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Review Article

Finger Millet (*Eleusine Coracana* (L.) Gaertn) Production Status, Challenges, and Seed Source in Ethiopia; A Review

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Abstract

Similar to other cereal crops finger millet is being produced in a large volume in Ethiopia, as they are the principal staple food crop. Finger millet is considered as underutilized cereal crop which is commonly grown in the northern, west-northern, and western parts of the country and it is considered as a crop which is important to overcome malnutrition. Regions including Tigray, Amhara, Oromiya, Benishangul-Gumuz, Southern Nation and Nationalities Peoples (SNNP) and Gambela are considered as the potential regions for the production of finger millet in Ethiopia. Relatively, it is considered as drought tolerant as compared to other major cereals such as rice, wheat, and barley. In addition to this finger millet is considered as a highly resilient crop which can grow in different weather conditions, including drought, floods, and marginal soils. In Ethiopia it is commonly grown for the preparation of local foods like 'injera' and porridge and local drink such as 'areki' or 'tella'. About 26 varieties of finger millet are cultivated in main season in the country. In Ethiopia, there are a limited source of cereal crop seeds which includes, farmer's own saved seeds and government seed distributing companies. In this review the status of production, seed source and nutritional importance of finger millet in Ethiopia is presented.

Keywords

Finger Millet, Seed, Nutrition, Production Status

1. Introduction

Finger millet ((*Eleusine coracana* (L.) Gaertn) is one of the most important cereal crops in the semi-arid and tropical regions of the world. It was a domestic crop in western Uganda and the Ethiopian highlands at least 5000 years ago before introduction to India [10]. Its name is derived from the appearance of spikes which appear like human fingers [14]. In the semi-arid tropical and subtropical regions of the world, it is considered the third most produced millet after pearl millet (*Pennisetum glaucum*) and foxtail millet (*Setaria italica*) [3].

After teff, wheat, maize, sorghum, and barley, finger millet is considered as the six major important cereal crops in Ethiopia [11]. Area coverage and production of finger miller is estimated at 4.5 million hectares and 5 million tons respectively worldwide. Ethiopia is considered as the largest producer of finger millet next to India [12] In Ethiopia, finger millet covers about 480,343.25 hectares (table 1) with a national productivity of 2.5 tons/ha [8]

Products derived from finger millet can be utilized in bone mass development in growing children as well as for preventing osteoporosis and other bone ailments in adults and the aging population. Thus, all the nutritional signifi-

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cance of finger millet must be properly translated to nutraceutical development and applied to other staple crops for their possible enrichment [22]. Finger millet is considered an underutilized cereal crop in Ethiopia and is commonly grown in the northern, west-northern, and western parts of the country in the main growing season [3]. It is commonly used for the preparation of local foods like injera and porridge and malting to prepare local drinks such as 'Areki', or 'tella' and non-alcoholic drinks such as 'karibu' and 'shamita' [14]. It covers about 5% of the area allocated for cereal production in the country [14]. However, despite its potential, finger millet production in Ethiopia faces several challenges that hinder its full potential. This paper aims to review the current status of finger millet production in Ethiopia, its importance, highlight the challenges faced, and identify opportunities and future direction for the crop in the country.

2. Current Status of Finger Millet Production in Ethiopia

A study conducted by [32] had reported that finger millet is one of the oldest domesticated cereal crops in Ethiopia, which was cultivated during 4000 BC. Finger millet is commonly grown in Tigray, Amhara, Oromiya, Benishangul-Gumuz, Southern Nation and Nationalities Peoples (SNNP) and Gambela regional states of the country [2, 28] According to the Central Statistical Agency [8] of Ethiopia, finger millet is the third most important cereal crop in the country, after teff and wheat, with an estimated annual production of 1.2 million tons in 2020/2021 (Table 1).

Table 1. *Finger millet area coverage and production in Ethiopia from 2012-2021.*

S.no	year	Crop	Area coverage (hq)	Yield (qt)	Yield (qt / ha)
1	2012	Finger millet	432,561.00	6,518,509.00	15.07
2	2013	Finger millet	431,506.89	7,422,971.46	17.20
3	2014	Finger millet	454,662.33	8,489,564.26	18.67
4	2015	Finger millet	453,909.38	9,153,145.18	20.17
5	2016	Finger millet	465,508.27	9,402,463.39	20.20
6	2017	Finger millet	456,057	10,308,231	10.40
7	2018	Finger millet	446,909	10,356,295	23.17
8	2019	Finger millet	446,909	10,356,295	23.17
9	2020	Finger milet	455,580.47	11,259,578.67	24.71
10	2021	Finger millet	480,343.25	12,030,164.02	25.04

Source; [8]

3. Types of Millet and Their Cultivation

In the developing world, especially in the dry lands of Africa and Asia, millets are considered as a staple food crop. Most of them are indigenous to Africa and latter domesticated to other parts of the world [33]. About 14 species of millets are being cultivated in the world including pearl millet (Pennisetum glaucum (L.) R. Br.), finger millet (Eleusine coracana (L.) Gaertn.), foxtail millet (Setaria italica (L.) P. Beauv), proso millet (Panicum miliaceum L. subsp. miliaceum), kodo millet (Paspalum scrobiculatum L.), barnyard millet (Echinocloa esculenta A. and Echinocloa colona L.), and little millet (Panicum sumatrense Roth. Ex Roem. & Schuit) [31]. In Africa and Asia finger millet is cultivated in more than 25 countries. In its production Ethiopia is considered as the largest producer next to India [24]. Finger millet is relatively drought tolerant as compared to other major cereals such as rice, wheat, and barley. It is an important cereal crop in the semi-arid and tropical regions of the world [14]. During 3000 B. C the wild type finger millet was discovered in Axum, Ethiopia [17]. The cultivated type of this millet *E. coracana subsp.coracana* is domesticated some 5,000 years ago from the wild *E. coracana subsp. Africana* in the highland areas, then it was gradually distributed from Ethiopia to Uganda [33].

4. Importance of Finger Millet

Finger millet is an important crop globally due to its nutritional value and resilience to different environmental conditions. It is a rich source of essential nutrients such as calcium,

iron, phosphorus, and fiber, making it a highly nutritious food option [11]. Additionally, finger millet is gluten-free, making it a suitable alternative for people with celiac disease or gluten intolerance [28]. Also, it has a low glycemic index, making it a suitable food for people with diabetes [5]. These nutritional benefits have made finger millet a popular choice among health-conscious individuals and those looking for alternative sources of nutrition.

Furthermore, finger millet is a highly resilient crop that can grow in a variety of weather conditions, including drought, floods, and marginal soils [32]. This makes it a crucial crop in areas where other crops may fail due to adverse weather conditions. In countries like Africa, where a large population relies on rain-fed agriculture, finger millet is a lifeline during times of food scarcity. Its ability to grow in harsh conditions makes it an important crop for food security and poverty alleviation.

Moreover, finger millet has played a vital role in addressing malnutrition in Ethiopia. The country has been facing high rates of malnutrition, especially among children, due to limited access to nutritious food. Finger millet's high nutritional value and affordability make it an important food for combating malnutrition. In addition, the grain is often used in the production of supplementary foods for malnourished children, providing them with the necessary nutrients for healthy growth and development [33].

Finger millet is primarily used as a food crop in Ethiopia. It is commonly consumed in the form of porridge, bread, and fermented drinks [32]. In addition to its use as a food crop, finger millet has other important uses in Ethiopia. The straw from the crop is used as animal feed, and the crop residue is used as a source of organic matter for soil fertility improvement. [14]; [32]. It is grown extensively in various region of Africa and India as a staple food. In India it ranks six in production after wheat, rice, maize, sorghum and bajra [26].

Finger millet is generally used in the form of whole meal which is used for the preparation of traditional foods like, *roti* (unleavened bread), *mudde* (dumpling) and *ambali (*thin porridge). In Ethiopia, finger millet is commonly grown in the northern, northwestern and western parts of the country in the main rainy season [33]. It is commonly used for the preparation of unleavened bread (locally named as enjera) and for malting to prepare drinks such as *areke*, *tella* and non-alcoholic drinks such as *karibu* and *shameta* while the straw is used for livestock feed [7]. Additionally, it is considered as a food security crop which is especially important for its high nutritive and culture value [4].

5. Nutritional Impact of Finger Millet

Different researches had shown that finger millet has a various health benefit such as reducing diabetes, anemia, and malaria [14, 6, 30]. This health value is due to its high calcium, iron, dietary fiber and being gluten free. The nutritional value (in aspect of proteins, carbohydrates and energy values) of millets are comparable to common cereals such as rice, wheat and barley (table 2). finger millet contains about 7-14% protein [33], 65-75 % carbohydrates and 2.5 - 3.5 % fiber. As it is compared with other cereals millet has the highest (344 mg/100g) mineral content [26], particularly it is a reach source of calcium, phosphorus and iron [33]. Finger millet is a reasonably good source of calcium with up to 350 mg/100 g of Calcium present in the seeds, which is 5–10 times higher than other cereals [29, 23, 21]. In comparison, cow's milk, which is a common source of Calcium for many people, contains an average 112 mg Calcium/100 g milk [31]. Unlike milk, however, the absence of lactose sugar makes it an easily digestible alternate source nutrient for lactose-sensitive patients and weaning babies. Millets contain many different nutrients, and chemicals which are useful for our health when consumed as a part of the diet. Millets are a hidden source of health-promoting phytochemicals, and antioxidants as nutraceuticals as well as a functional food [17].

Table 2. *Nutritional composition of finger millets and some common cereals.*

Cereals	Protein (%)	Fat (%)	Crude fiber (%)	Ash (%)	Carbohydrate (%)
Wheat	13 {1}	1.8 {1}	2.6 {1}	0.5 to 1.5 {1}	64 {1}
Rice	7.3 {2}	2.2 {2}	0.6 to 1 {2}	1.4 {2}	64 {2}
Finger millet	7 {3}	1.3 {3}	3.6 {3}	3 {3}	65 {3}
Teff	8 to 11 {2}	2.5 {2}	4.5 {2}	2.8 {2}	73 {2}
Maize	8 to 11 {2}	4.9 {2}	2.6 {2}	1.4 {2}	72 {2}

Note; NA= data not available. References: [27] {1}, [9] {3}, & [19] {2}.

6. Seed Source of Finger Millet

The availability of quality seeds is crucial for the success of any crop production. In Ethiopia, there are few sources of finger millet seeds, including farmers' saved seeds, and government seed distribution program. However, the quality and quantity of finger millet seeds available from these sources are often inadequate to meet the growing demand for the crop thus, there is a significant dependency on the Ministry of Agriculture, agricultural research centers and from farmer-to-farmer seed exchange [14]. Farmers saved seeds are poor in germination and not free from seed-borne diseases which leads to low yield [20]. There are about 21 released varieties of finger millet in Ethiopia (Table 3).

Table 3. *Lists of released varieties of finger millet in Ethiopia.*

No.	Variety	Year of release
1	Metekili	2020
2	Kumsa	2019
3	Jabi	2019
4	Tekeze-1	2018
5	Diga-2	2018
6	Bako-09	2017
7	meba	2016
8	axum	2016
9	Diga-1	2016
10	Urji	2016
11	Mereb-1	2016
12	Kako-1	2015
13	Addis-01	2015
14	Tessema	2014
15	Gudetu	2014
16	Mecha	2014
17	Necho	2011
18	Debatsi	2010
19	Bareda	2009
20	Gute	2009
21	Wama	2007
22	Baruda	2007
23	Degu	2005
24	Boneya	2005
25	Padet	1998/99
26	Tadesse	1998/99

From those released varieties only five of them are in production [14]. The possible reason for this problem is the lack of farmer's involvement in previous breeding programs. The study conducted by [31] reported that the majority of farmers from northern Ethiopia use self-saved seeds or seeds from the local market. Similarly, [18] reported that in Kenya, the seed source of finger millet was a self-saved seed. To address this issue, the Ethiopian government has been promoting the use of improved finger millet varieties through the National Seed Strategy and Law. The government has also established community-based seed production systems to increase the availability of quality seeds to smallholder farmers. Furthermore, research institutions are conducting research and development activities to develop new and improved finger millet varieties with higher yield potential, disease resistance, and nutritional value.

7. Challenges and Opportunities on Finger Millet Production in Ethiopia

Despite its importance, the production of finger millet in Ethiopia faces several challenges that hinder its potential. One of the major challenge is the low adoption of improved technologies, lack of access to fertilizers and declining soil fertility. Most farmers still rely on local varieties and farming practices, which result in low yields and susceptibility to pests and diseases. Additionally, the lack of access to credit and markets also poses a challenge to small-scale farmers, limiting their ability to invest in inputs and improve their production [1]. In spite of the challenges, there are several opportunities for finger millet production in Ethiopia. One of the main opportunities is the increasing demand for finger millet both locally and internationally. With the growing interest in healthy and nutritious foods, finger millet has gained popularity due to its high nutritional value, including its rich content of iron and calcium. This presents an opportunity for farmers to tap into the market and increase their income.

On the other hand, Limited access to agricultural inputs such as fertilizers, pesticides, and improved seeds is related to limited financial resources and has been widely reported in Africa and, particularly, Ethiopia [25].

8. Conclusion

Finger millet is an important crop in Ethiopia, as a staple food crop. The crop has high nutritional value and is adaptable to diverse agroecologies, which makes it an essential food security crop for smallholder farmers. However, the

availability of quality seeds remains a major challenge, and more efforts are needed to increase the production and distribution of improved finger millet seeds to meet the growing demand. The government, research institutions, and other stakeholders must continue to work together to promote the production and use of finger millet in Ethiopia and this will not only increase the productivity and profitability of finger millet production but also contribute to food security and the economic development of the country.

Abbreviations

CSA Central Statistical Authority

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Author Contributions

Bethlehem Melese: Conceptualization, Methodology, Supervision, Writing – original draft, Writing – review & editing

Werotaw Sisay: Writing – original draft, Writing – review & editing

Hailu Garkebo: Visualization, Writing – review & editing

Conflicts of Interest

The authors declare no conflict of interest.

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