



Strengthening Seed Systems in Eritrea



Seed Systems Group, Nairobi, Info@seedssystemsgroup.org,
Tel.: +254 20 525 8042, www.seedssystemsgroup.org



Background and Introduction

Eritrea is a country in East Africa with a land mass of 117,600 sq km and a population of approximately 3.5 million. Agriculture provides employment for approximately 80% of Eritrea's workforce and accounts for 11% of the country's GDP. The most widely grown crops are barley, wheat, sorghum, millet, maize, pulses, and vegetables.

Seed Systems Group is a non-profit, scientific and technical assistance organization dedicated to extending the benefit of higher-yielding, climate-resilient seed to smallholder farmers who lack access to this crucial technology. SSG is headquartered in Nairobi, Kenya.

During the period of October 15-18, 2020, SSG's leadership, represented by Dr. Joseph DeVries (president) and Mr. Paul Tikani (chief operating officer) visited Eritrea at the invitation of the Ministry of Agriculture. During this visit, the SSG team met with the Ministry's leadership, including H.E. the Minister, Mr. Arefaine Berhe, and the Director Generals of the Division of Regulatory Services, Division of Extension, and the Division of Planning and Statistics. The team also travelled to National Agricultural Research Institute's (NARI) headquarters and main research station at Halhale to meet with the head and senior researchers and to tour crop breeding fields and seed production plots.

SSG likewise contracted a leading Eritrean seed systems expert, Dr. Tesfamichael Abraha, to conduct a seed systems feasibility study based on agreed terms of reference. The report from this study, observations made during the visit, and the advice given by the Minister and divisional Director Generals, have permitted the formulation of the current draft strategy for improving seed supply systems, allowing more farmers to gain access to quality seed of the best crop varieties available in the country with good adaptation to Eritrea's diverse agro-ecologies.

While not an exhaustive analysis of all the factors which influence seed supply, it is hoped that the areas of focus and ideas for increasing supplies of seed included herein will serve to catalyze further discussions and recommendations, eventually resulting in the elaboration of a well-rounded strategy which meets the approval of the Government of Eritrea.

SSG would like to express its sincere gratitude to H.E., the Minister and the Directors Generals and other Ministry staff who committed their time to meeting with the team and shared their insights. In particular, the team would like to express their heartfelt gratitude to Mr. Bereket Tsehaye, Director of the Division of Planning and Statistics in the Ministry of Agriculture, who hosted the team and expertly organized the various meetings and discussions.

Crop Profile

Sorghum, millet, barley, and wheat dominate the cropping system in Eritrea. Sorghum and millet occupy 54% of area and account for 45% of crop production (Figure 1). Other key crops are maize,



fava bean, common bean (red kidney), green gram, and cowpea. Seed supply in Eritrea is dominated by the public system, which produces seed of improved varieties released by NARI. Some farmers also use seed imported from neighboring countries. Production of seed by the public system averages approximately 2,000 tons/year. In addition, some quantities of certified seeds are imported. 773

tons of certified potato seeds were imported from the Netherlands in 2009. More

recently, hybrid maize seed has been imported from India, China, and South Africa.

Though the yields of major crops have increased slightly over the last decade, they remain quite low (Figure 2).

However, several improved varieties released by NARI, such as 'White Kona' pearl millet variety and 'Seare' sorghum variety, offer the possibility of much higher yields.

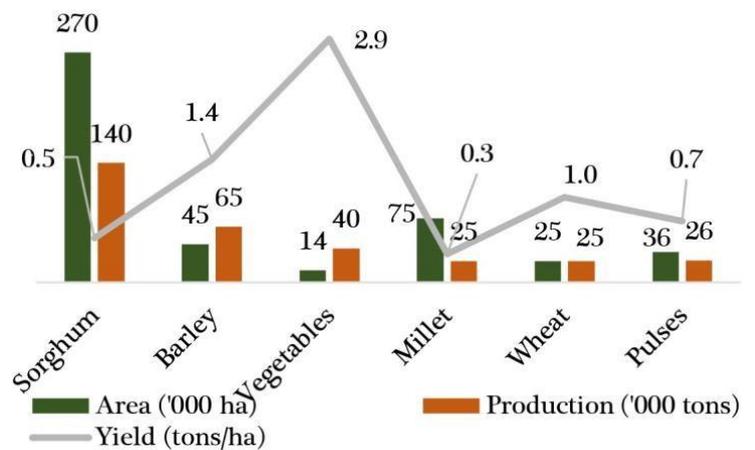


Figure 1: Crop Profile (2017) - Eritrea

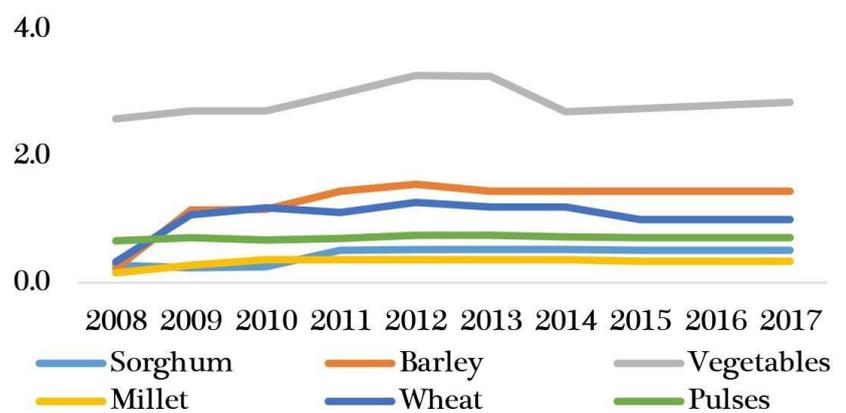


Figure 2: Yield Trends (tons/ha) – Eritrea

Breeding, Variety Development and Release

The public agricultural research system of Eritrea was established in 1992, initially as the Department of Research and Extension, which was then transformed to the Department of Research and Human Resource Development. In 1994, it was re-established as the National Agricultural Research Institute (NARI), with a mandate to conduct basic and adaptive research in the fields of crop improvement, soils, plant protection, agricultural engineering, livestock and forestry, and to carry out in-house training in agriculture. In addition to its headquarters in Halhale, NARI today operates in six regional agro-ecological zones to fulfill the research needs of the country's farmers and pastoralists, with stations in Goluj and Sheib (for lowland crops), and Keren (for sorghum, millet, and fruit trees). Its sub-divisions include those for genetic resources management, crop improvement, soil testing and tissue culture.

At the Halahale research center the infrastructure includes laboratories for general seed testing, soil



science, tissue culture, biotechnology, and the national gene bank. These laboratories have basic equipment to conduct research that can contribute to crop enhancement. The Center also has facilities and laboratories for general agronomy, general seed testing, tissue culture, food science, and biotechnology.

NARI conducts varietal testing and cooperates with extension staff working at the Zoba (regional) and Cluster levels, who multiply certified seed through contracts with commercial farmers.

Foundation seed production is also the responsibility of NARI, which has recently identified three high-yielding and locally-adapted varieties of wheat, millet, barley and sorghum. NARI has released 16 different improved varieties of wheat between 1994 and 2014 through a collaboration between NARI and International Centre for Agricultural Research in the Dry Areas (ICARDA).

NARI is currently working with CIMMYT, ICARDA, ICRISAT, and IITA on variety development and evaluation. As of late 2019, 444 ha of improved wheat and 200 ha of improved pearl millet seed were in production. The next priority crops are sorghum, maize, legumes, and oil crops. In 2011, NARI requested parental lines of maize hybrids from CIMMYT in order to begin producing hybrid seed. This research is still on-going. Several improved varieties of beans developed by NARS in Uganda were likewise tested in 2019.

In 2019 an improved sorghum variety tested in Gash Barka Region produced yields of 3-4 tons per hectare. In a sorghum genetic analysis of Eritrean and ECA countries collection it was found that the Eritrea sorghum collection have unique traits as compared to East and Central Africa sorghum collections (Tesfamicael, et al., 2014). Therefore, there may be an opportunity for sorghum improvement using landrace-based diversification and breeding programs.

The Pearl Millet Improvement Program at NARI has identified five high-yielding pearl millet varieties, including 'Kona', 'Hagaz', 'White Kona', and 'Bristle White Kona', in collaboration with ICRISAT, which are adapted to Eritrea's marginal environments. In some regions of Eritrea, farmers are shifting from sorghum to pearl millet production due to heavy *Striga* infestation in sorghum fields. Pearl millet is resistant to *Striga* infestation in Eritrea.

NARI collaborates with the Division of Agricultural Extension and Ministry of Agriculture personnel at Zoba level to multiply certified seed through contracts with commercial and smallholder farmer seed producers in the form of cluster-based seed production approaches.

In addition to these on-going CGIAR collaborations, effective linkages have been established with regional research networks such as ASARECA and INTSORMIL. With these networks, the Eastern and central African countries conduct breeding programs jointly. Most of these linkages have historically been with neighboring Sudan and Ethiopia, as well as Kenya, Uganda, and Tanzania, which share similar climatic conditions and field crops.



One of the limiting factors for seed supply in Eritrea is the limited availability of information among farmers about new varieties and the best agronomic practices for them. In addition, a lack of current market data for farmers can lead to a low level of awareness about the appropriate varieties to use and the source of supplies of the seed of these varieties. Smallholder farmers in Eritrea have a long history of using their own traditional varieties and tend to be hesitant toward new varieties. However, since 2016 the trend of farmer interest to use improved varieties is increasing through the continuous popularization and promotion by the Ministry of Agriculture. This is being strongly encouraged by the Ministry of Agriculture's approach of multiplying certified seed through contracts with local exemplary farmers in the form of cluster-based seed production.

Hamelmallo Agricultural College (HAC) is the main university involved in agricultural sciences. Established in 2005 under the National Higher Education and Research Institutes, the college currently has six departments: Agronomy, Horticulture, Plant Protection, Animal Science, Veterinary Sciences, Land resources, Environment and Allied Science. All the six departments offer undergraduate programs at degree and diploma level. The departments of Agronomy, Horticulture, Animal Science, and Land resources and Environment also offer post-graduate programs at the M.Sc. level. Along with academic teaching activities, faculty in Plant Science (Agronomy, Plant Protection and Horticulture departments) are also engaged in research programs, including the improvement of crop varieties through breeding.

Table 1: Number of National Staff Involved in Plant Breeding and Their Educational Level in NARI and HAC- Eritrea

Educational Level	Plant Breeding by year						Biotechnology by Year (Molecular Breeding and Tissue Culture)		
	1995	2000	2005	2010	2015	2019	2005	2015	2019
PhD	1	2	3	3	2	2	2	3	4
MSc	2	4	3	2	2	3	-	-	1
BSc	4	6	7	10	12	17	1	2	4
Diploma	3	6	4	2	3	1	1	1	1
Total	10	18	17	17	19	23	4	6	10

Proposed Interventions

Priority crops for the proposed initiative on Strengthening Eritrea's Seed Systems will include barley, wheat, sorghum, millet, legumes, maize, and vegetables. As the work progresses, additional crops can be included as deemed necessary.

- Varieties/hybrids of sorghum, maize, vegetables and rice with competitive yields will be introduced, tested and released as needed through existing procedures established by NARI and the National Variety Release Committee;

^o *Sorghum*: When needed, hybrids and open-pollinated varieties (OPVs) available from ICRISAT and several leading national agricultural research institutes (Mali, Niger) will be



introduced, tested and released

- ° *Pearl millet*: When needed, hybrids and OPVs from ICRISAT, INRAN (Niger) and India will be introduced, tested and released, provided they have adequate downy mildew resistance
 - ° *Maize*: Yellow maize hybrids with early maturity will be sourced from IITA and CIMMYT, together with the parental lines for their formation
 - ° *Beans*: The best performing lines from CIAT, IITA, NARO and other neighboring countries will be advanced for release and multiplication
 - ° *Vegetables*: Improved varieties of brassicas, pepper, onion, tomatoes, and okra will be introduced in collaboration with mid-sized vegetable companies such as East West, Advanta, Technisem, Sakata, and the World Vegetable Center. These hybrids will be tested and validated by NARI prior to commercialization
- Increase NARI's capacity for crop improvement by awarding fellowships to six MS students and two PhD students
 - Support NARI breeders to conduct hybrid and variety development trials

Seed Systems

Seed supply in Eritrea is primarily shouldered by the government and Hamelmalo University. The Ministry of Agriculture and Hamelmalo Agricultural College maintain a seed production and distribution system managed by the Ministry of Agriculture's Extension Department which produces 1,000-2,000 MT per year, mostly by exemplary farmers contracted by the government for this task, who are paid a 25% premium for their seed.

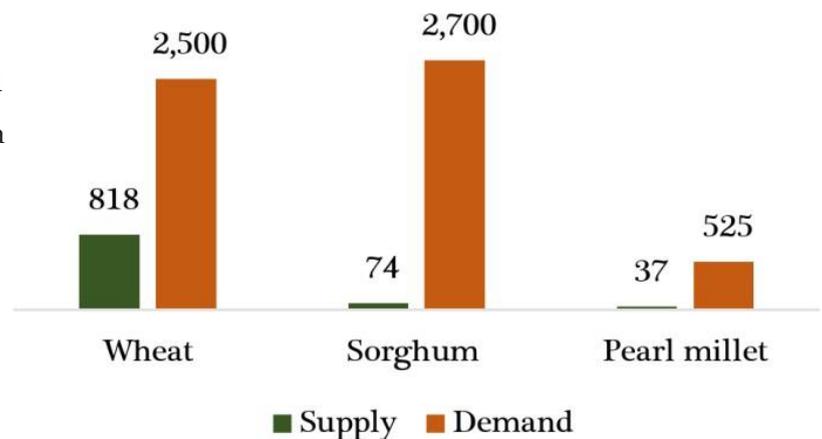


Figure 3: Seed Supply Demand Gap (MT) - Eritrea

This seed is sold to smallholder farmers at subsidized prices via the Extension Department's offices. Linkages between NARI and the Extension Department are very good. Improved, adapted varieties of wheat, millet, and barley have been identified and are in production. Demand for seed of these varieties is high and seed supply is increasing in response to this demand. Eritrea has two seed processing plants, based in Teseney and Dubarwa, which are insufficient to meet the increasing demand from farmers for improved seed. Currently, an estimated 16% (Figure 3) of Eritrea's annual crop seed requirement is met through certified seeds.



Table 2: Quantity of Seed Production and Distribution (Tons)

Year	Wheat	Barley	Sorghum	Pearl millet	Total
2015	7.0	NA	98.1	13.0	118.1
2016	104.7	NA	121.7	17.2	243.6
2017	25.4	NA	98.8	12.4	136.6
2018	110.6	NA	68.6	33.8	213.0
2019	818.9	NA	73.5 *	36.8*	929.2*
Total	1,066.6	NA	460.7	113.2	1640.5

The Extension Department provides expertise in seed production at headquarters level, Zoba (regional) level, sub-Zoba (district) level, and village administration levels. There are limited numbers of private agro-dealers in Eritrea, and tend to be concentrated in the central highlands, the capital city, Asmara, and Tesseney, in Gash Barka. These agro-dealers mainly sell chemicals such as pesticides, herbicides and sprayers. They also sell some vegetable and forage grass seed. Currently there are no agro-dealers focused on sale of seed of field crops.

Seed Policy Advocacy

The Regulatory Services Department (RSD) of the Ministry operates at headquarters level in Asmara and at Zoba level (Table 3) to plan and monitor seed production activities. The RSD also oversees the National Variety Release Committee, which includes members from the Department of Extension, as well as NARI to manage seed production standards at Zoba level. The Committee has been proposed for increased number of representatives in order to improve seed quality in the current context of increasing supply.

In all Zobas, the work of seed certification is done by the regional inspectorate office based on seed certification procedures and guidelines circulated from headquarters in Asmara. All laboratory work for seed certification is conducted in Asmara. Seed certification and quality control are done in accordance with standard procedures and techniques developed by the RSD. The parameters used in checking the seed certification and testing for quality include germination test, moisture content and purity test.

Table 3: Number of Regulatory Services Staff in Seed Certification

Number of staff	Zoba/ region					Total
	Head Quarter (Coordinators and laboratory technicians)	Anseba	Debub (South)	Maekele (Central)	Gash Barka	
MSc	1	-				
BSc	4	1		2	2	11



The RSD has one seed laboratory that helps with seed certification. All the regional inspectorates send seed samples to the seed laboratory for checking before seed is granted certification. A major constraint identified in seed regulatory services is the lack of capacity among younger staff members. M.Sc.-level training is required in plant health and quarantine, seed science technology, agronomy, and plant protection.

Proposed Interventions

- Provide grant funding for leading seed production groups and/or exemplary farmers in order to:
 - Increase the capacity of quality seed production: employ the effective system of contracting exemplary farmers to increase the quality seed production of existing varieties/hybrids and newly introduced ones by 35% of the current levels of production
 - Increase the effectiveness of the Variety Release Committee to allow for broader membership and extend its reach at Zoba level to ensure production of increased quantities of quality seed
 - Begin production of hybrid seeds and capacity development of hybrid seed producers
 - Expand the seed distribution network
 - Strengthen business entrepreneurship skills of 48 personnel through professional training courses over a period of five years
- Strengthen the capacity of exemplary farmers in seed production/processing through specialized training and infrastructure development
- Increase seed processing infrastructure and install additional capacity of 2 tons/day at seed enterprise premises with versatile processing equipment for production of small batches of large and small seeds
- Promote farmer knowledge dissemination towards enabling wider adoption of improved varieties for demos, distribution of small packs, etc.
 - Promotion and introduction of ICT-enabled infrastructure through various stakeholders to accelerate adoption of quality seeds
 - Provide professional training to 1,000 village-based advisors (VBAs) over a period of five years. Trainings will be provided on aspects related to crop management, on-farm demonstrations, and farmer training through deployment of ICT tools
- Engage in dialogue with public sector stakeholders for sensitization on national seed laws and outreach methods to stakeholders, linkages between different actors in the seed value chain, seed standards and regulations refinement and oversight of seed delivery by national players and



harmonization with regional practices

- Provide professional training to 40 seed inspectors on proper seed quality assessment and seed certification aspects
- Facilitate an increase in quality seed production for the key crops to 3,894 tons covering an area of 54% under quality seeds (Figure 4) at the end of five-year period, and 5,448 tons covering 95% area at end of 10 years.

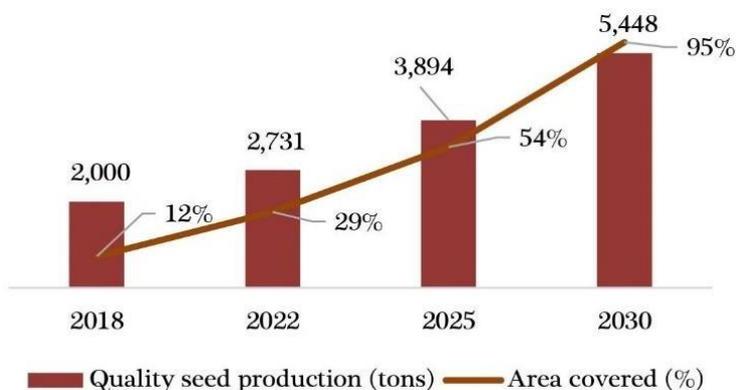


Figure 4: Projected Seed Increases (MT)

Table 4: Proposed Eritrea Budget

Components	Amount (USD million)					
	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Component 1: Crop Variety Improvement						
NARI Varietal Trials	0.15	0.15	0.15	0.15	0.00	0.60
Early generation seed production	0.05	0.05	0.05	0.05	0.00	0.20
MSc fellowships	0.07	0.14	0.00	0.00	0.00	0.21
PhD fellowships	0.15	0.15	0.00	0.00	0.00	0.30
Component 2: Seed Production Systems						
Training and capacity for seed multipliers	0.15	0.15	0.15	0.00	0.00	0.45
Hybrid seed production training	0.13	0.13	0.13	0.00	0.00	0.39
Professional trainings	0.00	0.05	0.05	0.05	0.00	0.15
Component 3: Farmer Seed Access						
Seed distribution and sales	0.10	0.10	0.10	0.10	0.10	0.50
Component 4: Seed Extension						
VBA recruitment, demos, small packs, etc.	0.30	0.30	0.30	0.00	0.00	0.90
Infrastructure and training	0.13	0.00	0.00	0.00	0.00	0.13
Professional training	0.05	0.05	0.05	0.00	0.00	0.15
Component 5: Seed Systems Coordination						
Stakeholder meetings)	0.03	0.03	0.03	0.03	0.00	0.12
Total	1.31	1.31	1.01	0.38	0.10	4.10