Strategy for the Development of Sustainable Seed Supply Systems in Sierra Leone

SEED SYSTEMS GROUP

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Country Snapshot

Population- 8 million

Age group < 15 - 41.8%; 15-65 - 54.5%; > 64 – 3.7%

60.7% Agricultural share to GDP

58% Agricultural employment

1.58 m ha Arable land

Climate Risk index- 15.67

25.6% Undernourished population

Global hunger index- 30.4

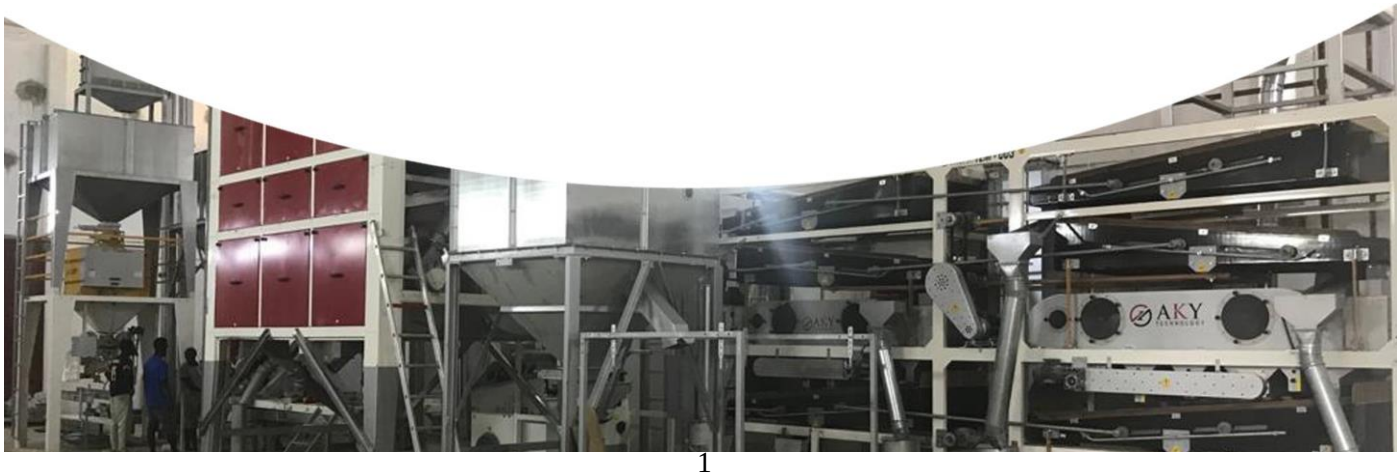
Figure 1: Country Snapshot - Sierra Leone

Nutrition Profile

- Malnutrition in the form of undernutrition remains a significant contributor to infant and- child morbidity and mortality in Sierra Leone
- Micronutrient status remains a major nutritional challenge
- Chronic undernutrition and micronutrient malnutrition remain issues of national concern, while the incidence of overweight, obesity, and NCDs are on the increase

Food insecurity	Nutrition	Dietary diversity	Average per capita Fruits & Vegetable intake
• About 20.2% of population affected by food insecurity • Poverty rate-52.9%	• < 5 stunting-31% • <5 wasting- 5.1% • Anaemia in women of 15-49 yearsage -48%	• 63% of energy source derived from cereals, roots and tubers representing low dietary diversity	• 103.8 and 155.8 g/ day against recommended guidelines 200-250g/day

Figure 2: Nutritional Profile - Sierra Leone



Crop Profile

Rice is the most important staple crop in Sierra Leone with 85% of farmers cultivating rice during the rainy season, followed by cassava (Figure 3). Cassava yields are particularly low given the yield potential of 20-40 tons/ ha of available improved cassava varieties (SLICASS).

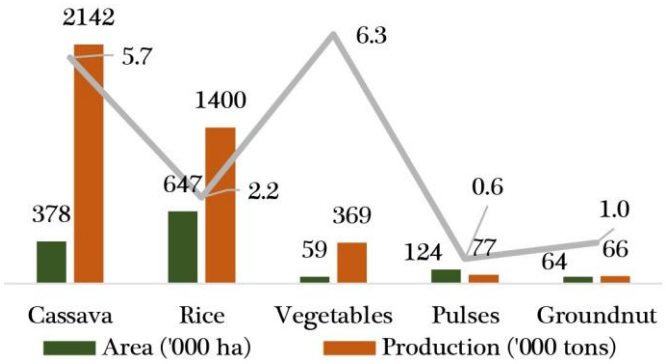


Figure 3: Crop Profile (2017) - Sierra Leone

Low yields on farmer fields can largely be attributed to poor management practices and predominant use of traditional varieties which are susceptible to diseases such as cassava mosaic virus. Other important crops are cowpea, groundnut, maize, and millet. Major vegetables cultivated in Sierra Leone are tomatoes, broad beans and pepper.

The yield for most of the crops cultivated in country has been stagnant in the last decade, with fluctuations in the yield of vegetables and cassava Figure 4. The yield of vegetables is relatively high due to the presence of private players, both regional and domestic, which market better varieties and hybrids of key vegetables in the country.

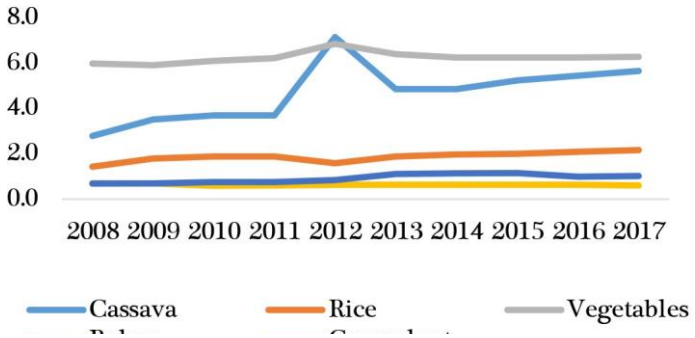


Figure 4: Yield Trends (tons/ha) - Sierra Leone

Policy Advocacy

Sierra Leone Agricultural Research Institute (SLARI) has the mandate to generate technologies and pass it to farmers. It operates seven research stations, each specializing on a different crop category. Current priority crops for farmers are rice, cassava, maize, and groundnut. The institute is working on increasing foundation seed production to avoid imports. The main characteristics sought by farmers in any crop include early maturity, pest and disease resistant, high yield, drought tolerance, and good palatability. The institution does not have a national gene bank in the country, but each center preserves its own genetic resource through maintenance of lines.

Njala Agricultural Research Center has a mandate for research on roots and tubers and grain legumes. The center has 32 personnel with MS- and Ph.D.-level of training. So far, the center has released 14 cassava varieties yielding between 25-40 tons/ha, four soybean varieties released yielding 1.5-1.6 tons/ha, two cowpea (CORAF project) and one groundnut variety. Adoption of released cassava varieties in the country is still a challenge. Rokupr Agricultural Research Center of SLARI has a mandate to carry out research on rice, maize, and sorghum. Rice accounts for 80% of the research with seven breeders working on different ecologies for rice (mangrove, upland, lowland). The center has 28 scientists under different departments, one sorghum breeder, and one maize breeder. Maize lines from IITA, CIMMYT, and ICRISAT are being evaluated. There are no officially released maize or sorghum varieties. Twelve rice varieties were released in 2014 (Rok 5, Rok 10, Rok 34, Rok 35, Rok 36, Nerica 1, Nerica 2, Nerica 3, Nerica 4, then Nerica L19 and Nerica L20 were released in 2015). These are the major varieties farmers are currently using, although most have been mixed. For maize, Western Yellow, developed in the 1970s, is still predominant and is cultivated by about 97% of maize farmers. The main challenge facing the flow of improved seed from the research center to the farmers is the lack of coordination between the ministry (extension directorate) and the research centers. On-station yield of rice is 3-5 tons/ha, for maize 7 tons/ha, and for sorghum 2 tons/ha, but yields obtained by farmers are much less due to poor agronomic practices, lack of pure varieties, and low fertilizer use. The cassava variety “Slica 4” was introduced by the Directorate of Extension in 2014, with a yield potential of 30 tons/ha. The regulatory body requires SLARI to conduct participatory variety selection and multi-locational trials for varieties to be released.

Current breeding efforts in cassava are aimed at developing high yielding and adapted varieties for food, feed, and industrial uses. Efforts are currently made to develop orange-fleshed cassava varieties rich in provitamin A (carotene) and other micro-nutrients (iron and zinc) for biofortification. Trials are ongoing at advanced stages on the development of cassava genotypes for high starch and dry matter.

Breeder seed multiplication of three promising groundnut genotypes was done in the IVS at Bye-Largo, Moyamba District in 2019 during the off season. Breeder seed multiplication of these three improved groundnut genotypes with high yielding, disease and pest tolerant and consumer accept- ability traits were selected by farmers in two locations on the upland (Makeni and Njala) and established in May/June 2019. These genotypes are in the pipeline for release by the Njala Agricultural Research center and include ICGV-IS-09992, ICGV-IS-09802 and ICGVIS-09801.

The main challenges are: lack of sufficient trained personnel, both breeders and other specialties; lack of infrastructure (most buildings are not operational because of lack of equipment); no irrigation facilities; and unreliable electricity.

The development of the breeding program in Sierra Leone started in the 1970s at the Rice Research Station (now Rokupr Agricultural Research Centre) with breeding efforts aimed at developing varieties that are drought tolerant with less shattering and resistant to major abiotic stresses.
The work resulted in the release of five ROK varieties in 1974. In the 1980s and 1990s, RRS developed another series of ROK varieties with various durations, tolerance, or resistance to iron toxicity, salinity, insect pests, and diseases for a large range of farming systems.

There was a gap in rice varietal release until 2014 when the newly established Sierra Leone Seed Certification Agency released new rice varieties tolerant to iron toxicity, salinity, and resistant to important pests and diseases, with yields ranging from 2-2.5mt/ha

Table 1: Released Rice Varieties, 2014-2015

Variety	Pedigree	Developing institution	Year of release	Year of registration	Production ecology	Days to maturity	Potential yield (t/ha)
ROK 34	Pa Kiamp	RARC	2014	2016	Upland	135-140	2.4
ROK35	GIBOB	RARC	2015	2016	IVS	140-150	2.3
ROK36	No. 1 B.P (148)	RARC	2015	2016	Mangrove	125-135	2.3
ROK37	WAR 77-3-2-2	RARC	2015	2016	Mangrove	135-145	3.0-4.0
NERICA 3	WAB 450-I-B-P-28-HB	RARC	2014	2016	Upland	100	2-4
NERICA 4	WAB 450-I-B-P-91-HB	RARC	2014	2016	Upland	100-105	2-4
NERICA 15	WAB 881-10-37-18-3-P3-HB	RARC	2014	2016	Upland	100	2-4
NERICA 16	WAB 881-10-37-18-9-P1-HB	RARC	2014	2016	Upland	105	2-4
NERICA 18	WAB 881-10-37-18-12-P3-HB	RARC	2014	2016	IVS	105	2-3
NERICA19		RARC	2015	2016	IVS	95-100	2-4
NERICA20		RARC	2015	2016	IVS	95-100	2-3.5

Cassava: The shift in research focus towards consumer preferences, particularly cooking quality, in the selection of cassava clones led to the development in 2012 of cassava varieties Slicass 1, 2, 3, 4 and 5. Slicass 6 was later developed and released in 2016. Since then there have been no new releases of cassava varieties due to poor funding of the breeding program and dismantling of the national seed board.

Maize: There have been no improved maize varieties released in Sierra Leone. Western Yellow and DMR are the main varieties grown by farmers. Western Yellow was introduced in the 1970s by the Sierra Leone Produce Marketing Board. DMR is relatively new and was introduced by Institute of Agricultural Research, (now Njala Agricultural Research Centre), in the early 1980s. Western yellow and its derivates are still predominant and is cultivated by about 97% of farmers.

Sweet Potato: Four improved sweet potato varieties (SLIPOT 1-4) with fresh root yield 10 MT/ha have been released by IAR (now NARC) in 2004 and adopted by farmers.

Cowpea: Research in cowpea breeding dates back to the 1980s with introductions from IITA. The first official release of three cowpea varieties was in 2004 through breeding efforts of the breeding team. There was no release until 2014, when another two high yielding and disease resistant varieties Slipea 4 and 5 were released through support from CORAF cowpea project and N2 Africa.

Soybean: No official release of soybean varieties until 2014, when four varieties were released from IITA.

Groundnut-: There is only one groundnut variety (SLINUT 1) developed from JL24 that has been officially released and catalogued in Sierra Leone. Released in 2002, the variety has a potential yield of 2.5 MT/ha. It is early maturing, moderately resistant to early and late spots, and can be grown on upland and lowland ecologies.

Inadequate capacity of public crop breeding institutions has contributed to the low rate of new crop varieties development Table 2.

Table 2: Number of Active Breeders by Crop, 2017

	Public	Private	Total	Satisfaction ratings
Rice	10		10	Fair (44.3%)
Maize	1		1	Extremely poor (15.7%)
Sorghum	1	1	2	Poor (22.9%)
Groundnut	2		2	Extremely poor (18.3%)
Cassava	3		3	Poor (23.9%)
Sweet potato	2		2	Poor (27.8%)
Total	**19**	**1**	**20**	

Proposed Interventions

- Test rice and maize varieties and hybrids sourced through regional research programs with focus on key traits. The aim is to release 20-25 varieties/hybrids of key crops and vegetables in the country over a period of five years. Some of the key sources for these crops include:
  - *Rice*: Improved rice varieties/hybrids will be introduced from major global seed companies and AfricaRice
  - Germplasm (EGS, varieties/hybrids) for *Maize* and *Soybean* will be sourced from IITA, ICRISAT and CIMMYT
  - *Groundnut* varieties willbe sourced from ICRISAT and Ghana
  - *Sorghum* varieties will be sourced from ICRISAT-Niger and Mali
  - *Vegetables*: tomatoes, broad beans and pepper hybrids will be introduced in collaboration

with Global seed companies. These crops can be validated with the help of SLARI and private companies in Sierra Leone for commercialization

- Enhancement of breeding capacity, especially for vegetable crop hybrids, and focus on validation trials, seed multiplication programs and development of human resources will be priorities
- Training of breeders for existing and new crops by awarding fellowships to five MS and two Ph.D. students to be trained by universities in Ghana (WACCI), Nigeria, and Kenya.

Seed Systems

There is a Memorandum of Understanding between the SLARI and a registered seed producer to obtain early-generation seed. Presently, there are no private seed companies producing commercial quantities of early generation seed. Most of it is imported, except by the African Seed Company (formerly Genesis Farm), which produces its own foundation sorghum seed. The ministry is open to having private seed companies in the country and allowing the production of foundation seed.

The government is currently highly involved in seed supply to farmers due to political reasons. This hinders the growth of private seed sector. Certified seed supply is also done by out growers' schemes under the auspices of SMP, RARC, and some seed entities. They provide seed and other production inputs such as fertilizer on loan to contract seed growers. At harvest, the input providers recover seed based on the terms of the contract and buy any excess seed from the producers. The Ministry of Agriculture also provides seeds and other inputs to farmers nationwide for pro- duction of certified seed. At the end of the season, rice seed is recovered for distribution to other farmers. Certified seed producers also sell seed in their communities at farmer-to-farmer level.

The level of adoption of seeds of improved released varieties among smallholder farmers is quite low, because of lack of financial or purchasing power to acquire improved seeds/planting materials without assistance. Also, poor extension services contribute to this phenomenon because of inadequate financial support and lack of logistics. Currently, only about 0.1% (Figure 5) of the seed requirement is met through certified seeds

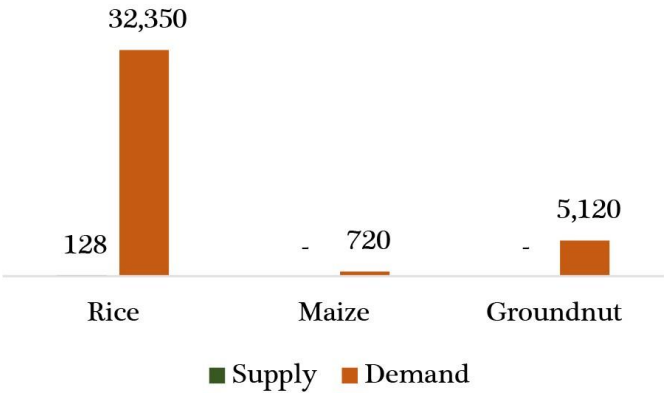


Figure 5: Seed Supply Demand Gap (MT)- Sierra Leone

There is need to strengthen extension service delivery to promote the use of improved seeds to farmers countrywide. The private sector also needs to be aggressive in the production and procurement of improved seed/planting material for farming activities and marketing of products. A promising solution is the dissemination and adoption of high-yielding varieties, such as rice, the main staple crop. The New Rice of Africa (NERICA) varieties have become known as the "miracle crop" to some rice farmers.

NERICAs combine the good genetic qualities and high yields coupled with high resistance to drought and disease. Also, because of its early maturing nature, NERICA can be harvested in the hungry season as it is believed to have great potential in food security for most households.
However, there are also concerns that NERICA requires more labor and must be dried during the rainy season, a major challenge during the first season of its production (May to August). Current estimates suggest that only 2% of farmers in Sierra Leone use NERICAs. Improved varieties cost farmers 40-100% more than traditional varieties, representing a significant barrier to adoption amongst farmers. This is also the case for most cereals, grain legumes, and vegetable crops.

For root and tubers, a study on adoption of improved cassava in southern Sierra Leone has shown that the main source of improved varieties was from extension agents and 88.2% of farmers adopted these varieties. An improved cassava variety, SLICASS 4, is the most widely adopted cassava variety. This may be as a result of its high dry matter content coupled with its mealiness and taste and mostly used for gari and foofoo production. The findings suggest that food quality, disease resistant, early maturing, high yielding and good market prices are reasons why farmers cultivate improved cassava varieties. Major factors influencing adoption of improved cassava varieties include farmers contact with extension provided by MAF and NGOs and close participation in cassava related activities. The major constraints of farmer in cassava production are non-availability of cassava cuttings when needed and inadequate access to credit facility for cassava production

In 2012, the NGO Concern Worldwide purchased and distributed a total of 125 MT of improved rice varieties (ROK 5,10, Nerica and Pa Kiamp), 2,000 bundles of cassava cuttings and potato vines and vegetable seeds and distribute to (at least 50% female) beneficiaries using local supplies, personnel (MAF extension workers), transport, and training (Farmer Field School). MAF sponsored by WAAPP also did some seed importation after the Ebola crisis. A total of 1,200 MT of NERICA rice seeds and 40 MT of maize seeds were distributed to farmers nationwide.

Giang Nam Seed Company (from Vietnam) is testing rice varieties from Vietnam. Seed Tech International is a local seed producer and importer and has been in operation since 2002. The company has installed a modern seed processing, seed treatment, and automatic packing plant at Makeni with a capacity of 5 tons/hour.

Table 3: Number of Private Seed Companies Operating in Sierra Leone

Name of seed company/entity	Crops	Estimated annual supply
Seed Multiplication Programme (SMP)	Rice and Maize	80,000 bushels or 2,000 MT
Seed Tech International	Rice, Maize, Sorghum, Groundnut, Sweet potato and Vegetable	1,000 to 2,000 MT
Debar Group	Field crops, vegetables , local crops	500 MT
Farming First Sierra Leone	Rice, sorghm, field crops, vegetables , local crops	1,000 MT
Genesis Farm	Field crops	0ver 3,000 MT
Mountain Lion		2,000 MT
Best Salone seeds	Rice , Maize and Sweet potato	300 MT
Equipping Ministries International Agric. Development Project	Rice , Sorghum, Groundnut	500 MT
Yeava	Rice, Maize	300-500 MT
Abhajar Rice Development Company	Rice, Maize	Data not available
BRAC	Rice and maize	Data not available
Sakata seed and input company	Vegetables (Cabbage, pepper, tomato, okra, onion, carrot, watermelon, spinach)	500 MT

The company has a seed multiplication farm as well. Maize seeds produced locally, imported vegetable seeds, and other farm inputs are being sold in their own outletsin Freetown. The company deals in certified seed and collaborates with research centers including AfricaRice to get foundation seed. It is also an accredited dealer of Becker Brothers from Holland for sale of vegetable seed. The farm is also doing trials on maize seed obtained from IITA-Nigeria to test its performance and produce it for making poultry food.

African Seed Company was started in 2018 and produces certified seed mainly for sorghum and soybean. The seed company supplies certified seeds to breweries. The seed company is currently not involved in direct seed marketing.

Village of Hope farmer group in Majori village is farmer group where members participate in pro- duction of rice and cassava seed. It has three different groups organized into cooperatives and has different activities. These farmers use their own recycled seed and other method of accessing seed is through farmer exchange. They are growing 'RoK 34' rice variety and 'Slica 4' cassava variety.

There are few existing seed companies in the seed business in part because the government regularly distributes free seed to farmers. In 2017, the government imported 750 tons of rice seed from Nigeria. Most farmers use recycled seed because of high cost of imported seed. Currently, there is one seed testing laboratory in the national research center which was commissioned in 2013 and does basic seed testing.

The SMP has two major processing machines in Makeni and Kobia and a warehouse of about 2,000 MT. Seed Tech also has a modern processing plant in Makeni and a warehouse of similar tonnage.

There are 43 documented agro-dealers servicing 732,461 households. The ratio of agro-dealer to agricultural households is 1: 17,033.

There are fifteen extension organizations operating in Sierra Leone. Three of them are public institutions, namely: Ministry of Agriculture and Ministry of Internal Affairs, Local Government & Rural Affairs and Njala University. There are several non-governmental organizations including: Grassroots Gender Empowerment Movement, Destiny Agricultural Development Association, Community Mobilization of Poverty Alleviation Services, and CREDO Community Research and Development Organization.
There are an estimated 684 agricultural extension workers in the country, 25% of which are female. Most of the extension agents are employed by the government. The estimated ratio of extension agents to farmers is 1:1,000. This is inadequate to meet the services required by farming communities. In order to promote the adoption of improved seed variety and good agricultural practices generated over the years, it is imperative for the government to invest on the quantity and quality of the extension system in the country. Lack of logistics and funding to carry out work effectively are some of the causes of non-service delivery by extension workers in the country. According to seed cooperatives interviewed in the current TASAI study, 111 extension workers are employed by the private sector and 18% are female. Overall, there are 795 extension workers and 24% are female Table 4.

Table 4: Extension Workers Disaggregated by Gender

Indicator	Male	Female	Total
Government extension workers	513	171	**684**
Seed companies' extension workers	91	20	**111**
TOTAL public and private	**604**	**191**	**795**

The government of Sierra Leone recognized the importance of quality seeds by finalizing the Sierra Leone Seed Certification Agency Act 2017. It aimed to regulate transactions in seeds by including institutional frameworks for the testing and certification of seeds. It also provided guidelines for the introduction of new varieties as well as importation and exportation of seeds, strengthening the capacity of breeders through training (WAAPP) and SLeSCA – VRC to facilitate release of varieties, and providing loans to FBOs involved in seed production through community banks and micro-credits. The government is investing heavily in the agricultural sector by improving transport infrastructure to ease the movement of goods, encouraging and supporting private sector investment, as well as lending support to farmers.

Although the agricultural sector is dominated by smallholder farmers in subsistence farming using traditional methods and limited use of farming inputs, there is growing interest in commercialization with several large farms owned both by the government and private interests being developed.

Linking formal and farmers' seed systems and improving the latter may in many cases be a more effective strategy to improve national and local seed supply than aiming only at improving the infrastructure and investment climate for the formal (private and public) seed sector.

There is a growing dearth of breeder and foundation seed supply from research, SMP and universities. The Research and Seed Multiplication program of MAF should be funded adequately and supported to produce breeder and foundation seeds. Universities like Njala University should also be empowered to conduct crop improvement or breeding activities and seed multiplication.

The government is striving to liberalize seed trade. It is therefore expedient to fast track its transformation of SMP to a private enterprise to spur competition with other private seed companies. Private seed companies should be supported with loans from commercial banks and other institution with lower interest rates. These enterprises have the potential to become more important in the future due of proximity to farmers and ability to meet location-specific needs, especially in terms of adapted varieties and reduced transportation costs for seeds. There is massive potential to be tapped both in the informal and formal sectors if capacities are strengthened. Nevertheless, the establishment of SLeSCA for quality assurances has gone a long way towards sanitizing the entire seed sector in the country.

Inefficient seed production, distribution, and quality assurance systems as well as bottlenecks caused by lack of good seed policy on key issues such as access to credit for inputs are major

factors that need to be tackled if farmers are to benefit from quality improved crop varieties produced in the country.

There is need for the development of a sustainable seed system will ensure that high-quality seeds of a wide range of varieties and crops are produced and fully available in time and affordable to farmers and other stakeholders.

A public-private seed delivery system is a priority area that is consistent with the development objectives of the government of Sierra Leone to substantially increase food production and farmer income, which in the long run would contribute to poverty reduction and enhance food security.

Proposed Interventions

- Provide seed grant funding to four seed companies like Seed Tech International, Africa Seed Company for early generation-seed and seed multiplication, and Village of Hope farmer group in Majori village for seed multiplication:
    - Strengthen business entrepreneurship skills of 64 personnel through professional training courses over a period of five years.
- Support to SLARI for hastening the breeding cycle and EGS seed production through infra-structure development
- Strengthening of seed processing infrastructure with upgrading the existing two processing centers and installation of additional capacity of 3-4 tons/day in the country at private sector premises
- Agro-dealer development
    - Provide matching grants to 500 agro-dealers in Sierra Leone to open new outlets, refurbish or relocate shops, procure inventory supplies, and build cost effective storage units.
    - Capacity building of the agro-dealers on aspects related to storage, quality control and safe handling of products, and how to better manage micro enterprises through courses on bookkeeping, cash management, inventory management, quality standards, customer relations and compliance. All 500 agro-dealers will be trained on these modules over a period of 5 years
- Extension and knowledge dissemination
    - Enabling wider adoption of improved varieties through grants to NGOs for demos, small packs, etc.

- Promotion and introduction of ICT enabled infrastructure through various stakeholders to accelerate adoption of quality seeds
- Professional trainings will be provided to over 125 extension professionals over a period of five years. Trainings will be provided on aspects related to farm demonstrations, farmer training through deployment of ICT tools

- Seed policy and advocacy
  - Continued dialogue with public sector stakeholders for sensitization on national seed laws implementation and outreach methods to stakeholders, seed standards and regulations refinement and oversight of the seed delivery by national and international players and harmonization of regional policy.
  - Professional trainings will be provided to more than 60 seed inspectors on effective seed certification system, seed health and quality control.

Facilitate an increase in quality seed production for the key crops to 3,125 tons covering an area of 8.2% under quality seeds (Figure 6) at the end of five-year period, and 8,943 tons covering 23.5% area at the end of 10 years.

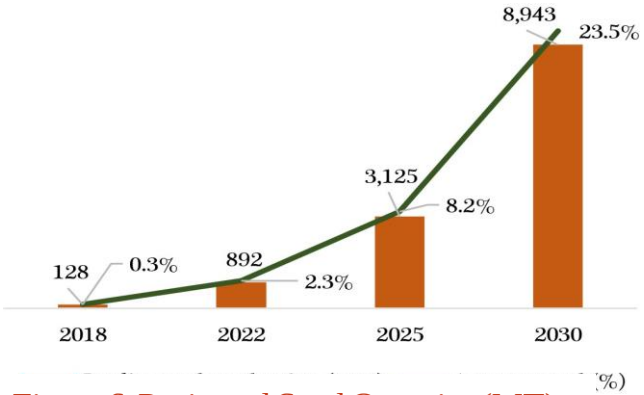


Figure 6: Projected Seed Quantity (MT)- Sierra Leone

Budget

Table 5: Sierra Leone Budget

Components	Amount (USD million)					
	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Component 1: Crop Variety Improvement						
NARS varietal Trials	0.19	0.15	0.08	0.00	0.00	**0.41**
Early generation seed production	0.06	0.08	0.00	0.00	0.00	**0.14**
MSc fellowships	0.07	0.11	0.00	0.00	0.00	**0.18**
PhD fellowships	0.15	0.15	0.00	0.00	0.00	**0.30**
Component 2: Seed Enterprise Development						
Grants for start-up seed companies	0.15	0.15	0.08	0.08	0.00	**0.45**
Multiplication support for vegetative crops	0.20	0.20	0.00	0.00	0.00	**0.40**
Hybrid seed production training	0.15	0.15	0.00	0.00	0.00	**0.30**
Professional trainings	0.05	0.08	0.00	0.00	0.00	**0.12**
Component 3: Agro-dealer Development						
Grants to agro-dealer development agencies	0.15	0.38	0.23	0.00	0.00	**0.75**
Capacity Development (Book keeping, information dissemination, inventory management etc.)	0.01	0.02	0.01	0.00	0.00	**0.03**
Component 4: Seed extension						
Grants to NGOs for demos, small packs, etc.	0.35	0.18	0.00	0.00	0.00	**0.53**
ICT infrastructure and training support	0.20	0.00	0.00	0.00	0.00	**0.20**
Professional trainings	0.03	0.06	0.03	0.00	0.00	**0.12**
Component 5: Seed Policy and Advocacy						
Seed Policy and Advocacy (grantee and stakeholder meetings)	0.05	0.05	0.00	0.00	0.00	**0.10**
Professional trainings	0.02	0.03	0.00	0.00	0.00	**0.05**
Total	**1.81**	**1.76**	**0.42**	**0.08**	**0.00**	**4.06**