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Farming Legumes for Food Security and Agricultural Sustainability in Somalia

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HIGHLIGHTS

- Agriculture is an essential input in human life all over the world.
- Legume production – especially for cowpea is mainly affected by insufficient rainfall, high temperature, drought, insects, diseases and weeds.
- It is of great importance for the government to provide agricultural inputs to local farmers, provide loans and grants, disseminate agricultural information, provide training and provide new ways and techniques for better agriculture, determine the adaptation abilities of different legumes, thereby ensuring food security and agricultural sustainability.

Abstract

This research was carried out in 2023 in a total five different regions of Somalia, including Mogadishu the capital city, along with four other towns: Afgooye, Baydoa, Jowhar and Belet-hawa, to reveal the problems faced by legume growers and to investigate ways to solve them, thus contributing to the security of food and agricultural sustainability. A total of 100 farmers, 20 randomly selected from each city/town, participated in 30 survey questions face to face. As a result of the research conducted in the mentioned regions, it was seen that there are problems in pest and disease control, weed control, fertilizer application and irrigation techniques and water use in legume agriculture. These problems are the main factors affecting the production of legumes. To prevent such problems and mistakes, farmers need to pay extra attention to get better quality and higher yields from their legume production, and sustainability-based studies must be increased to solve such problems, especially for food security.

Keywords: Farmer problems, Legume productions, Rural development, Sustainable agriculture

1. Introduction

Agriculture is an essential input in human life all over the world. It provides all the nutrients, vitamins and minerals that both animals and humans need. It provides proteins that both build and repair the body and carbohydrates that provide energy for the body to healthy life. Agriculture has a crucial impact in

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ensuring the security of food besides promoting economic development in both developing and developed nations (Yurtkuran, 2021). Climate changes pose a persistent and increasing challenge to the sustainability of global food security. The changing of temperature and rainfall patterns have a significant impact on crop yields in numerous growing nations where agricultural production plays a crucial role (Aziz & Peksen, 2020; Ali Warsame & Hassan Abdi, 2023; Doruk Kahraman & Kahraman, 2023). In organic farming - not using mineral fertilizers prevents significant greenhouse gas emissions from fertilizer production and field fertilizer application. This system leads to the formation of organic matter in the soil and the retention of atmospheric carbon. A conclusion can be drawn that organic agriculture has a significant potential to contribute towards the mitigation of climate change (Holka et al., 2022). In this respect, legumes are of great importance due to their symbiotic nitrogen fixation mechanism.

Among the various legumes grown in the world, beans, chickpeas, cowpeas, peanuts, lentils, peas and soybeans are the most preferred legumes worldwide. In terms of production, the highest annual growth rate was observed in soybeans (4.5%), followed by cowpeas (4.1%), lentils (3.5%), peanuts (2.2%), peas (1.8%), followed by beans (1.5%) and chickpeas (1%). In terms of productivity, the highest annual growth rate was observed in peanuts (1.5%), followed by soybeans (1.4%), cowpeas (1.4%), lentils (1.4%), beans (1.1%) and chickpea (0.9%), respectively (Nigam et al., 2021).

Legumes and cereals stand out as excellent sources of high-quality protein due to their significant protein content. The development of protein concentrates and isolates further enhances their versatility, allowing for integration into a wide array of consumer products. Beyond their nutritional value, plant proteins offer distinct health advantages over animal protein sources, including reduced cholesterol levels, reduced risk of cardiovascular diseases, increased satiety, and potential applications in the development of new therapeutics, such as utilizing plant proteins for drug delivery mechanisms (Nosworthy et al., 2023).

Food security is a major issue in Somalia, which mostly caused hunger and scarcity in 2011/2012, 2015/2016 and 2017, normally related to rainfall scarcity (Abdi-Soojeede, 2018). According to official data, the area where legumes are grown in Somalia is large, but the total production amount and unit area yield are very low. Like the other plants, legume production is mainly affected by insufficient rainfall, high temperature, drought, insects, diseases and weeds (Kahraman & Gökmen, 2022; 2023). The combination of these factors prevents farmers from achieving higher yields per unit area. A previous study (The Ministry of Planning, 2021) shows that the area planted with cowpeas in Somalia is large, but the production and yield per unit area is very low. Legume production – especially for cowpeas is mainly affected by insufficient rainfall, high temperatures, drought, insects, diseases and weeds. The combination of these factors prevents farmers from achieving higher yields. The surface area of Somalia is 637657 square kilometers. According to estimates from the World Bank/FAO report, Somalia possesses around 3 million hectares of arable land, with approximately 2.3 million hectares suitable for rain-fed crop cultivation, while the remaining 700,000 hectares, primarily located along the Shabelle and Juba rivers, have the potential for crop production through pumped or controlled irrigation. However, at present, only 110,800 hectares are actively being irrigated (FAO, 2020; Worldbank, 2020). The agricultural sector, constituting about 70% of the gross domestic product from 2013 to 2016, stands as the primary employer for rural households and serves as a crucial contributor to export income (The Ministry of Planning, 2021).

This research was conducted in the provinces between and surrounding Somalia's two largest rivers. The reason for choosing these regions is that farmers in this region mostly grow edible legumes. Within the scope of the research, the main problems and current situation of legume producers were determined and a situation assessment was made to ensure food security and determine the principles of sustainability.

2. Materials and Method

It is known that Somalia imports more legume products than some other countries produce or even export. Somalia's legume exports are very low. Somalia's exports are mainly affected by a combination of factors such as recurrent drought and scarcity, unpredictable rainfall patterns, insecurity, as well as lack of support for farmers. Most farmers in Somalia are small-scale farmers who produce agricultural products

only for domestic consumption, which may not be sufficient to meet the needs and food security of Somalia's growing population. This situation has forced Somalia to import many products from other countries. Therefore, this study was planned to serve to ensure sustainability, especially in healthy human nutrition and food safety.

This research was conducted in 5 different regions of Somalia including Mogadishu the capital city, along with four other towns: Afgooye, Baydoa, Jowhar and Belet-hawa in 2023, a total of 100 farmers, 20 randomly selected from each city/town, answered 30 survey questions. The results obtained from the survey questions were converted into a percentage (%) rate (Kahraman & Onder, 2015; Karimi et al., 2024).

3. Results and Discussion

In this part of the article, the Questions of the survey are abbreviated as "Que" term.

Que 1) In your opinion, what factors affect legume production?

a) Human factor= 7%

b) Biotic factor= 18%

c) Climate factor= 60%

d) Edaphic factor (Soil structure and composition)= 15%

Survey responses indicate that primary challenges encountered by legume growers revolve around biotic factors, including insects, pests, and diseases, as well as adverse climatic conditions like insufficient rainfall and elevated temperatures. The changing climate and environmental warming contribute to a decline in agricultural production (Mohamed & Nageye, 2021).

Que 2) In your opinion, which climate factors affect legume production the most?

a) Rainfall= 33%

b) Temperature= 50%

c) Relative humidity= 2%

d) Wind= 15%

The results show that the main problems faced by legume growers are adverse climatic conditions such as lack of rainfall and high temperatures. A one-degree Celsius rise in temperature results in a 3% reduction in agricultural production (Mohamed & Nageye, 2021).

Que 3) What kind of edible legumes do you grow most?

a) Cowpea= 76%

b) Mung bean= 11%

c) Pea= 7%

d) Soybean= 6%

Based on the research findings, Somalia predominantly cultivates cowpeas and mung beans as the primary legume crops. In the southern regions, rain-fed agriculture is prevalent, particularly in the Juba River and Shabelle basins, with two growth seasons corresponding to the Deyr and Gu rainy seasons. The cultivated crops encompass vegetables, millet, sorghum, corn, peanuts, cowpeas, sesame, mung beans and cassava. These kinds of agricultural products serve dual purposes, catering to both human consumption and animal feed (Boitt et al., 2018).

Que 4) How do you prepare your soil before planting seeds?

a) Shovel by hand = 50%

b) Tractor = 50%

Most farmers in Somalia who do not have a tractor and cannot afford to rent one use the tiring and time-consuming hand hoeing method. Farmers who have the means and power use rental tractors to make their work faster and easier despite constraints such as limited labor force and farm equipment in Somalia, many

farmers continue to rely on traditional methods, such as hand hoeing. Nevertheless, there are instances of exceptions where individuals opt for rented older model tractors with more expensive working hours during initial tillage (Abdi-Soojeede, 2018).

Que 5) When do you sow your seeds?

a) Jilaal season (hot and dry season)= From late December to early March = 7%

b) Gu' season (rainy season)= From late March to early June = 71%

c) Hagaa season (dry, windy and rarely rainy season)= End of June - beginning of September = 7%

d) Deyr season (little rainy season) = From the beginning of September to the end of December = 15%

The "main Gu" rains begin in April and end in June. This is normally followed by the Hagaa season, a period of showers and cloudy skies that usually ends in August. Deyr rains begin in mid-October and end at the end of December. The Jilaal dry season occurs between Deyr and Gu, it is the most severe time of the year with the highest temperatures and almost no rainfall (Madany, 1992). The results obtained from the survey show that the main growing seasons in Somalia are Gu and Deyr seasons. Somalia's agricultural calendar is characterized by two main seasons: crop production during the Gu season, spanning from April to June, and crop cultivation in the Deyr season, which occurs from October to December (Boitt et al., 2018). Besides adaptation for seasons, breeding studies against different stress conditions are of great importance (Doruk Kahraman, 2021; Okumuş et al., 2023).

Que 6) What sowing methods do you use?

a) Sowing in row = 72%

b) Spreading sowing= 28%

Row planting of legumes is recommended as it facilitates crop management practices during hoeing, weeding, fertilizer application and harvesting (Bozoglu et al., 2007; Beshir et al., 2019).

Que 7) What is your sowing density of legumes?

a) Between rows 20-25cm, On row 4-8cm= 2%

b) Between rows 40-50cm, On row 5-10cm= 98%

Cowpeas which are the most grown legumes in the region, are grown as the main crop, the planting norm is recommended with a spacing of 40x20 cm (Nderi, 2020).

Que 8) How to irrigate your plants?

a) Surface irrigation= 21%

b) Bucket use = 22%

c) Canal use= 57%

The primary sources of water loss in and around canals include leakage from canal embankments, openings created by rodents along the canals (mouse holes), and surface runoff. In agricultural lands, water loss occurs through surface evaporation, over-irrigation, and percolation (Omar, 2018).

Que 9) What irrigation methods do you use?

a) Drip irrigation= 65%

b) Surface irrigation= 35%

Drip irrigation systems are extensively employed to enhance the efficient utilization of agricultural water. This technique involves the gradual delivery of water directly to the plant's base, minimizing water loss due to evaporation and reducing the overall quantity of water needed (Kumari & Singh, 2016). Drip irrigation offers the benefit of water conservation, as it minimizes water wastage. Presently, numerous companies have emerged, introducing cost-effective and user-friendly drip irrigation systems to the market (Omar et al., 2022).

Que 10) Do you use certified seeds?

a) Yes= 30%

b) No= 70%

While 70% of the farmers participating in the survey stated that they did not use certified seeds, 30% declared that they used certified seeds. The result obtained from this research is like a study conducted by another study that focused on chickpea cultivation in Sarayönü-Konya region (Kahraman & Onder, 2015).

Que 11) Why you do not use certified seeds?

a) Expensive= 62%

b) Insufficient government support= 27%

c) I have available seeds= 11%

Almost 62% of the farmers who participated in the survey stated that certified seeds were expensive for them. Additionally, 27 of them stated that they could not use certified seeds because there was insufficient government support and 11% of farmers said they had existing seeds.

Que 12) From where do you obtain the seeds?

a) Self-production= 42%

b) Purchase from a seed dealer= 30%

c) Obtained from other farmers= 28%

In Somalia, farmers commonly acquire seeds from local seed traders in villages, particularly after periods of drought. During favorable seasons, the majority either rely on saved seeds or purchase them from relatives (Manyasa & Ismail, 2005).

Que 13) How many kg da^{-1} of seeds do you use?

a) 10 kg and low= 40%

b) 10-12 kg= 29%

c) 12-14 kg= 15%

d) 14-16 kg= 9%

e) 16 kg and more= 7%

The area where legumes are grown in Somalia is quite large, but production and yield per hectare are very low. Legume production is mainly affected by insufficient rainfall, high temperature, drought, insects, diseases and weeds.

Que 14) Do you intercrop?

a) Yes= 85%

b) No= 15%

Most of the surveyed farmers indicated that they practice intercropping to optimize land usage, as it involves cultivating different crops together on the same piece of land. Additionally, different crops grown together in the same field do not compete for the same overall resources, reducing competition between crops. Moreover, applying such a method also helps in increasing efficiency Intercropping offers advantages, including enhanced yield stability and increased productivity per unit area. It also contributes to reduced pest issues and minimizes the reliance on agrochemicals, all while fostering biodiversity (Jensen et al., 2020).

Que 15) What crops do you intercrop with legumes?

a) Cereals= 92%

b) Vegetables= 8%

Most legume farmers in Somalia grow legume crops, often in combination with cowpeas and grains such as sorghum or maize. In small-scale agriculture, the practice of intercropping legumes with cereals emerges as a crucial factor in enhancing farm productivity. This approach contributes to the supply of essential plant nutrients, particularly nitrogen, in the soil. Furthermore, it plays a vital role in improving the physical properties of the soil (Mohamed Abdi, 2020). The intercropping of maize with cowpeas has been documented to enhance light interception, decrease water evaporation, and promote better conservation of soil moisture in comparison to sole cultivation of maize (Ghanbari et al., 2010).

Que 16) Do you practice crop rotation?

a) Yes= 100%

According to the survey, all farmers declared that they implemented crop rotation. The result obtained from this research is like a study conducted by Kahraman and Önder (2015) on chickpea cultivation in Sarayönü-Konya region.

Que 17) Which plants do you rotate with?

a) Cereals= 86%

b) Forage crops= 14%

While 86% of the farmers surveyed said that they planted legumes together with cereals, the remaining 14% of farmers declared that they planted legumes together with forage crops.

Que 18) Do you use organic fertilizer?

a) Yes= 40%

b) No= 60%

Most of the farmers who use organic fertilizer in Somalia make their organic fertilizer through manure obtained from farm animals like cows, chickens, and goats. Additionally, they incorporate green manure sourced from young plants, particularly various types of legumes. In sustainable agriculture, organic fertilizers play a vital role and offer a variety of benefits that contribute to both environmental and agricultural well-being. Organic fertilizers contribute to enhancing soil structure and increasing the capacity of water retention. They promote the growth and development of beneficial microorganisms, thereby improving the soil's capability to retain water and resist erosion. Key benefits of organic fertilizers include the enhancement of soil texture, increased water retention, and improved resistance to erosion (Sharma & Chetani, 2017). Organic fertilizers are mainly cost-effective, and readily available from local materials, in contrast to chemical fertilizers (Solomon Wisdom et al., 2012; Ucar et al., 2021).

Que 19) Do you use fertilizer?

a) Yes= 60%

b) No= 40%

Some of the Somali farmers use both organic and inorganic fertilizers to increase crop yields. Previous reports have indicated that the application of both organic and inorganic fertilizers by farmers leads to increased yields and the preservation of soil fertility (Chukwu et al., 2012).

Fertilizers provide the essential nutrients that plants need. Plants need nitrogen, phosphorus, potassium, calcium, magnesium and other microelements for growth and development. Fertilizers contain essential nutrients required for plant growth, and therefore, they are applied to the soil to enhance its physical, biological, and chemical properties. Fertilizers are also used to increase soil fertility (Sharma & Chetani, 2017). However, improper or excessive application of fertilizers may lead to environmental issues and soil degradation. Hence, it is crucial to employ fertilizers responsibly and in a balanced manner. Inorganic fertilizers, characterized by their high costs, can have adverse environmental effects if not managed properly (Morris, 2007).

Que 20) What type of fertilizers do you use?

a) DAP (18-46)= 86%

b) NPK 20-20-20= 12%

c) NPK 15-15-15= 2%

While 86% of the surveyed farmers declared that they use DAP for legumes, 12% of the farmers chose NPK 20-20-20 fertilizer type for legumes. The remaining 2% of farmers stated that they use NPK 15-15-15 fertilizer type in legume cultivation.

Que 21) How do you control weeds?

a) Chemical using= 42%

b) Mechanic control= 30%

c) Cultural control= 28%

Weeds compete with crops or desirable plants for vital resources, including water, nutrients, sunlight, and space. The rivalry between weeds and cultivated plants for essential resources can result in diminished yields and stunted growth in the cultivated plants. Weeds also cause economic harm not only to farmers but to the entire country. Crop losses because of weeds are estimated to vary between 10-20% and exceed US$ 15 billion annually in the USA alone (Bridges, 1994). Nevertheless, a more recent and likely more precise estimate places the annual cost of non-native weeds to U.S. agriculture at $27 billion (Pimentel et al., 2000).

Que 22) Where do you get agricultural information?

a) Friends= 49%

b) From nowhere= 32%

c) Company= 19%

Due to weakness and fragility, agricultural policies struggle to disseminate important agricultural information, provide early warnings and provide necessary training to farmers. He noted that the most cost-effective factor for enhancing rural agricultural development is ensuring sufficient access to knowledge and information in various fields. This includes new agricultural technologies, early warning systems for events like droughts, pests, and diseases, as well as advancements in seedlings, fertilizers, credit options, and market price information (Balit et al., 1996).

Que 23) A) Do you get agricultural information from official institutions?

a) Yes= 55%

b) No= 45%

Some non-governmental organizations and volunteers support the idea of agricultural extension services, including the provision of farm inputs, access to farm credit, and the provision of education and information to farmers. However, according to the survey results, 45% of the farmers participating in the survey do not receive information and agricultural extension services from government institutions, non-governmental organizations or volunteers. The results are like the survey conducted by another study (Maow & Temizel, 2021).

B) If yes, how many times a year?

a) Once= 50%

b) Twice= 50%

Research confirms that the importance of education will result in the enhancement of farmers' skills in agricultural work. Enhancing farmers' capabilities through training proves more advantageous than offering financial assistance in terms of boosting production and income. (Maow & Temizel, 2021).

Que 24) Can you sell your products easily?

a) Yes= 60%

b) No= 40%

Farmers lack advanced knowledge and skills in agribusiness and marketing, persisting in traditional systems for their livelihoods. Hence, the degradation of the environment and the utilization of resources in agriculture pose a threat to the production of food (Doruk Kahraman & Gökmen, 2021; Ali, 2022).

Que 25) Do you have your silo?

a) Yes= 20%

b) No= 80%

Farmers interviewed about seed storage and seed purchasing reported that the quantity of seeds saved after harvest depends on the area of the land to be planted in the next season. Most farmers in Somalia, especially small-scale farmers, still use traditional seed storage by storing their seeds in sacks, plastic jars,

and clay pots. The seeds are combined with ash and then put into sacks, 200-litre closed barrels, plastic containers, or earthenware containers, based on the number of seeds and the availability of containers (Longley et al., 2001). Traditional seed storage methods have been associated with a decrease in seed quality. Post-harvest crop losses are high due to poor storage structures as well as less knowledge and skills for all farmers (Abdi-Soojeede, 2018).

Que 26) Do you want to continue legume farming?

a) Yes= 100%

According to the survey, farmers stated that they would never give up and continue legume farming despite the difficulties they faced. It has been found that after facing problems such as drought and climate change, lack of government support, insufficient agricultural inputs, lack of certified seeds, farmers still want to continue growing legumes.

Que 27) How much area do you cultivate legumes?

a) 1 hectare and low= 12%

b) 2 hectare= 37%

c) 5 hectare= 25%

d) 10 hectare= 13%

e) More than 10 hectare= 13%

The results show that most of the legume growers manage small plots of land such as 2 hectares, which means that the majority of the legume growers engage in small-scale farming. Most of the subsistence farmers operate on a small scale, mainly in the Southern regions, participating in crop production, typically managing an average land area ranging from 0.2 to 3 hectares (The Ministry of Planning, 2021).

Que 28) How many years have you been growing legumes?

a) 5 years and less= 25%

b) 5-7 years= 30%

c) 10 years= 40%

d) 15 years and more= 5%

Almost 95 percent of the farmers participating in the survey have been growing legumes for periods ranging from 5 to 10 years. Despite facing several challenges, these agricultural practitioners expressed satisfaction with their current farming methods. They stated that they were satisfied with the farming method they chose.

Que 29) Do you own all agricultural tools and equipment?

a) Yes= 45%

b) No= 55%

The research shows that not all farmers have agricultural tools and equipment, so they miss out on important machines such as tractors that would make their work easier less time-consuming and also less laborious because the machines do the work. In addition, most farmers who can afford it use rental tractors for hours during land preparation at high prices.

In Somalia, limitations like a shortage of labor force and farm equipment persist, leading farmers to rely on traditional technologies such as manual hoeing. However, there are situations where people use rented older model tractors with more expensive working hours during initial tillage (Abdi-Soojeede, 2018).

Que 30) What are the important problems you encounter in legume production?

a) Insect and disease infestation,

b) Weed,

c) Drought and climate change,

d) Water stress,

e) Soil degradation,

f) Insufficient farm inputs,

g) Lack of certified seeds,

h) High taxes,

i) Insecurity,

j) Lack of qualified personnel,

k) Poor infrastructures such as roads,

l) Lack of support from the government,

m) Lack of market access.

Farmers continue traditional practices as they struggle to access sufficient technical and support services, due to the lack of strong agricultural planning in the country and the insecurity of rural areas and the lack of control mechanism, most of the farmlands are controlled by terrorist groups. For this reason, agricultural production is low (Abdullahi & Arısoy, 2022).

4. Conclusions

The results of the study show that the main problems faced by legume growers in Somalia are biotic factors like insects, pests, diseases, and adverse climatic conditions like lack of rainfall and high temperatures. It shows that most of the farmers do not use certified seeds, most of them irrigate their crops through canals which wastes a lot of water, and they also control weeds by using chemicals like herbicides. The research also shows that not all farmers have agricultural tools and equipment, so they do not have important facilities such as tractors that would make their work easier and less time-consuming and also less laborious as machines do the work. It shows that most legume growers manage small plots of land such as 2 hectares, which means that most legume growers are small-scale farmers. Additionally, according to the research, the most grown legumes in Somalia are cowpeas and mung beans. It was also concluded that most legume growers use DAP as fertilizer for legumes. According to the survey questions applied, it shows that farmers want to continue growing legume crops despite facing many difficulties. Most farmers stated that they did not receive support from the government and faced difficulties such as high taxes on products and reduced access to markets due to poor infrastructure such as roads.

Based on the results obtained from the survey questions, farmers can be advised to control weeds, pests and diseases through crop rotation. Additionally, implementing appropriate chemicals such as pesticides and herbicides is essential in this regard. Farmers are required to utilize water usage by using irrigation methods such as drip irrigation and also to preserve water by storing it so that it can be used when water is needed or there is a shortage of water and rainfall. Farmers should stop using old methods such as surface irrigation, which wastes water.

Since it shows that most of the legume producers do not use certified seeds, it may be recommended that they use certified seeds to obtain high-quality and high-yield legume products. Finally, it is of great importance for the government to provide agricultural inputs to local farmers, provide loans and grants, disseminate agricultural information, provide training and new ways and techniques for better agriculture, and determine the adaptation abilities of different legumes, thereby ensuring food security and agricultural sustainability.

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