Strategy for the Development of Sustainable Seed Supply Systems in Senegal

SEED SYSTEMS GROUP

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Country Snapshot

Population- 16 million

17% Agricultural share to GDP

3.80 m ha Arable land

11% Undernourished population

Age group < 15 - 43.2%; 15-64 - 54%; > 65 – 2.8%

60% Agricultural employment

Climate Risk index- 110.67

Global hunger index- 17.9

Figure 1: Country Snapshot- Senegal

Nutrition Profile

- Senegal's food and nutrition situation is classified as "moderate" according to the 2019 Global Hunger Index.
- Approximately 10% of children suffer emaciation, according to a 2014 national survey. Worse situations were seen in some regions where 6.8% of children suffered severe emaciation (MSAS, 2016).
- Micronutrient deficiencies are alarmingly high with 66% of children under 5 years being anemic (ANSD 2017 and ICF2017).
- The prevalence of chronic malnutrition is lower in Senegal than in many other West African countries. Poor complementary feeding, hygiene, and sanitation practices contribute to stunting.

Food insecurity	Nutrition	Dietary diversity	Average per capita Fruits & Vegetable intake
• About 17% of the population affected by food insecurity • Poverty rate-47%	• < 5stunting-16.5% • <5 wasting-2.2% • Anemia in women of 15-49 years age -54%	• 60% of energy source derived from cereals, roots and tubers representing low dietary diversity	• •59g/day fruits and 149 g/day vegetables against recommended guidelines 200-250g/day

Figure 2: Nutritional Profile- Senegal

Crop Profile

Major food crops cultivated in Senegal can be grouped under four categories: cereals (maize, rice, millet, sorghum); legumes (groundnut, cowpea, beans); roots and tubers (potatoes, sweet potatoes, cassava); and horticultural crops (fruit trees and vegetables such as onions, tomatoes, watermelon, etc.). Groundnut dominates the cropping system of Senegal, followed by rice, millet, maize, sorghum and cassava (Figure 3). Total horticultural production was estimated at 905,000 tons in 2012 and 1,446,360 tons in 2018, a net increase of 60% (ASEPEX, 2020). Farmers typically use more fertilizers for maize, groundnut, millet and irrigated rice.

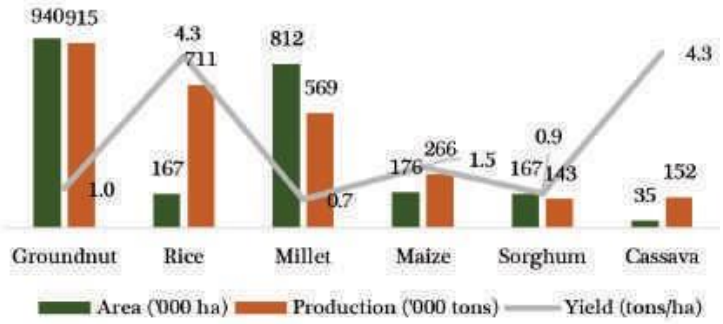

Figure 3: Crop Profile (2017) - Senegal

The highest fertilizer rate is for maize at 186kg/ha. Rice yields increased from 3.3 tons/ha in 2008 to 4.3 tons/ha in 2017 (Figure 4). In 2017, the yields of maize (1.5 tons/ha), and cassava (4.3 tons/ha) were very low compared to global averages of maize (5.74 tons/ha) and cassava (12.8 tons/ha).

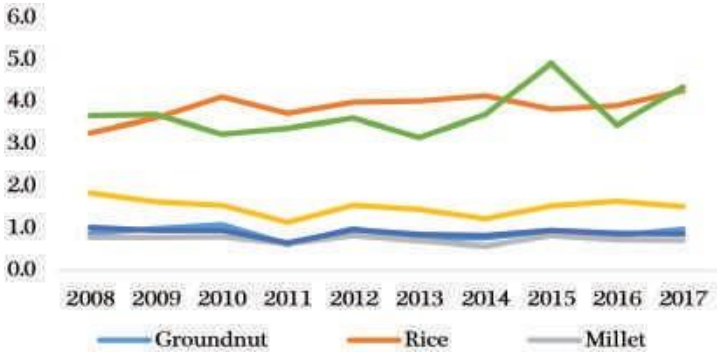

Figure 4: Yield Trends (tons/ha) - Senegal

The country has six agro-climatic zones: Bassin Arachidier, Casamance, Senegal Oriental, Fleuve Senegal, Zone Sylvo-Pastorale or Ferlo and Niayes. Agricultural systems can be divided into four main categories: rain-fed farming; peri-urban farming; flood retreat and lowland farming; and irrigated farming. The major crops grown in the country can also be grouped in three categories: subsistence farming (consists mainly of rice, millet, sorghum and maize; cash-crop farming (con- sists mainly of groundnut, sugarcane and cotton); and horticulture (vegetable crops and fruit trees production). Arable land in the country represent 20% of the total land. Approximately 66% of the total arable land is under cultivation, only 2% of which is irrigated.

Since 2012, the Emerging Senegal Plan (or Plan Senegal Emergeant, PSE) was officially adopted as Senegal's overall strategy for economic and social policy for the medium- (2023) and long-term (2035). The PSE is designed to accelerate Senegal's progress towards emerging market status and is based on three pillars: economic transformation, well-being, and good governance. The strategy is implemented via 5-year Priority Action Plans (PAP). The first PAP covered 2014-2018; the second PAP is in progress through 2023. Agricultural development is considered a top priority by public officials and is the main driver of the PSE's first pillar of economic transformation. The agricultural component of the PSE is embodied by the Recovery and Acceleration of the Agricultural Cadence in Senegal or Programme d'Accélération de la Cadence de l'Agriculture Sénégalaise (PRACAS). As with previous national programs, there are three critical elements integrated with it. Cereal cultivation is first and foremost intended to meet the country's nutritional goals. Groundnut is a fully integrated value chain backed by local mills, with great export potential of groundnut oil. The horticulture sector is seen as a high-value sector with huge export potential to be exploited.

Low yields and low productivity characterize current Senegalese agriculture. Some causal factors are:

- Insufficient and irregular rainfall patterns (95% of farmers rely on rain)
- Soil degradation and lack of adequate soil regeneration programs
- Land access
- Lack of funding
- Rudimentary equipment and accessories are still used by the vast majority of smallholder farmers
- Lack of access to key inputs such as fertilizers and improved seeds

Breeding, Variety Development and Release

The Senegalese Institute of Agricultural Research (ISRA for its French acronym) was founded in 1974. The institute is responsible for all public research activities in agriculture, forestry, livestock, fisheries and rural economy. ISRA is technically under the Agriculture Ministry (MAER - French acronym) and financially under the Finance and Economy Ministry. The institute has a mandate to create new technological innovations, to train young scientists and share its scientific results.

The institute has a total of 15 research centers equipped with laboratories throughout the country (Table 12). The location of research centers takes into consideration agro-ecologies as well local agricultural and cropping systems. There are also important and strategic research centers, such as the National Agronomy Research Center of Bambey (CNRA - French acronym), that carry out

research programs for the entire country. In total, ISRA has 40 laboratories for the various fields of agriculture, forestry, livestock, etc. There are laboratories dedicated to entomology, phytopathology, weed sciences, genetics and molecular biology, plants and more. Some older buildings are showing signs of deterioration. This is the case for the CNRA of Bambey, the Horticultural Re- search Center of Camberene (CDH), the CRA of Saint Louis (Gaye et Sène, 2014).

ISRA has several crop improvements programs with a focus on main staple crops such as ground- nut, rice, millet, maize and sorghum. In general, agricultural productivity, disease and pest resistance, climatic adaptation are research themes followed by NARS (ISRA, 2018). Some examples are as follows:

- ***Rice:*** Rain-fed rice adapted for the Bassin Arachidier with short cycle varieties, high yield, medium plants and mite resistance. New tested varieties were more productive than 'Nerica 6'. The variety 'Nerica 14' yielded 3,89 tons/ha, while 'ART 3-7-L9P8-1-B-1-B' yielded 3.20 tons/ha compared to 'Nerica 6's 1.43 tons/ha. NERICA 14 and ART 3-7- L9P8-1-B-1-B varieties also show better earliness, flowering 60 days after sowing compared to 73 days for 'Nerica 6'
- ***Millet:*** 15 short cycle varieties (70-80 days) with a yield of 2.77 tons/ha in 2018 were tested in Sahelian environment. Fifteen intermediate varieties (80-90 days) with a yield of 1.36 to 2.46 tons/ha were also tested in Soudano environment. Six hybrids were also tested in the North and Center of the country: 'ICMA-90 X SL103' and 'ICMA-90 X SL123' for the North, 'ICMA-90 X SL232' and 'LICMA-7 X SL76' for the Center-North, and 'LICMA-7 X ICMV IS 89305' and 'LICMA-7 X Sosat C88' for the South. These hybrids showed good adaptation.
- ***Groundnut***: Research programs for resistance against the fungus Aspergillus flavus is being carried out. Three resistant accessions, '12CS_084', '12CS_037' and '12CS_106', 213 show great potential and could help introgress resistance into elite cultivars. Ten new varieties with better yields and climatic adaptation have been released in last 3-4 years.
- ***Sorghum:*** Ten new varieties (five for the north and five for the south) were developed. These hybrids yielded 10-60% more than the controls. Traits such as grain size, yield, and losses due to fungi were considered. After multi-local and adaptation trials, four varieties showed great performance: 'Nguinthe', 'Faourou', 'Darou' and 'Nganda'. These varieties were developed from original crosses from the landrace 'Ce151-262x Sarvato-1' and are being promoted.
- ***Maize***: In the 1980s and 1990s, there were many research efforts put forth by ISRA to improve maize adoption with the creation of the 'HVB' series: 'HVB1' and 'HVB2' (Hybrides variétaux de Bambey - French acronym) in CNRA, Bambey. In the 21st century, OP varieties with better adaptation and high yield were released. Some of these varieties are: 'Acroos pool-16-DR', 'Suwan-1', 'TZEE-Y', and 'TZEE-W'.

These varieties yielded over 3 tons/ha. Some hybrids currently grown are: '1109- 21 STR', '1113- 5 STR', 'LW1120-41', 'LW1120-19', 'LY1001-23', with '1113-5 STR' yielding close to 5 tons/ha. Other common open-pollinated varieties are 'Early Thaï' and 'Suwan' (Sokhna, 2018).

- ***Onion:*** Techniques for production of in vitro plants by organogenesis are now available and used by ISRA. These techniques will help speed up the onion breeding program and seed production.

Table 1: List of current popular varieties

Crops	Yield	Current varieties
Cowpea	Average yield < 1t/ha Yield Potential > 1.5t/ha	Melakh, Mougne, Pakau, Yacine
Groundnut	Average yield : 1.2t/ha Yield Potential > 2t/ha	55-437, 28-206, 55-33, 69-101, 73-33, Fleur 11, H75-0, PC 79, PC 79-79, SRV1-19
Maize	Average yield : 2t/ha Yield Potential > 4t/ha	Espoir, Komsaya, Suwan1, Tieba, Tzee Y
Millet	Average yield < 1t/ha Yield Potential > 2.5t/ha	Gawane, Sosat C, Souna 3, Thialack 2
Rice	Average yield : 5.5t/ha Yield Potential > 7t/ha	BG90-2, DJ12-519, DJ684D, IR1529, ITA 123, Nerica 1, Nerica 3, Nerica 4, Nerica 44, Nerica 6, Nerica S44, Sahel, Sahel 108, Sahel 134, Sahel 177, Sahel 328, TOX
Sorghum	Average yield < 1t/ha Yield Potential > 2.5t/ha	Darou, Faourou, Nganda, Nguinthe

From 2014-2018, there was a net increase of researchers from 68 to 86 in total. As of 2018, there were 10 senior researchers compared to 5 in 2014, and 76 researchers of other categories compared to 63 in 2014. While there was a net increase, there were staff departures from retirement and others leaving for the private sector or for international organizations.

Proposed Interventions

- Introduce hybrids of maize, millet, sorghum, rice and groundnut, with superior performers released for commercial production
    - Maize hybrids will be sourced from IITA
    - Millet hybrids will be sourced from ICRISAT
    - Sorghum hybrids will be sourced from Malian Agricultural program
- Strengthen ISRA to ensure production of quality inbred line seed
- Train additional plant breeders for existing and new crops, especially vegetables, by awarding fellowships to 10 MS and two Ph.D. students

Seed Systems

The adoption of improved and certified seeds varies depending on crop. On average, 16% of farmers use certified seeds (Table 2). The highest level of adoption is found in cotton, with 91% of farmers using certified seeds, followed by irrigated rice with 78%. The lowest is found in rain-fed rice with 12%. Around 9% of farmers do not know the origin of seeds used (FAO, DAPSA, 2018).

Low usage of certified seeds for groundnut, maize and other crops can be attributed to lack of quality certified seeds and awareness. The current need for vegetable seeds is estimated at 3,000 tons, from which 375 tons are produced in a formal and traceable way. (PAPSEN, 2020).

Table 2: Level of adoption of certified seeds

Crop	Use of certified seeds (%)	Origin of seeds unknown (%)
Groundnut	17.2	8.4
Cotton	91	9
Maize	17.3	3.7
Irrigated rice	74.5	2.3
Rain-fed rice	12.2	15.9
National Average	15.9	9.1

In the above table, groundnut seeds include seeds of R3 generation due to the fact that national needs for groundnut are still not covered, which brings seeds quality issues with the production of R3 seeds. As an example, the 2017-2018 season produced 142,969 tons groundnut seeds: 915.5 tons of G4 (foundation seeds); 8,613 tons of R1; 47,930 tons of R2 (R1 and R2 certified seeds); and 85,510 of R3 (RCSA, 2017). Annual needs for certified seeds for groundnut are estimated at 100,000 tons.

Overall, there was significant improvement in production for most crops in the 2018-2019 season, especially for groundnut, rice and maize.

Table 3: Production of certified seeds (tons)

Crops	2016-17	2017-18	2018-19
Groundnut	92,798	142,969	168,923
Millet	3,997	2,236	3,775
Maize	21,094	15,212	28,100
Rice	7,414	7,528	12,420
Sorghum	5,904	4,187	9,420
Cowpea	1,284	953	1,150

Figure 5 shows the supply demand situation of certified seeds in Senegal. From the figure it is clear that more than sufficient seeds are produced for almost all the crops except cowpea but these are not quality seeds and are not used by farmers, instead these seeds are also used as grains for consumption.

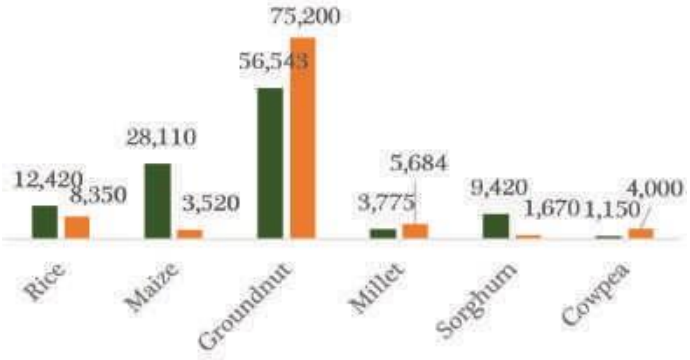

Figure 5: Seed Supply Demand Gap (MT) - Senegal

Table 4: Quantity of breeder seeds for main crops

Crops	Year	Quantity (Kg)	Needs covered
Groundnut	2013	18,350	No
	2014	64,650	Yes
	2015	78,500	Yes
	2016	103,800	Yes
	2017	42,000	No
	2018	28,300	No
Millet	2016	20,925	Yes
	2017	4,327	Yes
	2018	5,079	Yes
Sorghum	2016	9,150	Yes
	2017	2,976	No
	2018	2,155	No
Maize	2016	8,750	Yes
	2017	5,084	No
	2018	5,185	No
Cowpea	2015	9,972	No
	2018	1,289	No
Rice	2013	16,433	Yes
	2014	21,732	Yes
	2015	29,394	Yes
	2016	52,801	Yes
	2017	11,875	No
	2018	8,472	No

Table 5: Forecasted and actual needs for breeder seeds (ISRA)

Year	Groundnut	Cowpea grain	Cowpea Fodder	Sesame	Millet	Sorghum	Maize	Irrigated rice	Rain-fed rice
2018	75	5	5	2	4	4	5	25	10
2019	100	10	10	2	5	5	10	25	10
2020	120	15	15	2	5	5	10	25	10

ISRA is the main source of foundation seeds in the country. Typically, breeder and foundation seeds are produced by ISRA's seed production unit (UPSE). However, if the needs for breeder seeds cannot be met by this unit, production is done by entities such as UNIS, RESOPP and ASPRODEB through farmer networks. Based on national needs and forecasts, ISRA tries to provide sufficient G3 seeds to these organizations for the production of foundation G4 seeds and subsequently certified seeds (R1, R2). Based on their forecasts, these farmer-based organizations place orders of G3 seeds to ISRA. In the case of RESOPP for example, agreements are signed between the network and ISRA for the supply of G3 and G4 seeds. In practical terms, ISRA barely produces G3 seeds due to lack of resources and instead relies on ASPRODEB, UNIS network, RESOPP and other private farmers to produce the foundation seeds (G4) and certified seeds (R1, R2). Since the G3 seeds were sold to these organizations, once foundation and certified seeds are produced, members of the organization or network agree to sell at least 75% of their seed production back to the network (RESOPP in this case) to take advantage of national subsidy programs (seeds, fertilizers, chemicals, etc.). The remaining 25% can be used for the farmer's personal needs and/or for direct sales to other farmers. Approximately 25% of the net-work's certified seed stock is sold to its other members (non-seed producers), generally at a discounted price. Non-members can also purchase seeds but with a 10% price increase. The remaining 75% certified seeds are then sold to the government, NGOs, and private companies as follows

- SEDAB (32%)
- Government rice program, Piriz (18%)
- Agronomes et vétérinaires sans frontières-AVSF (13%)
- FEPRODES (8%)
- Catholic Relief Service, CRS (3%)
- Government, ANCAR (1%) (Bonnefin and Thiam, 2011)

In summary, agencies such as SPRODEB, RESOPP and UNIS help with the production of foundation seeds (G4) but are mainly responsible for the production of certified seeds (R1 and R2), that in turn are sold directly to farmers and in a large part to government, private companies and NGOs. It is to be noted that many farmers obtain certified seeds directly from other farmers involved in seed multiplication programs.

Almost all major field crops such as groundnut, maize, millet, rice, cassava, sorghum and some horticultural crops (watermelon) benefit from government subsidy programs. Depending on the crop, the Senegalese government subsidizes between 42 to 52% for R1 and R2 seeds and between 57 to 60% for R3 seeds (ANSD, 2016). Rice, maize and groundnut benefit the most from these pro- grams.

Seeds are imported from countries like Burkina Faso (NAFASO) and Mali (SOPROSA, FASO KABA). The imports from SOPROSA are mostly for rain-fed rice (around 600 tons of 'Nerica 4' and 'DKA-27' varieties) and sometimes for maize hybrids. Imports from FASO KABA were mainly for rice varieties such as 'Nerica 4', 'Wassa' and 'BG'. The highest import from FASO KABA was observed in 2015 with approximately 200 tons; there has been no imports from FASO KABA since 2017.

A partnership between ISRA and ANCAR helps local seed producers and farmer-based organizations with extension and advisory services. This partnership also involves DA/DISEM, CARITAS, POGV, RESOPP, ASPRODEB, UNIS, and others. Presently, all certified seeds of rice, millet, maize and sorghum are produced through these channels. Improvements are noted but in general national needs are still not covered (DISEM, 2020).

Seed production in the country is carried out by farmers organized into farmer-based organizations (FBOs) and cooperatives. ASPRODEB, UNIS and RESOPP are major seed production organizations in the country, and most farmers involved in seed production belong to these organizations. ASPRODEB has 34 cooperatives, while RESOPP has six and UNIS has 69. While ASPRODEB and RESOPP engage in various agricultural activities besides seeds, UNIS is exclusively engaged in the seed sector. Unlike typical FBOs (such as ASPRODEB, and RESOPP), UNIS was created in the 1990s in the wake of the government withdrawal of the seed sector. UNIS serves as a union, point of contact and facilitator for all seed sector stakeholders in the country. Seed companies and seed cooperatives such as SEDAB, ASPRODEB, TROPICASEM, SODISEM, to name a few, are all members of UNIS. ASPRODEB's seed co-operatives formed the Réseau national des coopératives de producteurs de semence (RNCPS) in 2009 that has its own network and is not a member of UNIS.

A list of private companies and cooperatives involved in the seed business are presented in Tables 6-7. Their activities are not restricted to seed but also involve inputs such as fertilizers, phytosanitary products, tools, etc. Among this list, companies like TROPICASEM and SEDAB have their headquarters in Senegal. TROPICASEM is a member of the international NOVALLIANCE group, which is a network of 45 companies with a presence in 40 countries and more than 600 employees. In Senegal, TROPICASEM has 90 employees with approximately 60% in the research department. SEDAB is also engaged in seed production, distribution and sale of field crops such as maize,

rice and groundnut. Another important player is the group TOOLBAYE, based out of Kaolack, which is involved in the production of groundnut and cereal seeds. Groupe TOOLBAYE currently works with a network of over 500 seed producers exploiting over 1,000 hectares of land and produces an average of 1,700 tons of certified seeds for crops such as groundnut, millet, maize, sorghum and cowpea. Some other organizations are TRAORE ET FRERES, TOP MOUNTAIN, SODISEM, SPIA, RMG and SOLEVO.

Table 6: List of private seed companies in Senegal

Company	Crops in portfolio		Company activities in country					
	Field crops	Vegetables	Breeding location	Testing location	Seed production	Processing location	Sales	Extension services
Bayer	✓	✓					✓	
Bejo	✓	✓		✓			✓	✓
Corteva Agriscience	✓						✓	
East-West Seed		✓		✓			✓	
Faso Kaba	✓						✓	
Known-You Seed		✓					✓	
Limagrain	✓	✓					✓	
NAFASO	✓						✓	
Nongwoo Bio		✓					✓	
Pop Vriend Seeds		✓					✓	
Rijk Zwaan		✓					✓	
Sakata		✓					✓	
Seed Co	✓				✓		✓	
SEDAB *	✓			✓	✓	✓	✓	
Soprosa	✓						✓	
Syngenta * **	✓	✓	✓				✓	
Technisem		✓	✓	✓	✓*		✓	✓
Tropicasem **		✓	✓	✓	✓*		✓	✓
Cadre de Concentration des Producteurs d'Arachide (CCPA)	✓				✓		✓	
GIE Khaly Amar Fall	✓				✓		✓	
Coumba Nord Thiam (CNT)	✓				✓		✓	

Réseau des Organisations Paysannes et Pastorales (RESOPP)	✓				✓		✓	
Réseau National des Coopératives de Producteurs de Semences (RNCPS)	✓				✓		✓	
Société de Commercialisation et de Distribution de Produits Agricoles (SOCODISPA)	✓						✓	
Etablissement Tambedou et Fils (ETB TAMBEDOU et Fils)	✓						✓	
Niayes Sarraut (NS)		✓					✓	

** Company involves smallholder farmers in seed production activities*

*** Company headquartered in Senegal*

**** Based on company data, sales activities include seeds and/or crop protection products.*

Table 7: List of seed cooperatives in Senegal

Company	Crops in portfolio		Company activities in country		
	Field crops	Vegetable crops	Testing location	Seed production	Sales
Coopérative agricole de Kelle Guèye (COOPAKEL)	✓		✓	✓	✓
Coopérative agricole de Diendé (COOPAD)	✓		✓	✓	✓
Coopérative de Kahi	✓		✓	✓	✓
Coopérative de Paoskoto	✓		✓	✓	✓

Table 8: Production of certified seeds- SEDAB

Rice				
Varieties	NIVEA U			Total per variety (Kg)
	Base	R1	R2	
BG 90 2		461,651		461,651
NERICA 6	110	310,128		310,238
NERICA 4	2,412	81,921	2,174	86,507
TOX 728 1		49,110		49,110
NERICA 8	4,624	17,301		21,925
WAR 77		53,337		53,337
SAHEL 108		23,433		23,433
ISRIZ 12	2,197	5,483		7,680
NERICA S44	6,580			6,580
ITA 123		1,900		1,900
SAHEL 329		6,090		6,090
SAHEL 201		21,339		21,339
NERICA 1		327		327
FKR 45 N		11,200		11,200
SAHEL 108		137,400		137,400
SAHEL 329		3,400		3,400
NERIA L19			12,960	12,960
NERICA 6		13,320		13,320
Total	**15,923**	**1,197,340**	**15,134**	**1,228,397**
		Maize		
OBATAMPA	30,818	29,003		59,821
SWAN	26,154	26,381		52,535
EARLY TAI		51,175		51,175
GAWNA	11,695			11,695
SOROOR	3,449			3,449
EARLY TAI		4,525		4,525
Total	**72,116**	**111,084**		**183,200**
		Groundnut		
73-9-11	173		553	726
Rafeet car	568			568
28-206	986			986
55-33	8,733			8,733
Yakaar		797		797
55-437		2,175		2,175
55-437			32,886	32,886
Fleur 11			20,930	20,930
73-33			79,690	79,690
GH 119 20		214,428		214,428
H 75 0		31,016		31,016
PC 79 79		69,439		69,439
69,101		15,000	1,266,376	1,281,376
Total	**10,460**	**332,855**	**1,400,435**	**1,743,750**

With the exception of Dakar, almost all regions are equipped with seed processing centers. Most of these processing centers, however, have old and outdated equipment. Some of these seed processing centers were recently renovated - the ones located in the North in Richard Toll, Center in Kaolack, and South in Kolda. The seed processing centers are fully equipped and the one in Kaolack is the latest one and was inaugurated in 2015. The Kaolack center has a capacity of 1.5 tons/hour and a yearly production capacity of 3,000 tons of certified seeds of millet, maize and sorghum. The Richard-Toll processing center was also renovated in 2015 with a capacity of 3.5 tons/hour and is for rice processing. The Kolda new processing center also has a capacity of 3.5 tons/hour mainly for rice, millet, maize and cowpea. The packaging that available are - 16 kg for maize, 40 kg for paddy rice, 50 kg for groundnut, and 4 kg for millet.

The agro-dealers in the country are very informal and are present in most towns, villages and markets in the country, however it is difficult to find an exact number. In most cases, agricultural inputs such as seeds, fertilizers, tools and pesticides are seasonal products and constitute a small aspect of their overall business. Some, however, serve as final points of sale for seed companies.
Some notable ones are Niayes Sarraut, Tropicasem agro-dealers network, Traore et Freres network, Top Mountain network, Sedab network, Groupe Toolbaye network, SPIA network, Sodisem, RMG, SOLEVO. Besides these notable agrodealers, the country has a network of government-owned warehouses ("Seccos") that are points of deposit and sale for subsidized seeds. The "Seccos" systems are very old and exist for several decades now. They were primarily intended for groundnut seeds but are now equally used for other crops and also serve as agro-input distribution points. There are approximately 700 "Seccos" across the country with capacities varying between 200 and 1,000 tons. A 2013 survey of farmers (Ndiaye, Audet-Belanger, & Gildermacher, 2015) confirmed that less than 5% of groundnut and millet farmers' source their seeds from agrodealers whereas none of the maize or rice farmers sourced their seed from agro-dealers. Apart from farmer-saved seeds, the most important sources of seed are the direct sales from seed producers, informal market, "Seccos", and friends and neighbors.

Proposed Interventions

- Provide seed grant funding to six private seed companies/cooperatives (such as Groupe Toolbaye and SEDAB) for:
    - Building capacity in quality seed production: aim to increase the quality seed production of existing varieties/hybrids and newly introduced varieties/ hybrids by 33% of the current quality seed production,
    - Production of hybrids seeds and capacity development,
    - Expanding the seed distribution network to reach farmers through extension activities,
    - Strengthen business entrepreneurship skills of 80 personnel through professional training courses over a period of five years, and

- Technical skill improvement such as varietal selection, inbred line maintenance, seed standards and quality, and controlled storage for seed sector stakeholders predominantly in the private sector and also in public sector.

- Incubating new entities from groups of seed producers/cooperatives to take up quality seed production and marketing.
- Support ISRA breeder to conduct trait validation trials for recommending suitable hybrids for seed enterprises.
- Operationalize the seed processing infrastructure and installing additional capacity of 2 tons/day in the country. Capacity building of technicians on operation of farm machinery and seed processing units.
- Agro-dealer development
    - Provide matching grants to 350 agro-dealers in Senegal to open new outlets, renovate 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 trainings on bookkeeping, cash management, inventory management, quality standards, customer relations and compliance. All the 450 agro dealers will be trained on these modules over a period of 5 years, and
    - Strengthening of agro-dealer network and association building.
- 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, and
    - Professional trainings will be provided to over 1,000 extension professionals over a period of 5 years 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, and
    - Professional trainings will be provided to more than 80 seed inspectors on proper seed quality assessment and seed certification aspects.

Facilitate an incremental quality seed production for the key crops to increase production to a total of at least 19,512 tons covering an area of 23% under quality seeds (Figure 6) by the end of five-year period, and 35,506 tons covering 40% area at the end of 10 years.

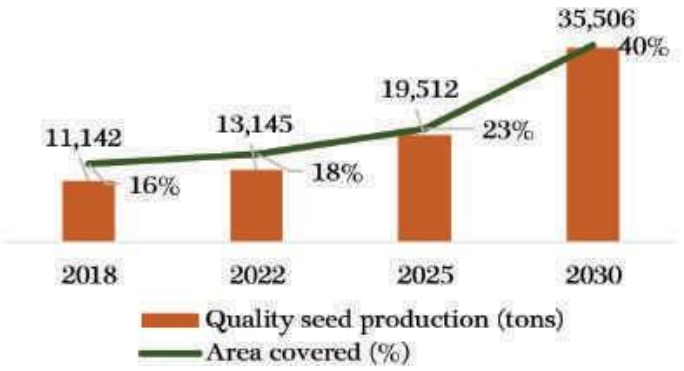

Figure 6: Projected Seed Quantity (MT) - Senegal

Budget

Table 9: Senegal 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	0.13	0.25	0.00	0.46
Early generation seed production	0.06	0.08	0.00	0.00	0.00	0.14
MSc fellowships	0.14	0.14	0.07	0.00	0.00	0.35
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	0.23	0.23	0.23	0.23	0.00	0.90
Multiplication support for vegetative crops	0.00	0.00	0.00	0.00	0.00	0.00
Hybrid seed production training	0.15	0.20	0.10	0.00	0.00	0.45
Professional trainings	0.05	0.06	0.05	0.00	0.00	0.15
Component 3: Agro-dealer Development						
Grants to agro-dealer development agencies	0.23	0.15	0.15	0.00	0.00	0.53
Capacity Development (Bookkeeping, information dissemination, inventory management etc.)	0.02	0.01	0.01	0.00	0.00	0.04
Component 4: Seed extension						
Grants to NGOs for demos, small packs, etc.	0.42	0.32	0.00	0.00	0.00	0.74
ICT, infrastructure and training support	0.25	0.00	0.00	0.00	0.00	0.25
Professional trainings	0.06	0.05	0.05	0.00	0.00	0.09
Component 5: Seed Policy and Advocacy						
Seed Policy and Advocacy (grantee and stakeholder meetings)	0.05	0.08	0.00	0.00	0.00	0.13
Professional trainings	0.02	0.03	0.02	0.00	0.00	0.06
Total	**1.99**	**1.63**	**0.79**	**0.23**	**0.00**	**4.63**