



Research Article



Wheat (*Triticum aestivum* L.) Production in Eritrea: Trends, Challenges and Future Prospects

Tesfamichael Abraha^{1*}, Fathi I. A. Brima¹ and and Bokretsion Habte²

¹Department of Agronomy, Hamelmalo Agricultural College. Po.Box 1224, Keren, Eritrea

²Department of Agricultural Extension, Crop and Animal Production Division, MoA, Asmara

*Corresponding author e-mail: tesfaniglusi65@gmail.com

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ABSTRACT

Wheat is a major staple crop in Eritrea, contributing nearly 60% of the daily calorie intake of the population and playing a crucial role in national food security. A survey of 120 wheat-growing farmers from the South and Central regions was conducted to identify production constraints and opportunities for sustainable wheat cultivation. Data were collected using a semi-structured questionnaire covering socio-economic characteristics, farming systems, seed sources, cultural practices, utilization patterns, and production challenges. Results showed that 65% of farmers were smallholders with farm sizes ranging from 0.5 to 2.0 ha, while 58% cultivated wheat primarily for household consumption. Most farmers practiced hand broadcasting of seed, regular weeding, and crop rotation; however, fertilizer application, irrigation, moisture conservation, and pest management practices were limited. Moisture stress (54.2%) and insect infestations in the field and storage were identified as major causes of low productivity. Marketing constraints also affected wheat production, with 81% of respondents reporting low and unstable market prices as the primary challenge, followed by lack of capital and labor shortages (73.3%). Eritrea possesses valuable wheat landraces with unique traits for tolerance to biotic and abiotic stresses. Harnessing these genetic resources through breeding and introgression into improved varieties could enhance productivity, resilience, and long-term sustainability of wheat production in Eritrea.

Keywords: Eritrea; wheat production; survey; constraint; opportunity; productivity Utilization

INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important industrial and food grain that ranks second among the most important cereal crops in the world after rice and is traded internationally (Asadallah, 2014; Falola et al., 2017). In sub-Saharan African countries, wheat is also a strategic commodity that generates farm income and improves food security status (Amentae et al., 2017; Minot et al., 2015). Many African countries are producing wheat for both home consumption and sale, but the level of production and sale is varied between countries.

Wheat has many uses like that of the other cereal crops produced in the country. In Eritrea, wheat grain is used in the preparation of different traditional as well as modern processed food products such as bread, injera and other industrially processed products like pasta and macaroni (Nigussie et al., 2015). Besides, wheat straw is commonly used as feed for animals. So, wheat is an important cereal crop that should get an emphasis on both its production and its marketing. Wheat provides about 19 percent of the calories and 21 percent of the protein needs of daily human requirements at the global level (Nigussie et al., 2015). The flour of bread wheat is

used to make bread, biscuits, and pastry products and for the production of commercial starch and gluten. In Eritrea, owing to the long tradition of wheat consumption, it has been used solely for bread or in mixture with other cereals (barley, maize, sorghum, rice, and millet) for the preparation of other dishes such as flat bread (injera), porridge, boiled grain (titiko), roasted grain (kolo) and soup.

While more than 80 different countries produce wheat around the world, the majority of global wheat production comes from just a handful of countries, according to data from the Food and Agriculture Organization of the United Nations (FAOSTAT 2022). Wheat is the most important food security crop at the global level with a production of 761 million tons (MT) from about 220 million hectares (Mha) in 2020. Africa produces more than 25.3 million tons of wheat on 10 million hectares. Sub-Sahara Africa (SSA) produced a total of 7.5 MT on a total area of 2.9 million hectares accounting for 35 and 1.0 percent of the wheat production in Africa and at global levels, respectively (FAOSTAT 2022). Bread wheat, which accounts for 95 percent of the wheat production at the global level, is

also the dominant wheat cultivar type produced in sub-Saharan Africa. Based on 2022 FAO yield estimates, the 10 major wheat producing countries include China, India, Russia, USA, France Canada, Germany, Pakistan, Australia and Ukraine.

In Eritrea, the rainfed production system exists dominantly during the rainy seasons i.e between the months June to September. The wheat growing areas in the highlands ranges 2300 to 2400 meter above sea level and in the mid-highlands between 1800 to 2200 in areas across the different regions (zobas). These regions have relatively moderate and variable rainfall across sub regions. The wheat cultivation system in Eritrea is a combination of traditional and modern practices. Most of the smallholder farmers use oxen for ploughing, inputs (quality seed, Farm Yard Manure (FYM) fertilizers, and herbicides), labor for weeding, sickles for harvesting, and animals for threshing followed by winnowing using local tools and labor. The harvested grain is stored for local consumption and the straw is used for animal feed. Surpluses produces are marketed through nearby market outlets. However, the productivity of such a system is usually low and depends primarily on the availability of rainfall. Whenever there is high rainfall, production and productivity also increase.

Mechanized wheat production in Eritrea is implemented through cluster farming on small scale which is a mechanism whereby farmers willingly cluster their farms and adopt the same technological inputs including the use of machinery such as tractors and combine harvesters (MoA, 2022). The approach of cluster farming is increasing in many parts of Eritrea and has contributed to better adoption of mechanization and inputs (seeds, fertilizers, chemicals, etc.) and improving productivity. The major wheat-producing areas in Eritrea include the mid and high lands of zoba Debub, the highland of the central region, and the highlands of Anseba region and some part of Gash Barka (figure 1).

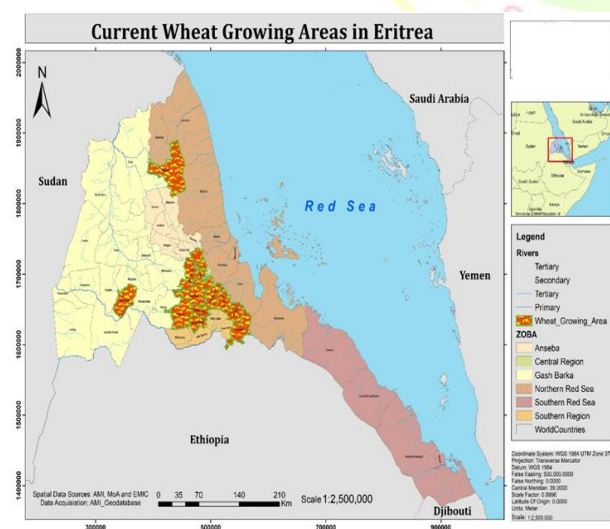


Figure 1. Wheat growing areas of Eritrea; source MoA, 2023

In Eritrea, wheat is mainly produced for household food consumption and as a source of cash. According to MoA statistics of crop production of Eritrea, during the 2012-2022 production seasons the total area and volume of wheat production under medium-to-large commercial farming conditions was fluctuating from year to year depending on moisture and rainfall availability (MoA, 2023). The Central Highlands of Eritrea, zobas Maekel, and South zobas are the main wheat-growing areas. The production data 2012-2022 of MoA indicates that zoba wise, 50.5% of the national average production of wheat comes from zoba Maekel followed by Debub accounts 43.5%, and other zobas 6.0% (figure 2).

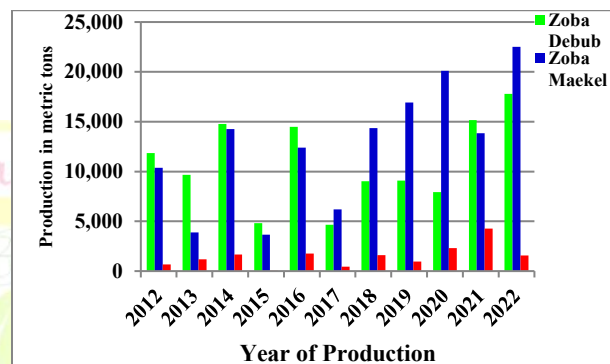


Figure 2. Zoba/ regional distribution of Wheat production (metric tons) in Eritrea (2012-2022)

In general, wheat production in Eritrea is low when compare the regional and international production standards. The low yield of wheat is attributable due to susceptibility to biotic (Wolday and Hodson 2009) and abiotic stresses and lack of modern production technologies such as optimal agronomic managing practices, row planters, and harvesters. Moreover, most Eritrean wheat growing farmers use landrace varieties of the crop that are fundamentally low yielders. The objective of this study was to document wheat production and productivity trends, assess utilization opportunities and constraints and identify farmer- and market-preferred varieties and traits in the major wheat growing areas of Eritrea. The result of the assessment can serve as a guide for large-scale production and breeding programs of wheat in Eritrea.

MATERIALS AND METHODS

Description of the study areas and survey form

The study was conducted in 2023 in two regions of Eritrea, Central (Maekel) region and South (Debub) region with total of 6 sub regions. These includes six villages in three sub zobas of Debub region and six villages in three sub zobas of Maekel region. Ten farmers from each village were selected with the assistance of extension experts on the basis of growing wheat as their major crop. A total of 120 wheat-growing households were randomly selected from these six sub zobas of Debub and Maekel. The sub zobas surveyed in zoba Debub were *Mendefera*, *Emni Haili*, and *Dubarwa* while

in zoba Maekel the sub zobas were *Serjeka*, *Berik*, and *Galaneፋhi*. The number of households that were sampled from each sub zoba and village is indicated in Table 1. A semi-structured questionnaire was used to collect information on socio-economic factors, farming

systems, landraces and improved varieties grown, source of their seed, traits of preference, cultural practices, post-harvest handling, wheat utilization, and major constraints in wheat production and productivity.

Table 1. Number of households sampled in the study areas

Zoba/ Region	Sub zoba/ regions	Sites/ villages	Number of Households	Sub-region total farmers	Total number of participants in FGD
Debub (South region)	Mendefera	Kudofelasi	10	20	10
		Adimengoti	10		
	Emni Haili	Maido	10	20	10
		DirKo	10		
	Dubarwa	Adi Geda	10	20	10
		Tera Emni	10		
Debub subtotal			60	60	30
Maekel (Central region)	Serjeka	Embaderho	10	20	15
		Quazen	10		
	Berik	Kushet	10	20	10
		Adi kuntsi	10		
	Galaneፋhi	Tselot	10	20	10
		Himbrti	10		
Maekel subtotal			60	60	35

Table 2. Social and demographic information of respondent farmers in the study areas by %

Variable	Class	Sub zoba						Mean
		Dubarwa	Mendefera	Emnihaili	Serejeka	Berik	Galaneፋhi	
Gender	Male	75	80	60	80	95	75	77.5
	Female	25	20	40	20	5	25	22.5
Age (years)	20-40	5	30	25	10	35	25	21.7
	41-60	30	35	60	55	45	35	43.3
	>60	65	35	15	35	20	40	35.0

Focused group discussion (FGD)

In the survey, a focused group discussion (FGD) with stakeholders has been organized with 10 -15 participants in each of the selected sub-regions. The participants of the FGD comprised farmers, local village administrators, and elders as well as extension experts. The FGD was conducted using a checklist of a predetermined study guide for quality data collection. The individual household surveys were conducted before the FGDs in all the study areas and villages.

Data Collection, Compilation and Data Analysis

Both primary and secondary data were recorded. Primary data were collected through interviews using a semi-structured questionnaire and focus group discussions. The responses of the selected farmers and FGD were based on wheat farming experience. The data were entered into an Excel spreadsheet, and the gathered information from the above methodologies has been compiled, organized, and cleaned using appropriate data handling methodologies. The data was then summarized in to averages, percentages, and frequencies.

RESULTS AND DISCUSSION

Socio-demographic Description of Respondent Farmers

One hundred twenty smallholder farmers from zoba Debub and Maekel were interviewed individually using semi-structured questionnaires. Of the 120 smallholder farmers interviewed, 77.5% and 22.5% were males and females, respectively (Table 2). Sub zoba Berik had a relatively higher number of male respondents (95.0%), followed by Mendefera and Serejeka each having (80%) while sub zoba Emnihaili had 60.0% male participants. Forty-three percent of the households participated in the survey were between the age of 41 and 60 years. Thirty-five percent were above 60 years of age while twenty-two percent of the participants ranged from 20 to 40 years of age. In general, 65% of the households were between 20-60 years of age indicating that the young and middle-aged adult farmers were highly engaged in wheat production in the study areas.

Wheat cultivation, farm size, and trends of productions

Wheat, Taff, Barley, Finger millet, Faba bean, and chickpea constitute the main crops of the respondents. Wheat is grown by the majority of the farmers in most of the sub-region. Of all the farmers interviewed about 76.7% grow wheat. The highest wheat grown was in sub-region Serejaka followed by Berik and Dubarwa. The lowest wheat grown was in Emnihaili.e, 2.5% (Table 3).

Table 3. Wheat cultivation, farm size, and potential productions (%) (n =120)

Variable	Class	Sub zoba						Total (%)
		Dubarwa	Mendefera	Emnihaili	Serejaka	Berik	Galanefti	
Ranking of wheat cultivation	1 st	15.0	12.5	2.5	16.7	15.8	14.2	76.7
	2 nd	1.7	3.3	8.4	0.0	0.8	2.5	16.7
	3 rd	0.0	0.8	5.8	0.0	0.0	0.0	6.6
Wheat farm size (%)	< 0.5 ha	5.0	1.7	7.5	3.3	1.7	3.3	22.5
	0.5-1 ha	10.8	10.0	8.3	10.8	5.0	10.8	55.8
	1-2 ha	0.8	3.3	0.8	2.5	2.5	0.0	10.0
	> 2 ha	0.0	1.7	0.0	0.0	7.5	2.5	11.7

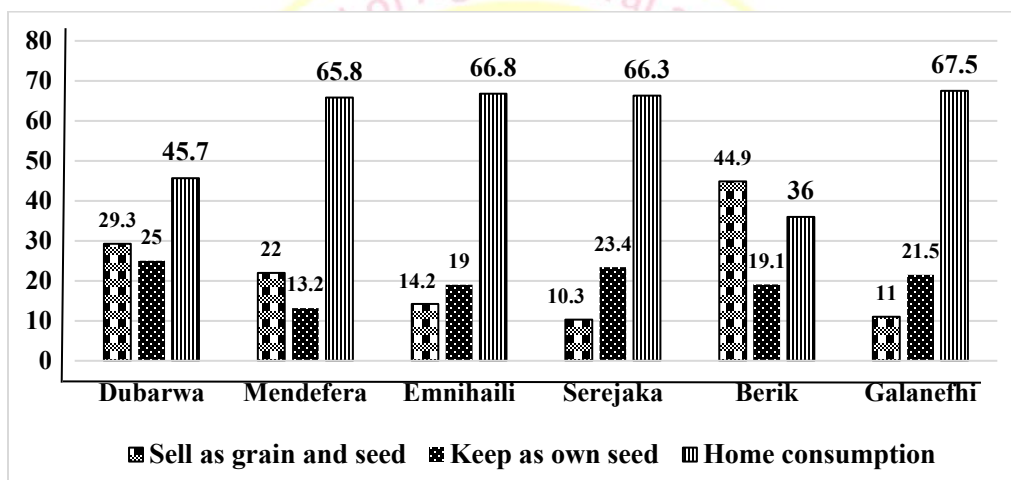


Figure 3. Wheat grain and seed utilization percentage across the surveyed sub-zobas

The productivity of wheat is low and stagnant in Eritrea (<1.2 tons/ha), and when compared to other major wheat-growing regions in sub-Saharan Africa, because of different production constraints. Based on the farmers' focus group discussion, the average yield of wheat in the surveyed sub-zones ranges from 0.55 tons/ha in Galanefti to 1.6 tons/ha in Emnihaili. Most farmers had wheat grain yield ranging from 0.8 to 2.0 tons/ha during favorable environmental conditions and with optimum management practices, which is low compared to the national research potential yield of more than 5.0 tons/ha.

Based on the Ministry of Agriculture field crop strategic plan, which is proposed by the Agricultural Extension Department, in high and medium rainfall areas, wheat production by small-scale farmers is expected to reach 2.4 tons/ha through the soil and water conservation on farmland practice, proper utilization of fertilizers, pesticides and herbicides by the rural community. With the current management practices, the production and productivity status of wheat was low as described by the

Farm sizes were quite variable ranging from 0.4 - 6 ha across the different sub-region. Majority of the farmers interviewed had farms size between 0.5 ha (22.5%) and 2ha (55.8%). On the other 11.7 % have a farm size of more than 2.0 ha for wheat production (Table 3). In general, wheat is produced on an average area of 1.25 hectares, with the largest wheat production area being 4 hectares.

farmers and is therefore clearly indicative that much is remaining to enhance the wheat production in Eritrea. Wheat utilization, cropping system and varieties grown by the farmers

The wheat produced by the interviewed farmers was utilized for different purposes. The interview focused on how they used the wheat grain after harvesting. On average, 58 % of the farmers mainly utilized wheat grain for home consumption. On the other hand, of the total farmers interviewed, 22% of the wheat produced was utilized for selling in the market as grain and seed, and 20.2% of the wheat produced by the farmers retain and preserved as own seed source to grow for the next planting season (Figure 3).

Wheat preferred traits, type of variety grown, storage and post harvest problems

The participant farmers identified local landraces within their farming system with local names: Mana, Felasi, Ruiso, Demhay, Kenya and Tselim Chir'u (Table 4). However, due to the main use and domination of improved varieties and unfavorable environmental

conditions, the local landraces of wheat are on the verge of endangerment. This is especially true in zoba Debub and some parts of zoba Maekel. In the focused group discussion (FGD), most farmers indicated that during adverse environmental conditions such as moisture stress period, the landraces are preferred as they give better yield and insurance to the wheat growing community than improved varieties.

In each cropping season, the household head decides which variety and how much seeds of a given variety was

Table 4. Type of wheat varieties grown in the six sub-zones during the survey time in 2023

Variable	Class	Dubarwa	Mendefera	Emnihaili	Serejaka	Berik	Galaneffh
Wheat varieties grown by farmers	Improved	Quafza Atila Sidra	Atila	Atila Sidra	Sidra Croc Pavon	Sidra	Sidra Crock Pavon Atila
	Landraces	Mana Felasi Ruiso Demhay	Mana Demhay	Felasi Ruiso	Mana Fela Ruiso Kenya	Mana Felas Tselm chir'u Kenya	Mana Felasi Tselim chir'u

Table 5. Farmers' preferred traits of wheat in the six sub zobas (n= 120)

Variable	Class	Sub zoba's in zoba Debub			Sub zoba's in zoba Maekel			Total (%)
		Dubarwa	Mendefera	Emnihail	Serejaka	Berik	Galaneffh	
Farmers preferred traits	Better adapted	6	0	5	6	8	5	25.0
	Early maturity	2	6	6	4	5	10	27.5
	Good utilization	10	10	6	6	6	3	34.2
	Combined traits	2	4	3	4	1	2	13.3
Total		20	20	20	20	20	20	

Farmer-preferred traits for wheat production were selected based on better adaptation, early maturity, and good attribute for utilization. Most of the respondent farmers ranked good for utilization (34.2%) as the most important preferred trait, followed by early maturity (27.5%) and better-adapted cultivar (25%) (Table 5). The ultimate goal of farmers when engaging in crop production is to increase productivity and obtain better income from the market, thereby improving their livelihood. Farmers in the FGD study areas suggested that wheat varieties with high yield, drought tolerance, and insect pest and disease resistance were highly preferred. These varieties avert the risks of crop failure due to abiotic and biotic stresses.

In general, it can be concluded that the majority of farmers use farm-saved seeds to plant for the following season, while those who cannot save enough seed, borrow from neighbors, relatives, or buy from the market. The role of neighbors and relatives in traditional seed systems is not new to Eritrean farmers and involves farmer-to-farmer seed exchange, seed donations, and other transfer methods to meet their required seeds.

Poor postharvest management is another barrier to wheat production. Farmer awareness and technical data information on post-harvest loss are still limited in Eritrea. There was no concrete study on wheat post-

to be planted. In most of the cases, farmers in the study area used their own saved seeds (unless unpredicted factors such as drought acts otherwise) although they may obtain seeds through exchange, gift, or purchase. In the current study, 43.3% of the respondent farmers retained seed from their own produce, while 24.2 % obtained from the market, 16.7 from the Ministry of Agriculture through extension service, and 15.8% from close relatives and neighboring farmers (Figure 4).

harvest loss in the country. However, wheat is subjected to quality losses during storage and farmers responded that storage pests such as weevils (*Sitophilus oryzae*) (51) as major post-harvest problems followed by poor threshing facilities (30) and high grain moisture (23%) at the time of harvesting (Table 6). About 77 of the interviewed farmers store their wheat produce in polythene bags which makes them susceptible to storage pests and followed by *Kofo* (26) store that is locally made from a mixture of clay and cow dung.

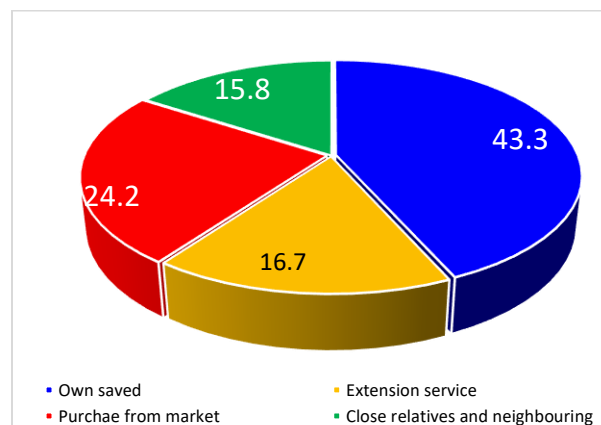


Figure 4. Wheat seed sources of the surveyed households

The same question was forwarded to the focused group discussion in the surveyed sub-zones. They mentioned that the post-harvest problem could have been avoided with different management practices that started before the harvest of the wheat crop. The main argument given by these groups of farmers was that 'seed loss due to post-harvest problems was considered as an indicator of the carelessness of the farmers themselves'. If one could have avoided the main factors that lead to post-harvest loss of wheat, then the loss wouldn't have occurred.

According to the elder farmers, the causes of post-harvest deterioration could be prevented in advance by keeping the wheat grain in optimum moisture content at maturity, care at the time of harvesting not to include immature plants, leaving the harvested spikes at the threshing floor for some days to dry well before threshing, ensuring the storage environment is clean and if the problem of post-harvest encountered then timely care should be taken such as drying and winnowing.

Table 6. Type of storage and post-harvest problems of wheat in the six sub-zones (n= 120)

Variable	Class	Sub zoba's in zoba Dehub			Sub zoba's in zoba Maekel			Total
		Dubarwa	Mendefera	Emnihaili	Serejaka	Berik	Galaneft	
Wheat storage facility	Kofo	11	1	5	1	2	6	26
	Polythene bag	4	16	13	17	16	11	77
	Metal Barrel	5	3	2	2	2	3	17
Total								120
Post-harvest problems	Storage Pests	6	5	14	10	6	10	51
	Poor Threshing	8	8	3	11	0	0	30
	High moisture	2	6	2	5	1	7	23
	Grain Mold	0	0	0	0	0	3	3
	Cost of Transportation and Marketing	3	4	0	2	2	2	13
Total								120

Table 7. Farmers' response management practices (weeding, fertilizer application, inter-cropping, and crop rotation) of wheat (%)

Variable	Class	Sub zoba						%
		Dubarwa	Mendefera	Emnihaili	Serejaka	Berik	Galaneft	
Weeding practice	Yes	100	100	100	100	95	100	99.2
	No	0	0	0	0	5	0	0.8
Fertilizer application	Yes	95	95	100	95	100	95	96.7
	No	5	5	0	5	0	5	3.3
Inter-cropping	Yes	5	0	0	40	15	55	19.2
	No	95	100	100	60	85	45	80.8
Crop rotation	Yes	100	100	100	100	100	95	99.2
	No	0	0	0	0	0	5	0.8

The post-harvest pest management practices used by farmers have been categorized into traditional, mechanical, and physical controls. Farmers have traditionally used plant extracts, neem tree leaves, and dried hot pepper by keeping them inside or around their

store to serve as a source of insecticides. However, there is very little direct evidence that demonstrates these botanical plants used by the farmers are effective and complete grain protectants.

Besides, the majority of the farmers practised traditional mechanical techniques such as sieving, and winnowing combined with sun drying, water traps, and baits that are considered insect control in storage. The addition of dust such as ash is practiced physically by a few farmers that provided a barrier to insect movement and damage the insect cuticle causing death by dehydration. With the potential increase in wheat production, the farmers in collaboration with extension experts advised to consider the use of efficient storage technology, upgrading infrastructure, and better storage facilities in Eritrea.

Farmers' response to the management practices of wheat. Almost all the household farmers reported that they practised weeding, crop rotation and cultural practice (Table 7 and figures 5a and 5b). However, the frequency of weeding practice differs from farmer to farmer and village to village (Figure 5a). Similarly, the rotation cycle basically differs from one sub-region to another based on the crop type and agro-ecology. The general pattern of crop rotation used by the respondent farmers in all sub-regions was cereals after pulses and oil crops or vice versa.

The cropping patterns practised in the surveyed sub-regions included sole cropping and intercropping. 'Fallowing' was not practised in the surveyed sub-regions due to a shortage of farmland. About 80.8%, i.e., 97 farmers, cultivated wheat as a sole crop, and 19.2% (23 farmers) intercropped wheat with other crops. The results indicated that intercropping was not common among the farmers except in sub region Galanefhi (Table 6).

Although most of the survey respondent farmers (96%) apply fertilizer in their wheat fields, commercial fertilizer is very rarely used by the farmers due to high cost and non-availability in the market. However, almost all of the farmers in the different sub-regions applied farm yard manure (FYM) in their fields located near the homestead. Within plant cultivation inside the field (cultural practice) is common exercise among the farmers that helps to minimize weeds and conserve water (figure 5b).

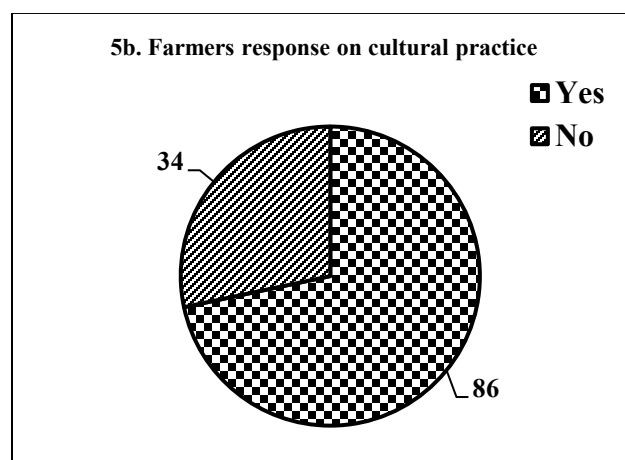
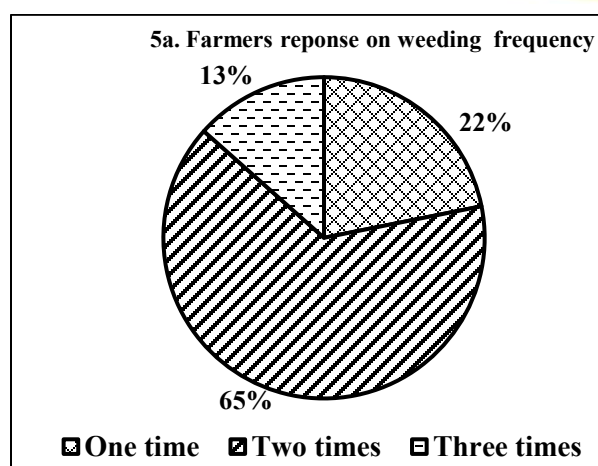


Figure 5. Number of Farmers response to weeding frequencies (5a) and Cultural practices (5b)

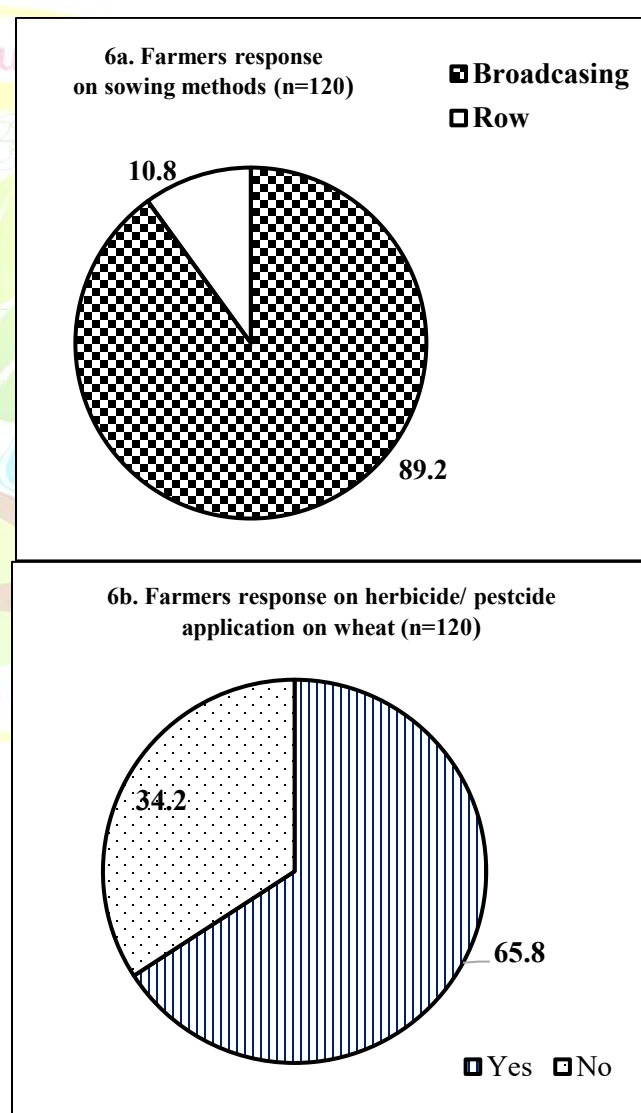


Figure 6. % of Farmers' response on sowing method (6a) and herbicide/ pesticide application (6b)

With regards to sowing methods, majority of farmers (89.2%) were still plant their wheat crops by broadcasting. Only 10.8% of farmers in sub zoba Serejeka, Berik, and Galanefhi plant wheat in row (figure 6a). About 65.8% (79) of farmers responded that they apply herbicide before or at the time of weed infestation (figure 6b). However, most of the farmers indicated that the cost of herbicide is high and the sources are not also reliable.

Soil and water conservation is very common in the Eritrean farmers. Capturing rainwater during the rainy

season was a common practice by the farmers. On average, 70% of the interviewed farmers practice water harvesting by establishing terraces and soil bundings to harvest the available rainfall inside their fields. Besides, they make flood diversions using a plough and hand farm tools to ensure water availability to their fields. Such activities of in situ water conservation increases soil moisture during dry spell period and increase their yields of wheat. All interviewed farmers in sub zoba Berik and Galanefhi have practiced water harvesting systems (Figure 7).

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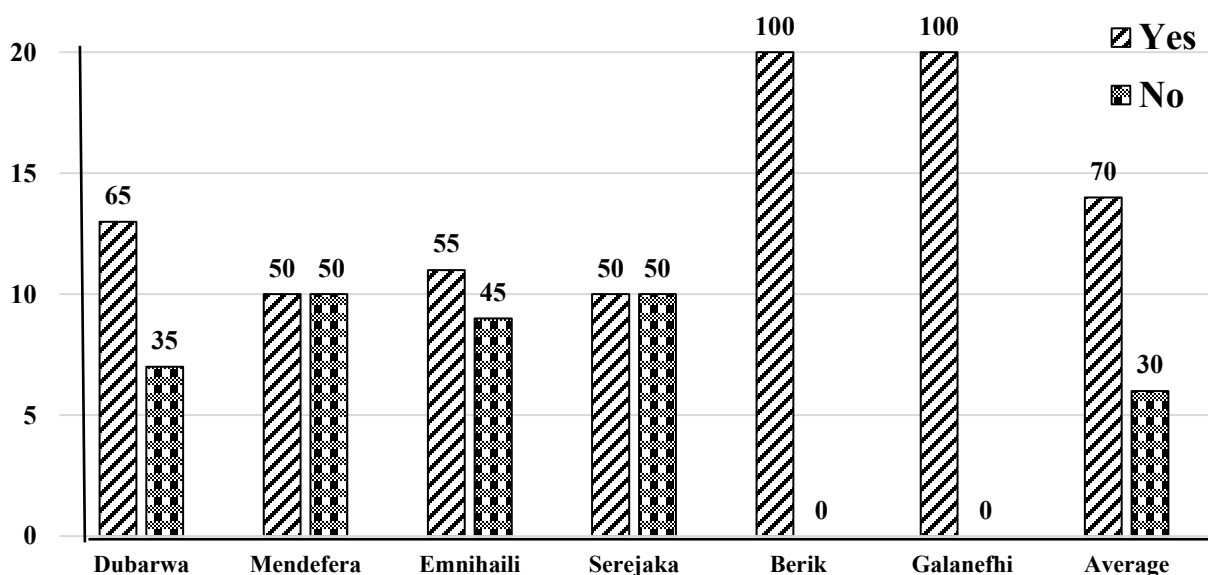


Figure 7. Farmers response on the practice of water harvesting system (%) in each sub-region

Major constraints of wheat production and productivity, and market problems

Wheat production in Eritrea is affected by many factors. This survey study collected extensive information on this issue to identify the farmer's main wheat production limiting factors and their prioritization. In the current surveyed sites, the two major wheat production and productivity constraints cited by the interviewed farmers in wheat production were drought (moisture stress) and the lack of inputs (fertilizer, machinery, and draft Animals). Across all four sub-regions, moisture stress (54.2%) ranked first, followed by lack of inputs (30%) (Table 8). Unpredictable onset and cessation of rainfall in Eritrea affect the production, productivity, and quality of wheat. Drought occurs when rainfall is generally low and its distribution is erratic, which sometimes leads to complete crop failure. The damage of drought on wheat depends on the onset of drought, crop varieties used, and the stage of growth.

Drought affects wheat at different developmental growth stages, such as seedling, vegetative, flowering, and post-flowering. The knowledge of the growth stage of wheat is an important feature to consider when such conditions occur. The results of the current survey indicated that the drought that happened at the post-flowering stage of growth was the most important in influencing farmers' production.

Most of the interviewed farmers are subsistence wheat producers who follow the traditional production system and have small land size. Poor agronomic management, nature of small size landholding and less soil fertility make wheat production to be highly constrained. Based on the current survey finding, these production constraints directly lead to the existence of marketing problems such as the production of low-quality of produce and low selling price at the market due to its low quality that leads to gaining low profit from the sell in the market.

On average, 65.3% of the farmers reported the existence of market and market-related constraints while 34.7% of the respondents indicated that they didn't face market problems (figure 8).

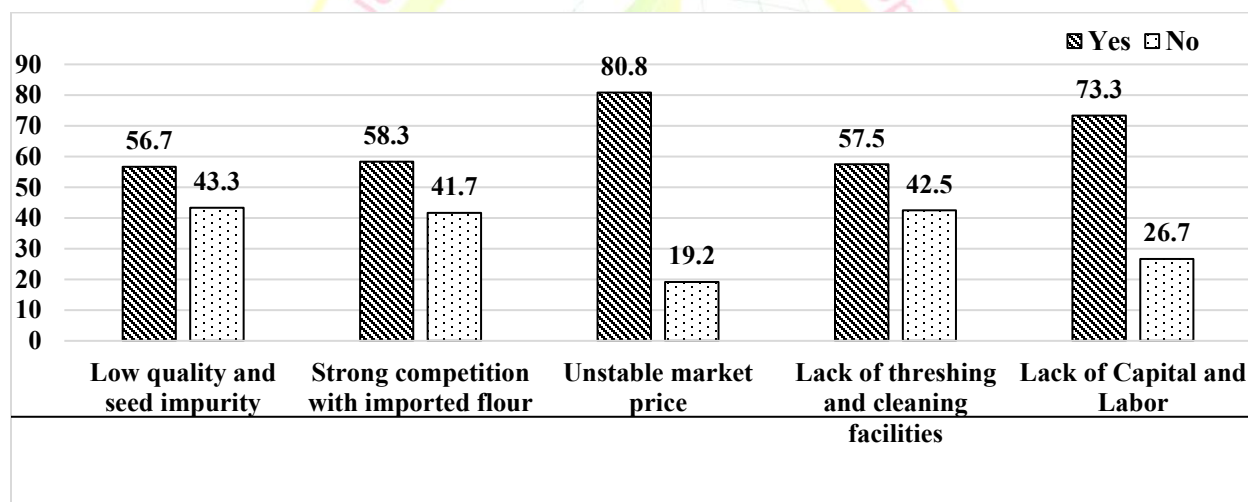
Table 8. Wheat production and productivity constraints (%)

Variable	Class	Sub zoba						Total (%)
		Dubarwa	Mendefera	Emnihail	Serejaka	Berik	Galaneffi	
Major wheat production constraints	Moisture stress (drought)	7.5	6.7	9.2	10.0	8.3	12.5	54.2
	Disease damage	2.5	0.0	0.0	1.7	1.6	0.0	5.8
	Insect Damage	0.8	0.0	4.2	3.3	1.7	0.0	10.0
	Lack of inputs	3.3	6.7	0.0	6.7	5.8	7.5	30.0

Table 9. Farmers' response on wheat market and market-related constraints in each sub zoba (%)

Variable	Class	Sub zoba						Average (%)
		Dubarwa	Mendefera	Emnihaili	Serejaka	Berik	Galaneffi	
Major market constraints of wheat	Low quality and seed impurity	54.2	37.5	0.0	79.2	75.0	37.5	47.2 (5)
	Strong competition with imported flour	58.3	41.7	16.7	62.5	75.0	37.5	48.6 (3)
	Low and unstable market price	66.7	62.5	41.7	83.3	75.0	75.0	67.4 (1)
	Lack of threshing and cleaning facilities	50.0	41.7	4.2	70.8	75.0	45.8	47.9 (4)
	Lack of Capital, Credit and Labor	62.5	25.0	83.3	75.0	37.5	61.1	57.4 (2)

Numbers in brackets are ranking priority on the market and market-related constraints

**Figure 8.** Percentage of farmers' response to market and market related constraints of wheat produce

Eighty-one per cent of the interviewed farmers reported low and unstable market prices as the first major constraint of wheat producers, followed by lack of capital and labour unavailability at 73.3% (Figure 8). Farmers' low purchasing capacity, shortage of required credit, and increasing cost of improved seed result in low adoption of improved varieties.

Seed quality variability, problems of availability and timely delivery of improved seed, and insufficient quantity of delivery were the major problems on the rate of adoption of improved wheat varieties, and thereby, directly affecting the market of wheat in the different studied sub-regions. The wheat market problem also varied from zoba to zoba and sub zoba to sub zobas. This indicates that the market problems are not similar across all the surveyed sites. For example, unlike the other subzobas, the unstable market price was not a major

problem in sub-zoba Emnihaili. Instead, shortage of capital, credit, and labour was the priority problem that contributed to the wheat market situation in this sub zoba (Table 9).

CONCLUSION

Wheat is a strategically important crop for food security in Eritrea, providing a major share of the daily caloric intake of the population. The present survey revealed that wheat production is predominantly carried out by smallholder farmers under rainfed conditions and is constrained by several biophysical, socioeconomic, and institutional factors. Moisture stress resulting from erratic rainfall and terminal drought was identified as the most critical production constraint, followed by limited access to essential agricultural inputs such as fertilizers, pesticides, farm machinery, and draft animals.

Inadequate agronomic practices, poor moisture conservation measures, and insufficient pest management further contribute to low productivity and reduced profitability.

The study also highlighted significant marketing challenges, including low and unstable market prices, labor shortages, lack of capital, poor market information, and weak value-chain linkages. Despite these constraints, Eritrea possesses considerable opportunities for enhancing wheat production through its rich genetic resources, fertile soils, expanding irrigation infrastructure, and favorable agroecological conditions. The conservation and utilization of indigenous wheat landraces offer valuable prospects for developing high-yielding, drought-tolerant, and stress-resistant varieties. To achieve sustainable wheat production, integrated efforts are required, including strengthening breeding programs, promoting improved agronomic and water-management practices, expanding irrigation, improving farmers' access to quality inputs and credit, and developing efficient marketing systems. Such interventions will enhance wheat productivity, improve farmer livelihoods, and contribute significantly to national food security and agricultural sustainability in Eritrea.

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CONFLICT OF INTEREST

The author declares that there is no conflict of interest regarding the publication of this manuscript.

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