly becoming an important component of Mozambique's agricultural exports (fourth largest by value after tobacco, sugar, and pigeon peas), with an increasing number of exporters committed to the crop (Feed the Future, 2023). However, most of the exported sesame is of low quality, undifferentiated, and unprocessed (raw), and is primarily meant for oil extraction (Feed the Future, 2023). Local consumption of sesame is negligible, local processing is minimal, and the domestic market for sesame oil is limited in Mozambique (Feed the Future, 2023). However, national sesame output has gradually been decreasing in recent times (Nagarwala, 2022). The low productivity is due to factors such as poor infrastructure, high cost of inputs and transport, lack of credit facilities, lac of production knowledge and poor extension services, and lack of government support, among others (Kleijn et al., 2013). Farmers grow local varieties and they plant farm-saved seeds or they purchase seeds of local unimproved varieties. Pesticides and fertilizers are rarely used; consequently, pests are a major threat to sesame production (Kleijn et al., 2013).

Conclusion

Sesame is one of the oldest oil crops. It performs well in warm environments and can withstand hot and dry conditions. It has a high oil content; 50 to 57%, depending on the growing conditions and seed variety. The primary marketable products of sesame are whole seeds, seed oil, and seed cake (meal). Nearly 70% of sesame seeds produced globally are processed into edible oil, while the seedcake left after oil extraction is used as a livestock meal. In Africa, sesame is produced mainly in the dry Sahel regions of West and North Africa, where it is a commercial crop, mainly for export markets. Most of the African sesame is exported to Japan, China, Middle East, Europe and USA. Despite its importance, sesame rarely receives policy and research attention. The crop is mainly grown by small-scale farmers with little input and minimal use of improved varieties and certified seeds.

Data availability statement: No data were generated in this work.
Declaration of funding: There was no sponsorship or funding in preparing this article.
Author contributions statement: The first author conceived the idea and made a reasonable draft. The second author did major editing and organized the manuscript.
Disclosure of interest: There are no interests to declare.

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