SEED SYSTEMS GROUP

FEASIBILITY STUDY FOR THE DEVELOPMENT OF PUBLIC-PRIVATE SEED DELIVERY SYSTEMS IN SENEGAL

AGRA
Growing Africa's Agriculture

The ROCKEFELLER FOUNDATION

SEED SYSTEM ANALYSIS IN SENEGAL

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LIST OF ABBREVIATIONS AND ACRONYMS

ACDI: Agence Canadienne pour le Développement International

AGVSAN: Analyse Globale de la Vulnérabilité, la Sécurité Alimentaire et de la Nutrition

ANCAR: Agence Nationale de Conseil Agricole et Rural

ANSD: Agence Nationale de la Statistique et de la Démographie

ASEPEX: Agence Sénégalaise de promotion des exportations

ASPRODEB: Association Sénégalaise pour la Promotion des Petits Projets de Développement à la Base

BAME:Bureau d'analyses macro-économiques

CA: Commune d'Arrondissement

CC: Commission de Cession

CDH: Centre pour le Développement de l'Horticulture

CIMMYT: International Maize and Wheat Improvement Center/Centro Internacional de Mejoramiento de Maíz y Trigo

CNRA: Centre National de Recherche Agronomique

CORAF/WECARD: Conseil ouest et centre africain pour la recherche et le développement agricoles

CR: Communauté Rurale

CRA: Centre de Recherche Agricole

CRODT: Centre de recherche océanographique Dakar-Thiaroye

CLCOP: Cadre Local de Concertation des Organisations de Producteurs

CNCSP: Comité National Consultatif des Semences ou Plants

DAPSA: Direction de l'Analyse, de la Prévision et des Statistiques Agricoles

DHORT: Direction de l'Horticulture

DHS: Distincte, Homogène et Stable

DA/DISEM: Direction de l'Agriculture/Division des Semences

DPV: Direction de la Protection des Végétaux

DRDR: Directions Régionales de Développement Rural

FAO: Food and Agriculture Organization

FNRAA: Fonds National de Recherches Agricoles et Agroalimentaires

GIE: Groupement d'Intérêt Economique

GOANA: Grande Offensive Agricole pour la Nourriture et l'Abondance

HVB: Hybrides variétaux de Bambey

IFPRI: International Food Policy Research Institute

ISRA: Institut Sénégalais de Recherches Agricoles

KM: Kilometer

LNERV: Laboratoire national d'élevage et de recherches vétérinaires

LNRPV: Laboratoire national de recherches sur les productions végétales

NPA: Nouvelle Politique Agricole

MAER: Ministère de l'Agriculture et de l'Équipement Rural

MSAS: Ministère de la Santé et de l'Action Sociale

NARS: National Agriculture Research System

PAPSEN: Programme d'Appui au Programme National d'Investissement dans l'Agriculture au Sénégal

PNAR: Programme National d'Autosuffisance en Riz

PNASA: Programme National d'Appui à la Sécurité Alimentaire

POGV: Programme d'Organisation et de Gestion Villageoise

PPAAO: Programme de productivité agricole en Afrique de l'Ouest

PRACAS:Programme d'accélération de la cadence de l'agriculture Sénégalaise

PRH: Pôle de recherche de Hann

PSAOP: Projet des Services Agricoles et d'Appui aux Organisations de Producteurs

PSE: Plan Senegal Emergeant

RESOPP: Réseau des Organisations Paysannes et Pastorales du Sénégal

RTP: Règlements Techniques Particuliers

SAED: Société d'Aménagement et d'Exploitation des Terres du Delta du Fleuve Sénégal et des Vallées du Fleuve Sénégal et de la Falémé

SDDR: Services Départementaux de Développement Rural

SSG: Seed Systems Group

SOC: Service Officiel de Contrôle

SODAGRI: Société de développement agricole et industriel du Sénégal

SODEFITEX: Société de développement et des fibres textiles

UNIS: Union Nationale Interprofessionnelle des Semences
UPSEM-CL: Unité de Production de Semences de Céréales et de Légumineuses

UPSE: Unité de Production de Semences

USAID: United States Agency for International Development

VAT: Valeur Agronomique et Technologique

WAAPP: West Africa Agricultural Productivity Program

I. INTRODUCTION AND BACKGROUND

Seed Systems Group (SSG) is an Africa-based non-profit organization working to help improve the livelihoods of African farmers. SSG uses a Public-private partnership seed model that aims at making improved varieties released from public breeding institutes available to the majority of African farmers. With a rapid growth of its population, African agriculture is now more than ever, in dire need of improved seeds to help improve agricultural productivity in the fight against hunger and malnutrition. Senegal is among the fifteen African countries expected to participate in this program. An analysis of the Senegalese agricultural landscape and, more specifically, its seed system, is therefore much needed to help SSG define its work strategy for Senegal.

Senegal is the westernmost country in Africa and is located within the western and northern hemispheres. The country lies between latitudes 12°20 and 16°40 and has a tropical climate in its southern part and a semi-arid climate in its northern part. Total land area of Senegal is 196,722 km2. The country is divided into 14 administrative regions and its population is estimated at 16,209,125 millions with 7,896,040 females (50.2%) and 7,829,997 males (49.8%) (ANSD, 2019). Along with mining and fisheries, agriculture is one of the main pillars of Senegalese's economy, with 60% of the population involved in this sector but only contributing 17% of the country's GDP (APIX, 2019).

The main staple food crops in Senegal are maize, millet, rice, sorghum and wheat. If wheat is not locally grown and imported, rice and millet are by far the two main cultivated and consumed cereals. In the wake of the 2006-2008 drought and food crisis, the Senegalese government established the *National Program in Support of Food Security* or the *Programme National d'Appui à la Sécurité Alimentaire (PNASA)* to address food insecurity in the country. The *Food Self-Sufficiency Rate* or *Taux d'Autosuffisance Alimentaire (TAS)* is a measure of a country's capacity to feed its population. From 2010-2014, the average TAS in Senegal was at 48% and considered low, showing vulnerability faced by the population especially in rural areas. Similarly, the *Level of Dependency on Imports* or *the Taux de dependance des importations (TDI)* for the same period was at 46% showing how much the national food balance relies on imports to cover its cereal deficit (DAPSA, 2014).

A national survey in 2014 showed that approximately 10% of children suffered emaciation. Worse situations were seen in some regions where 6.8% of children suffered severe emaciation (MSAS, 2016). In 2018, USAID reported that 17% of children under five years of age suffer from chronic malnutrition (stunting) (USAID, 2018)

Facing all these serious problems, past and current Senegalese governments have always given priorities to the Agriculture sector by implementing various programs that have produced mixed results so far. With food insecurity, a high unemployment rate of 15.7%, and women being the most affected (22.1%), agriculture continues to be a top priority for the current government. Senegalese agriculture faces many problems and challenges but low yields and low productivity are very prevalent factors. There are several causes for persistently low yields, but one key issue that has long been identified by different political regimes and farmers is the lack of access to improved seeds.

1. Agricultural production systems

Total arable land in Senegal is 3.8 millions hectares, representing approximately 20% of the country's total land area. Around 2.5 millions hectares is under cultivation representing 66% of the total arable land (FAO). The country's different agro-ecologies can be divided into six zones:

* ***Bassin Arachidier***
* ***Casamance***
* ***Senegal Oriental***
* ***Fleuve Senegal***
* ***Zone Sylvo-Pastorale or Ferlo***
* ***Niayes***

Based on the type of farming, agro-ecology and water availability, agricultural systems can be divided into four main categories:

* ***Rain-fed farming***
* ***Peri-urban farming***
* ***Flood retreat and lowland farming***
* ***Irrigated farming***

Although some crops are predominant in certain agro-ecologies and agro-systems, they are not exclusive to those areas and systems and can be found in various agro-ecosystems. Rice, for instance, can be cultivated in flood retreat, lowland and irrigated areas, but is also predominant in agro-ecologies such as the *Fleuve Senegal* zone and in the *Casamance* zone. Groundnut has its largest acreage and production in the *Bassin Arachidier* but can similarly be found in almost the entire country.

The major crops grown in the country can also be grouped in three categories or cropping systems:

* ***subsistence farming:*** consists mainly of rice, millet, sorghum and maize farming
* ***cash-crop farming:*** consists mainly of groundnut, sugarcane and cotton farming
* ***Horticulture:*** consists mainly of the vast majority of vegetables and fruit trees production.

The Senegalese agricultural landscape is vast but for the sake of this study, we will be focusing primarily on *rain-fed farming* system with crops such as groundnut, millet, sorghum, maize and on *irrigated* and *flood retreat and lowland farming* systems for rice.

2. Current and recent agricultural development initiatives

Senegal obtained its independence in 1960, and since then, several agricultural policies, initiatives and programs have seen the light of day. Amongst the most notable, were the *New Agricultural Policy* or *la Nouvelle Politique Agricole (NPA)* of 1984 with a goal of reaching the country's self-sufficiency in cereals. Then, in the 2000s, with the country's first political regime change, was launched the *Big Agricultural Program* or *la Grande Offensive Agricole pour la Nourriture et l'Abondance (GOANA)* with similar goals but with a more ambitious vision of a prosperous agriculture. More recently, with the new political regime in place since 2012, a new plan, the *Emerging Senegal Plan* or *Plan Senegal Emergeant (PSE)*, was officially adopted in 2012. The PSE is Senegal's overall strategy for economic and social policy in the medium (2023) and long term (2035) designed to accelerate Senegal's progress towards emerging market status. The PSE is based on three pillars: economic transformation, well-being, and good governance. It

is implemented via 5-year *Priority Action Plans (PAPs).* The first PAP that covered the 2014-2018 period has ended. The country is now under the 2nd PAP (2019-2023).

The development of agriculture is considered by public officials to be a top priority, the heart and the main driver of the PSE through its first pillar of economic transformation. To that end, 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)*

In the first PAP, some of the goals of the PRACAS were as followed:

* Reach the country's autonomy in rice (paddy rice) of 1,600,000 tons by 2017 (lowland and irrigated rice)
* Boost cereal production in general by creating cereal production areas or "cereal belts"
* Reach the country's autonomy in onion of 350,000 tons by 2016
* A net improvement of the groundnut value chain and a production target of 1,000,000 tons with 100,000 to 150,000 tons for export by 2017
* The development of the horticultural sector (counter-season fruits and vegetables) with 157,500 tons for export by 2017
* Boost agricultural productivity in general
* Strengthen the seed sector by facilitating access to improved and quality seeds with additional funding allocated to the National Agricultural Research System (NARS) and extension services

For its successful implementation, the PSE is accompanied by supporting measures such as reforms for the facilitation of rightful ownership of agricultural lands, funding alternatives, extension services, the creation of market linkages, and access to agricultural inputs to name a few (BAME, 2020). As with previous national programs, 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 peanut oil. As previously mentioned in the PRACAS goals, the horticulture sector is seen as a high value sector with huge export potential that need to be exploited.

The PSE via the PRACAS, foresees the establishment of 100 to 150 integrated farms, particularly in the field of horticulture, cereal crops and poultry farming. The end goal being to reorganize all productions around agricultural zones or agro poles in order to develop processing and transformation for end-products. All donor-funded, bi- and multi-lateral agricultural projects will operate under the umbrella of the PRACAS program.

3. Scope for the development of agriculture

Small-scale or family based farmers represent the vast majority of farmers in Senegal (95%), whereas modern and large-scale farmers represent 5% (DAPSA, 2009).

Low yields and low productivity characterize the current Senegalese agriculture. Some explanations are:

* Insufficient and irregular rainfall patterns (95% of farmers rely on rain)
* Soil degradation and lack of adequate soil regeneration programs
* Land access is still a big challenge
* Lack of funding
* Rudimentary equipments and accessories are still used for the vast majority of small holder farmers
* Lack of key inputs such as fertilizers and improved seeds

II. CROP PRODUCTION SYSTEMS

1. Current crop production levels of majorstaple food crops, average crop yields, and trends, by crop

Major food crops cultivated in Senegal can be grouped under these four categories:

* Cereals: maize, rice, millet, sorghum
* Legumes: groundnut, cowpea, beans
* Roots and tubers: potatoes, sweet potatoes, cassava
* Horticulture: fruit trees and vegetables (onions, tomatoes, watermelon, etc.)

Table 1: Cereal 2017-2018 Production & 2018-2019 Forecast

Crops	Forecast production 2018-2019 (tons)	Production 2017/2018 (tons)	Average production 2013-2017 (tons)	Increase 2018-19 vs past 5 years (%)
Rice	1132795	1011269	771682	47
Millet	827601	875484	640170	29
Maize	476621	410364	293065	63
Sorghum	291171	217491	155274	80
Fonio	3921	3857	2902	35
Total Cereals	**2732109**	**2516466**	**1863113**	**47**

Source: DAPSA

Table 2. Legumes 2017-2018 Production & 2018-2019 Forecast

Crops	Forecast production 2018-2019 (tons)	Production 2017/2018 (tons)	Average production 2013-2017 (tons)	Variation 2018-19 vs past 5 years (%)
Groundnut	1432086	1405223	958695	49.4
Cowpeas	151055	108662	78836	92
Beans	20350	18700	15800	28.8
Cotton seed	19924	20000	22168	-10.1
Sesame	18552	12879	9810	100

Source: DAPSA

Table 3. Tuber Production & Forecast 2017-2019

Crops	Forecast production 2018-2019 (tons)	Production 2017/2018 (tons)	Average production 2013-2017 (tons)	Variation 2018-19 vs past 5 years (%)
Cassava	1022802	747473	459026	123
Potatoes	140000	118783	64625	110.83
Sweet Potatoes	76300	72000	51750	47.43
Total Tubers	**1239102**	**938256**	**552125**	**124.4**

Source: DAPSA

Table 4: 2017-2018 Production & 2018-2019 Forecast (Key Horticultural Crops)

Crops	Forecast production 2018-2019 (tons)	Production 2017/2018 (tons)	Average production 2013-2017 (tons)	Variation 2018-19 vs past 5 years (%)
Watermelon	1174416	801417	241182	386
Onion	428615,3	400000	347681	23,3
Mango	135700	132000	129250	5
Processing Tomato	77000	70000	52425	46,9
Cherry Tomato	76300	68000	82625	-7.7
Citrus	50500	45000	46250	9.2
Banana	35330	30000	34625	2
Cantaloupe	33435	28000	21300	57

Source: DHORT, DAPSA

Table 5: National Productivity/Yield of main crops (kg/ha)

Regions	Groundnut	Cow peas	Millet	Sorghum	Maize	Rice
Dakar	764	400	450	565	700	-
Diourbel	910	489	858	787	891	-
Fatick	1293	416	1061	966	1836	1633
Kaolack	1201	481	1189	963	2057	1848
Kolda	1220	606	977	964	1585	2392
Louga	843	521	560	457	600	1000
Saint-Louis	868	495	277	383	3077	6467
Tambacounda	1261	800	904	966	1627	2135
Thies	1087	608	965	762	803	-
Ziguinchor	1274	378	801	964	1897	3004
Matam	235	710	286	195	1345	6000
Kaffrine	1075	413	1028	1147	1477	1212
Kedougou	1068	622	-	2038	2760	3324
Sedhiou	1669	604	1157	1228	2043	1866
National Average	**1055**	**539**	**809**	**885**	**1621**	**2807**

Source: FAO, MAER, 2018

Among the cereals grown in the country, rice is by far the most important one, reaching over 1 million tons in 2017 (Fig.1). A study done in 2017 showed that national consumption for ricewas at an average of 78.1 kg/inhabitant/year. Rice was followed by millet with a national consumption average of 30.2 kg/inhabitant/year. Maize came in third position with 9.2 kg/ inhabitant/year and finally sorghum with a mere 0.7 kg/inhabitant/year (IPAR, 2017). It is be noted that although not grown in the country and imported, wheat is also a very important cereal (used for french bread and pasta-like food). National consumption for wheat was estimated at 32 kg/inhabitant/year, making it the second most consumed cereal after rice and just before millet (Berthelot, 2017).

Development of cereal crops were among the top priorities for the government after the independence. These included rice, millet, maize and sorghum. Millet is primarily found in the *Bassin Arachidier* along with groundnut and is typically associated with groundnut cultivation as followed: millet as staple food and groundnut as cash crop. Besides traditional culinary habits, factors that favor millet production are: large acreages in the *Bassin Arachidier*, its ability to grow in soil with low level of fertility and its ability to withstand drought and heat, to name a few. This can explain why millet has been the number one cereal produced in the country during all this time, being surpassed by rice just recently in 2014 (Fig.1). The rice performance can be in part explained by the GOANA agricultural program launched in 2008, that made rice a top priority by the government. The program set a goal of reaching rice autonomy of 1,000,000 tons by 2012 and this was to be implemented through the rice autonomy program (PNAR). Although this target goal was not reached, the rice value chain still benefited from the government efforts to boost this sector with thousands of hectares of new irrigated land in the *Fleuve Senegal* and the supply of subsidized inputs (fertilizers and seeds). As a result, rice production showed a steady increase in production and for the first time, surpassed millet production in 2014 and also broke the million tons barrier in 2017 (Fig.1).

Maize is primarily grown in the regions of Tambacounda, Kaolack and Kolda. It also benefited from a National Maize Program launched in 2003 in order to promote its adoption throughout the country, but its expansion did not go as planned for various reasons. Although maize is not as widely adopted as millet, for instance, this has not stopped its production to continue to be on the rise, especially for the past five years (Fig.1). This rise is mainly attributed to new culinary habits of adding maize (in small proportions) in traditionally millet-only dishes, but more importantly the rising demand in maize for animal and poultry feed.

In a chronological order, however, and even before talking about cereal value chains, groundnut was the first crop to be really developed in Senegal. This development took place in the 19th century by the French who started to send shipments to France for the groundnut oil industry. After independence in 1960, groundnut continued to be main cash crop and the number one crop in the country. To this day, groundnut still holds the number one spot, with a record production of 1,405,223 tons in 2017 (Fig.2).

Tubers consumed in Senegal are mainly cassava, potatoes and sweet potatoes. Cassava is by far the leading tuber crop, with over 600,000 tons produced these past years (Fig.3). It is mainly produced in the *Bassin Arachidier* and more specifically in the department of Tivaouane. Cassava has been grown in the country since even before independence. That, added to the fact that cassava is relatively easy to grow, well-integrated into the culinary habits, and an important cash crop, are some factors that make cassava the number one tuber grown in the country. Potatoes are also widely consumed but imports still remain important. Its production is on the rise and is expected to grow even more as new ambitious programs see the light of day, especially with foreign investors. Sweet potatoes are mostly grown in the *Fleuve* and its production, although less than potatoes still remains important (Fig.3).

During the 2006/2007 campaign, there were low production levels for all crops (cereals, legumes, tubers). This was mainly due to a lack of rainfall, with the rainy season shorter than usual, and delays in the distribution of inputs (subsidized seeds).

Several types of vegetables are grown, especially in the *Niayes* and in the *Fleuve* regions. The two main vegetables in terms of importance are tomatoes and onions grown respectively in the *Fleuve* and *Niayes.* Onion is the most important vegetable with early varieties developed by the

CDH in the 1980s. Onion is used in the preparation of almost all national dishes, especially in rice dishes. Its production is even more important than tomatoes that still has the advantage of benefiting from a longer and organized value chain. Tomato processing (paste) is very important and along with rice, are the two main irrigated crops promoted in the *Fleuve* region with extension services from SAED. Decline in tomato production noticed during 2014-2016 was in part due to imports of processed triple concentrate (Fig.4)

Figure 1: Trend of Cereal Production (tons)

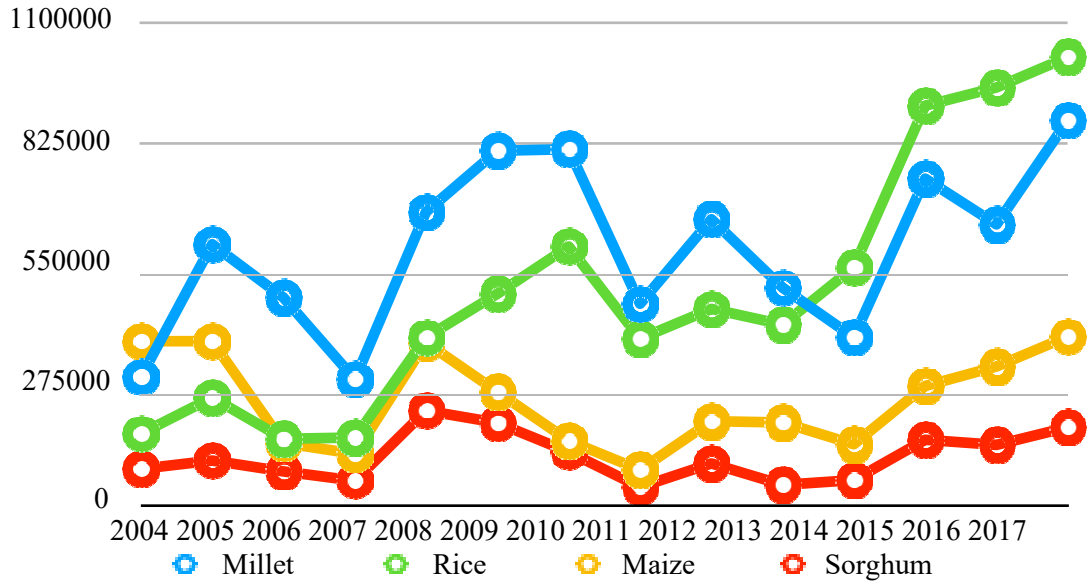
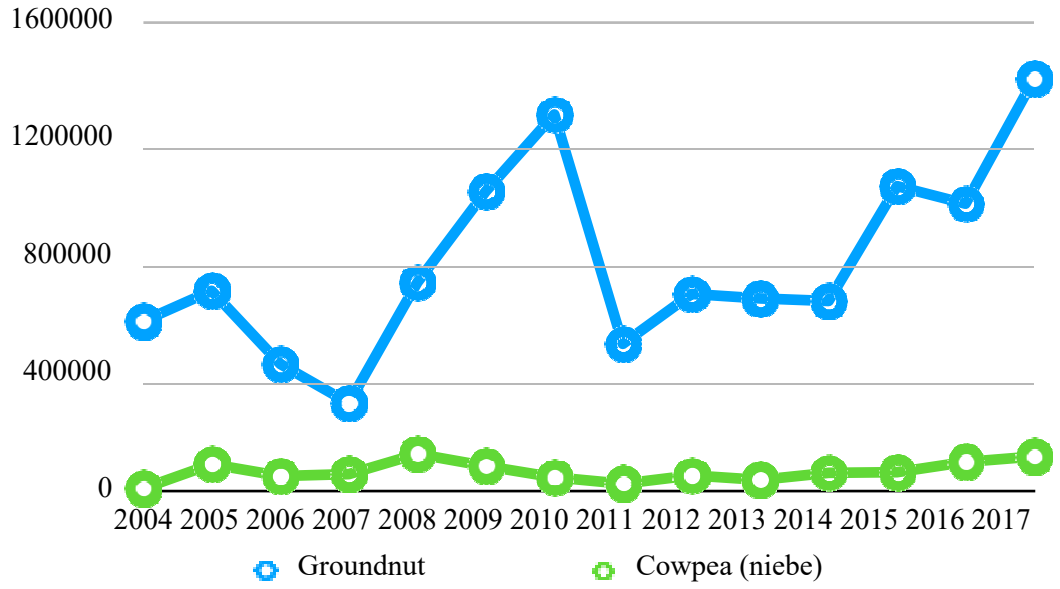


Figure 2: Trend of Legume Production (tons)



Source: FAOSTAT, Hubrural

Figure 3: Trend of Tuber Production (tons)

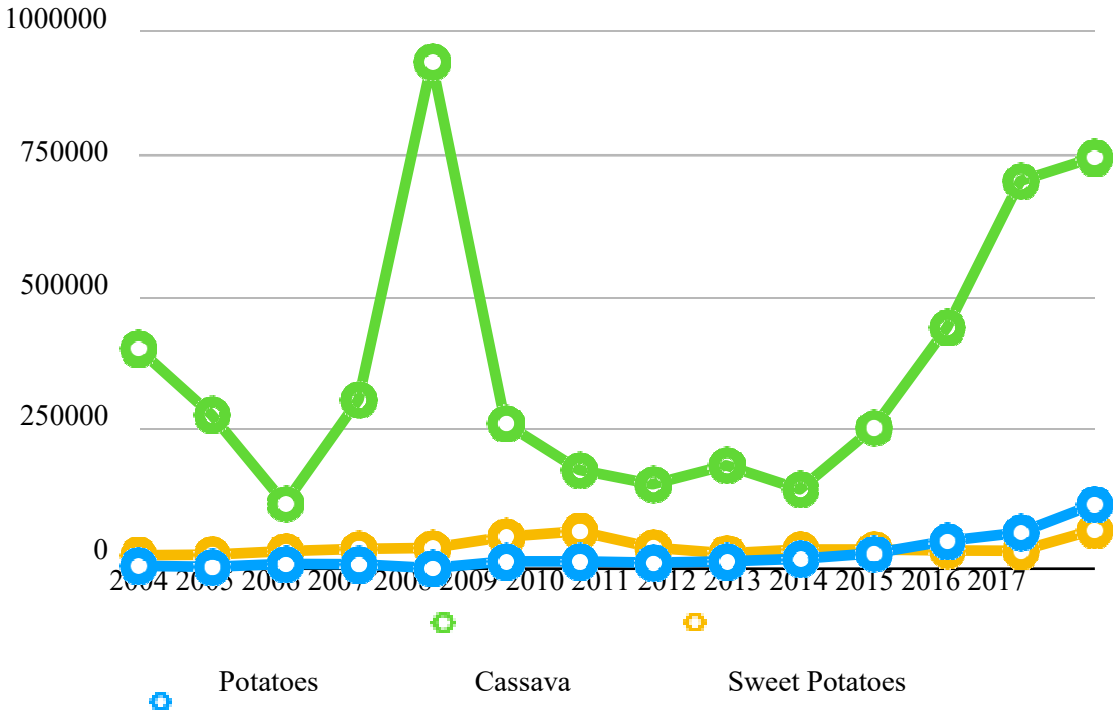
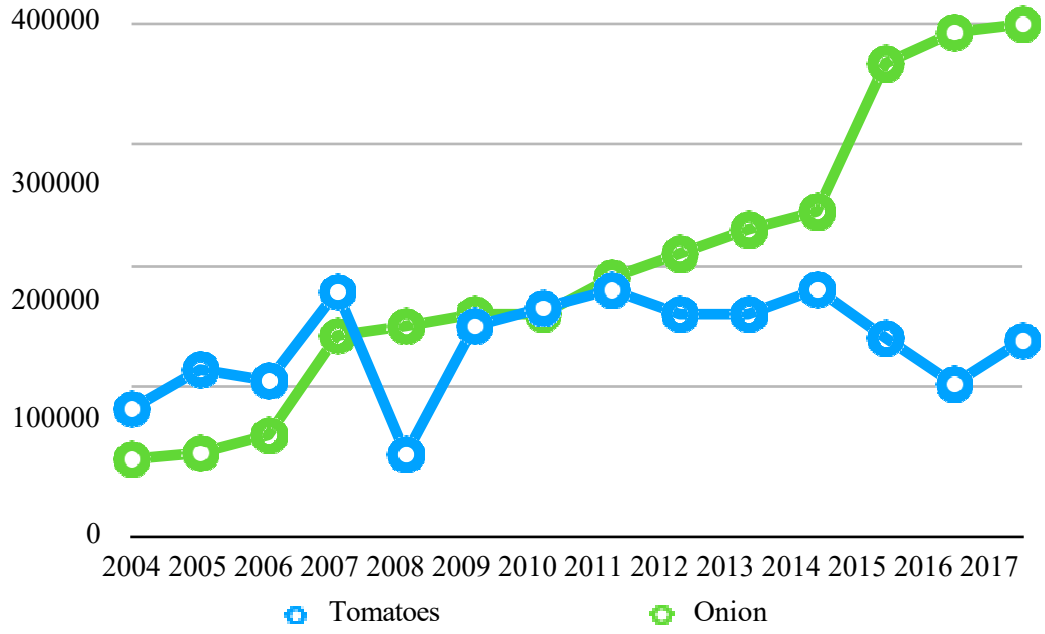


Figure 4: Trend Production Main Vegetables (tons)

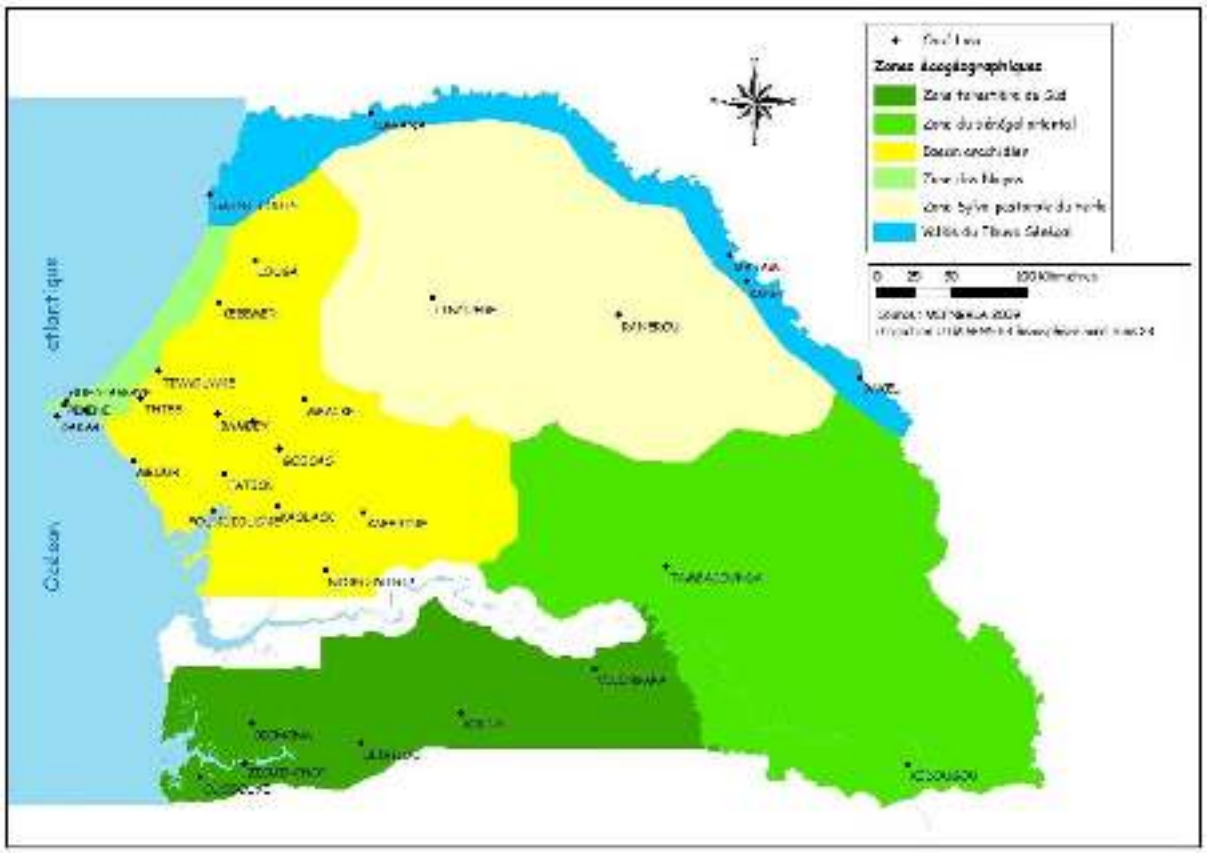


Source: FAOSTAT, DAPSA

2. Description of the country's main agro-ecologies and their cropping systems

There are six agro-ecology zones (Fig. 5) and the country's farming system relies essentially on rain. It is estimated that rain-fed farming represents 95% of total faming systems (DAPSA), so it comes as no surprise that this system is found in the entire country, but is predominant in extensive cropping systems areas or in mixed areas, i.e., areas where both extensive cropping systems and extensive livestock systems co-exist.

Figure 5: Agro-ecology zones of Senegal



**** Le Fleuve Senegal***

Covers a total area of 22,472 km2. Crops such as sorghum, maize and rice are grown in *flood retreat* systems. The *Senegal River* is the primary zone for *irrigation farming* with rice cultivation (irrigated rice). In the *Fleuve Senegal*, we can distinguish:

- *The Diéri:* Rain-fed farming with cultivation of millet, sorghum, cowpeas and peanut
- *The Fondé:* Flood retreat farming with cultivation of sorghum as a main crop, followed by yams, maize and cowpea. Local varieties are usually used.
- *The hollaldè:* This is *w*here irrigated farming is predominantly found with various irrigation schemes and land. There are three seasons:
    - Cold counter-season: From November to February for Horticultural crops (vegetables)
    - Warm counter-season: From March to June for rice and groundnut
    - Rainy season: From June to October for rice, maize and sorghum

**** Les Niayes***

Covers a total area of 8,883 km2 along the northern coastal area.

- A relatively small area with traditional agricultural system consisting mainly of groundnut and millet
- Alarger horticultural area: From the *Gandiolais* of Saint-Louis to Dakar with a diversification of horticultural crops but with a predominance of onion cultivation. Besides onion, European-types vegetables are grown in the cold counter-season and African-types vegetables in warm counter-season

**** Le Bassin Arachidier***

Covers a total of 38,728 km2 with mostly sandy soil, low organic matter content and degraded soil from over cultivation and lack of adequate soil regeneration programs. The southern part of the *Bassin Arachidier* has more fertile soil where groundnut, sorghum, maize and cassava are grown. This is the primary groundnut production area in the country.

* ***La zone sylvo-pastorale***

Covers a total of 36,289 km2 but faces desertification and continuous disparition of vegetation. Farming systems are mainly rain-fed and subsistence farming of millet and cowpea. This is the primary zone for extensive livestock in the country.

**** La Casamance***

Covers a total of 16,632 km2 and has a tropical climate with lots of vegetation and forests. Agriculture in the *Basse Casamance* is dominated by lowland farming of rice with a rotation of millet, and groundnut in the plateaus. In the *Moyenne Casamance*, it's rain-fed farming of millet, sorghum, maize with rotation of groundnut and lowland rice. The same farming system and crops are similarly found in the *Haute Casamance*.

**** Le Senegal Oriental***

Along with the *Haute Casamance*, covers a vast area of 73,718 km2. This is an area with extensive livestock. Most of the firewood consumed in the nation also comes from this area. The Senegal Oriental is primarily known for its cotton production.

Arable land in the country represent 20% of the total land. Approximately 66% of the total arable land is under cultivation and from which, only 2% benefit from irrigation schemes. A detail of arable land availability by agro-ecology and agricultural systems can be found in Table 6.

Table 6. National arable land and agricultural systems land use (ha).

Agricultural Systems	Fleuve Senegal	Niayes	Bassin Arachidier	Sylvo-Pastorale	Casamance	Senegal Oriental
Rain-fed	40000	17200	1748900	107800	297800	-
Irrigation	60000	6400	600	-	1200	-
Flood retreat	30000	-	-	-	-	-
Total cultivated land	130000	23600	1749500	107800	299000	-
Non-cultivated land	170000	12600	419200	42200	451500	-
Total arable land	300000	36200	2168700	150000	750000	-
National Arable Land	8%	1%	57%	4%	20%	10%

Source: Plan Céréalier, DEL/L Berger et al. in Plan d'Action Foncier, 1996

3. Current status of agricultural extension activities

Extension services have been present in the country since the independence, in the early 1960s. At that time, extension services were directed to then export crops, such as cotton, rice, and groundnut. Services have evolved over time.

Following the world Bank new strategy, *From Vision to Action* of 1997*,* the *Projet des Services Agricoles et d'Appui aux Organisations de Producteurs (PSAOP)* was founded with agricultural productivity at the heart of its preoccupations. Some key components of this program were:

* Funding and development of NARS and facilitating access of farmers to technological innovations
* Strengthening of farmer-based organizations and cooperatives, the main one being *l'Association Sénégalaise pour la Promotion des Petits Projets de Développement à la Base (ASPRODEB).* Another one that intervenes in seed multiplication programs is the *Réseau des Organisations Paysannes et Pastorales du Sénégal (RESOPP)*

* Facilitating the development and privatisation of agricultural extension services with the establishment of *l'Agence Nationale de Conseil Agricole et Rural (ANCAR)* in 1999.

ANCAR became then responsible of all agricultural extension services in Senegal and uses these approaches:

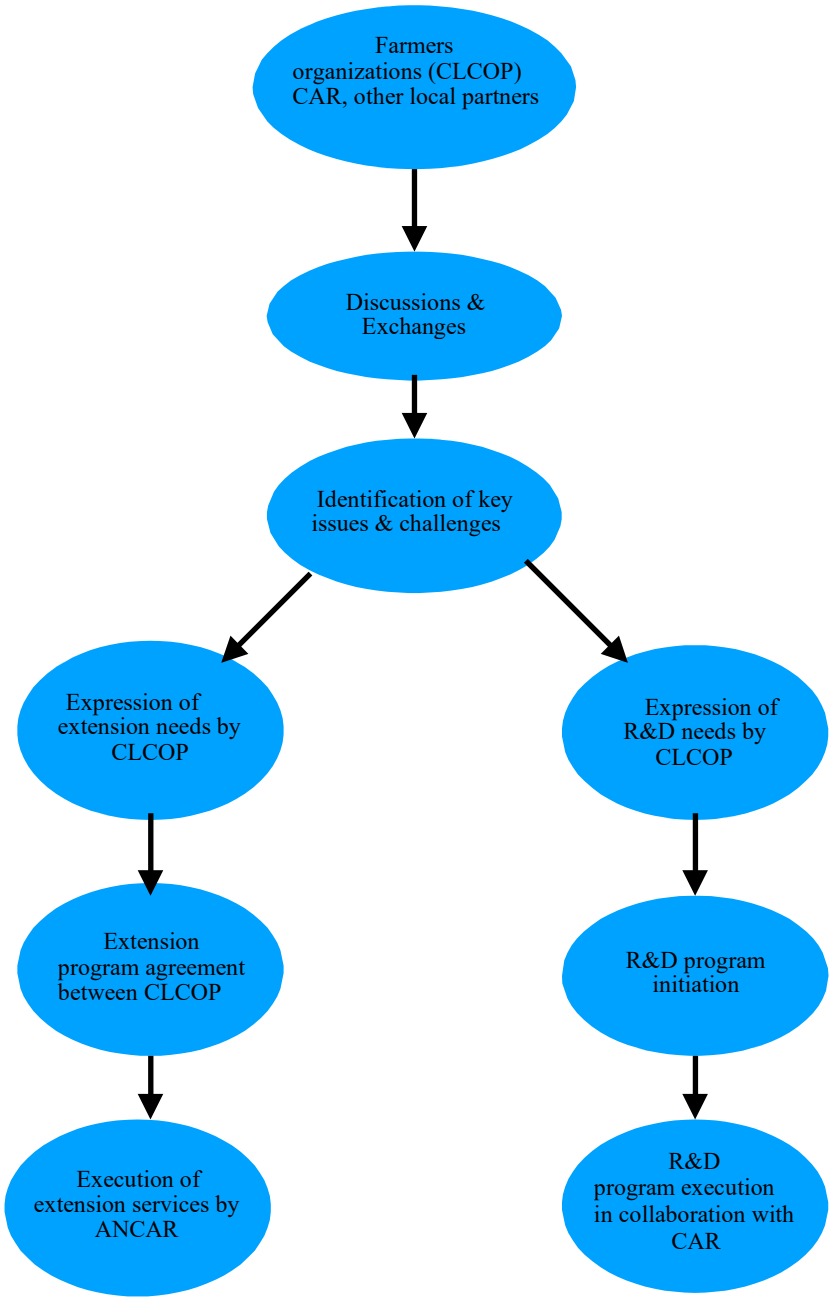
* Global: ANCAR intervenes in all agriculture-related activities
* Participative: Nature of extension and advisory services will be determined by farmers, following their needs, therefore requiring a strong partnership and dialogue between ANCAR and farmer-based organisations
* Communication: Strong communication channels to provide relevant and appropriate information to farmers

In summary, the PSAOP program had farmer-based organizations and extension services at the heart of its preoccupations.

Senegal is administratively divided into 14 regions, 45 districts or *départements,* 133 sub-districts or *communes d'arrondissements (CA)* and finally, 320 *communautés rurales (CR).* Within a CR, various farmers organizations can be organized into a local committee (CLCOP for its French acronym).

ANCAR's extension agent at the CR level is called *Conseil Agricole et Rural (CAR).* The CARs directly work and interact with farmers organized into CLCOPs, nationwide. With its participative model, ANCAR's extension programs and advisory services are initiated at the farmer-based level in the CRs. A flow chart of how an extension program is initiated is shown in Figure 6.

Figure 6. Initiation of Extension Programs at ANCAR (IPAR, 2018)



A survey done in 2010 showed that 85% of CLCOP were satisfied with services provided by CARs. About 72% of farmers adopted at least one technological innovation from extension services and 62% saw improvement in their food security. ANCAR coverage rate was estimated at 64% with a presence in 205 out of 320 CRs (World Bank, 2011).

In 2017, there was a 24% vacancy rate due to lack of funding to pay salary of new staff (Feed the Future, 2017). CARs have basic equipment like PADEX boards that they use during their training sessions but not much technological equipment.

Besides ANCAR, there are also Regional Rural Development Agencies or *Sociétés Régionales de Développement Rural (SRDR),* established by the government to operate in particular zones and on particular themes. In the Senegal River Valley, the Senegal River Development Agency (SAED for its French acronym) was established in 1965 for the development of irrigated agriculture (rice and horticulture crops). In *Casamance* and *Senegal Oriental*, the Agricultural and Industrial Development Agency (SODAGRI for its French acronym) also established back in 1974 focuses on rice, maize, banana value chains, irrigation schemes, extension and advisory services to name a few. In *Senegal Oriental* and *Haute Casamance,* the textile development agency (SODEFITEX for its French acronym), established in 1974 is responsible of cotton production in Senegal with extension and advisory services.

There are also development projects implemented by government agencies, national or international NGOs or private firms. These projects are usually funded by particular donor agencies and focus on particular areas and are of limited duration. Such projects include "Naatal Mbay", implemented and funded by USAID (Feed the Future, 2017).

The Federation of Non-Governmental Organizations (FONGS for its French acronym), also founded in 1976 counts 31 farmers associations, 3000 villages and 120,000 members. The organization manages development projects and sometimes provides advisory services to its members (Feed the Future, 2017).

4. Level of adoption of improved crop varieties, by crop

The level of adoption of improved and certified crops varies, depending on the crops considered. On average, 16% of farmers use certified seeds (Table 7). The highest level of adoption is found in cotton, with 91% of farmers using certified seeds, followed by irrigated rice with 78%, and only 17% for groundnut and maize. The lowest is found in rain-fed rice with 12% and a national average of 16%. Around 9.1% of farmers declare not knowing the origin of seeds used (FAO, DAPSA, 2018). The high level observed with cotton can be explained by the resources and the organization of SRDRs such as SODEFITEX, cotton being an important cash and export crop. SODEFITEX has been operating since 1974 and has been doing extension and advisory services for decades with the development of varieties from ISRA. The same situation applies for irrigated rice with SAED, which is another SRDR that has been promoting rice and tomato cultivation in the *Fleuve* region for several decades now, and with encouraging results. Low usage of certified seeds for groundnut, maize and other crops for that matter can be attributed to lack of certified seeds and awareness among other reasons.

Table 7. 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

Source: FAO, DAPSA, 2018

5. Level of adoption of climate-smart and highly nutritious crops

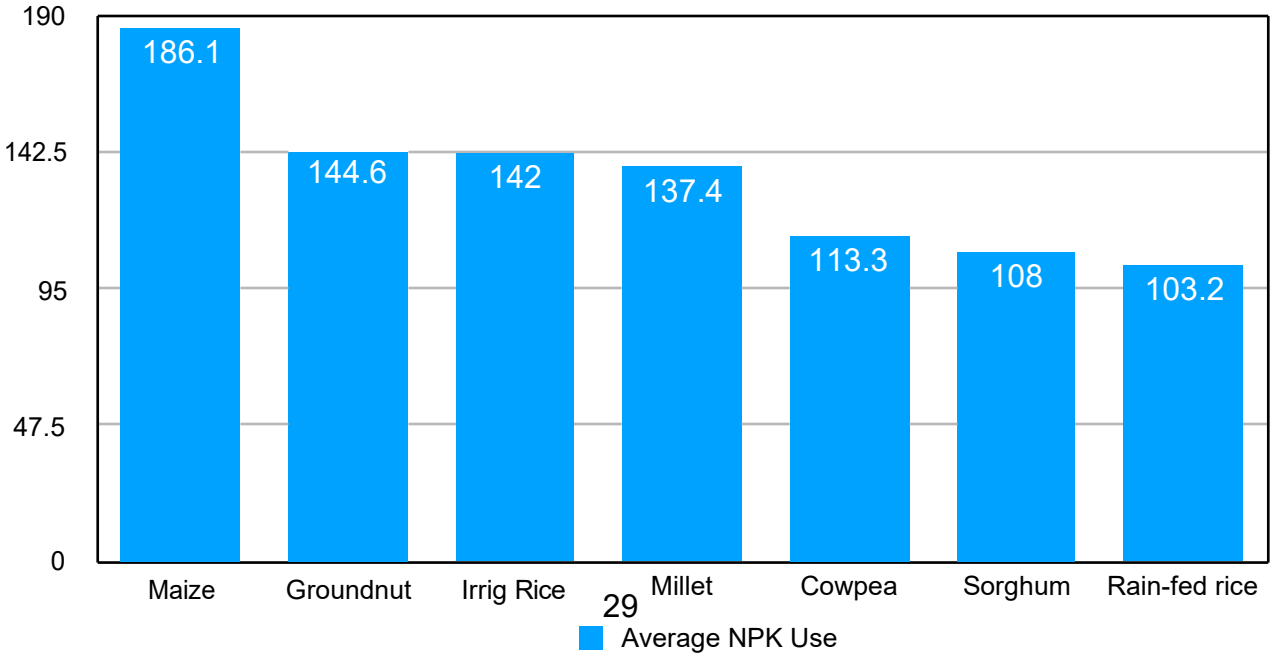
Horticulture was introduced in Senegal in the 19th century, with the first vegetable gardens seen around the capital Dakar (MDR, 1989). Traditionally, staple and cash crops value chains such as groundnut, cotton, irrigated rice have been the ones well supported and structured by the National government. However, in an effort of diversification and developing the horticulture sector, the research center for horticulture development (CDH for its French acronym) was founded in 1972. With the creation of "horticulture belts" in the *Niayes* area, irrigation schemes in the *Fleuve* area, and the support of CDH with the creation and introduction of improved horticultural varieties, it was possible to see a diversification of the agricultural sector and an improvement in nutrition. Current needs for vegetable seeds is estimated at 3000 tons from which, 375 tons are produced in a formal way with traceability (PAPSEN, 2020).

Horticultural crops in general are well adopted by the population for they are high income sources but also for the nutritive values they bring. 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).

6. Level of utilization of fertilizer and manures to increase crop yields, by crop

The use of NPK fertilizers and urea is shown in table 8. There is a larger use of NPK than urea

Figure 7: Average Fertilizer Use for Field Crops-NPK (kg/ha)



with 31.5% for NPK and 15% for urea (FAO, DAPSA, 2018). There is more NPK use in the regions of Kaolack, Kédougou, Saint-Louis and Kaffrine. Urea use is more important in Saint-Louis, Sédhiou and Kaolack due to the predominance of rice production in these regions. Farmers typically use more fertilizers for maize, groundnut, millet and irrigated rice with the highest for maize with an application rate of 186kg/ha (Fig.7). Although, maize is the third cultivated cereal in terms of importance after rice and millet, it benefited from the National Maize program launched in 2003. Similarly, 34.2% of farmers use organic matters and less than 10% use other types of organic fertilizers (table 9). The use of organic matter is more important in the regions of Thiès, Diourbel, Kaolack with more than 50%. There are extensive livestock systems in those areas that favor the use of organic matter.

Table 8: Mineral fertilizer use by region

Region	NPK (%)		Urea (%)	
	No	Yes	No	Yes
DAKAR	92,8	7,2	95,2	4,8
DIOURBEL	80,6	19,4	95,8	4,2
FATICK	73,1	26,9	85,5	14,5
KAFFRINE	51,5	48,5	91,2	8,8
KAOLACK	53,3	46,7	84,7	15,3
KEDOUGOU	49,5	50,5	86,5	13,5
KOLDA	50,1	49,9	75,7	24,3
LOUGA	93,1	6,9	99,8	,2
MATAM	78,0	22,0	78,9	21,1
SAINT-LOUIS	25,0	75,0	25,8	74,2
SEDHIOU	57,3	42,7	72,4	27,6
TAMBACOUNDA	75,2	24,8	91,9	8,1
THIES	82,9	17,1	93,9	6,1
ZIGUINCHOR	82,0	18,0	86,7	13,3
Total	68,7	31,3	85,0	15,0

Source: FAO, DAPSA, 2018

Table 9: Organic fertilizer use by region (%)

Region	Compost	Organic Matter	Phosphates	Biofertilizer
DAKAR	3,2	23,2	7,2	5,6
DIOURBEL	3,5	62,4	5,4	6,9
FATICK	20,0	41,9	14,7	14,7
KAFFRINE	5,6	42,9	5,7	9,5
KAOLACK	9,4	52,6	9,8	7,5
KEDOUGOU	5,3	9,9	7,0	8,1
KOLDA	2,4	8,1	2,2	5,8
LOUGA	15,8	47,5	17,2	18,5
MATAM	2,9	16,6	9,1	5,1
SAINT-LOUIS	1,7	11,4	2,4	7,1
SEDHIOU	7,0	24,5	8,4	6,9
TAMBACOUNDA	7,9	31,9	8,6	9,4
THIES	6,0	61,7	6,4	5,9
ZIGUINCHOR	2,7	7,2	3,4	3,5
Total	7,7	36,9	8,2	8,9

Source: FAO, DAPSA, 2018

7. General description of the current system for marketing surplus production of staple crops

Although efforts are being made, the production of staple crops still falls short of covering the country's needs, so there were no surpluses to be commercialized. Total raw cereal production for 2018 was estimated at 2,732,109 tons, with a net production of 1,985,286 tons. For 2017, raw production was estimated at 2,549,357 tons, with a net production 1,559,770 tons (DAPSA, 2018).

To cover the deficits, there was an import of 1,213,264 tons in 2018 and 1,107,113 tons in 2017 (ANSD, 2018)

8. Trends in development of markets for staple food crops

In Senegal, average distance between villages and local markets is approximately 10 kms. In certain regions, this distance can be even more important, reaching for instance 17 kms in Tambacounda and 35 kms in Kedougou. In addition, around 40% of villages are at least 10 kms away from functional roads (AGVSAN). For long, this has been the biggest hurdle faced by farmers in marketing their products. Fortunately, with the PRACAS program of the PSE, the government has made it a priority with an ambitious program of a stronger road network in rural areas. Markets do already exist for all crops but since this program has started several years ago, it has tremendously helped farmers in growing more crops and improved their marketing capacities.

III. NATIONAL AGRICULTURAL RESEARCHSYSTEM

1. Description of the public institutes and universities actively engaged in crop breeding

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 responsibility of the Agriculture Ministry (MAER for its French acronym) and financially under the responsibility of the Finance and Economy Ministry. The institute has a mandate to create new technological innovations, to train young scientists and share its scientific results.

A law voted in 1997 allowed ISRA to become a public institute with scientific and technological mandate, giving ISRA more autonomy with the possibility of generating profit from the results of its research activities and widen the collaboration with the private sector and international organisations. In this regard, funding from the Senegalese government has diminished and ISRA finds additional funding with National and International Donors (CORAF, FNRAA, PPAAO, IFPRI, AfricaRice, ACDI, USAID, etc.).

All public plant breeding activities are under the responsibility of ISRA. The various breeding programs are carried out within ISRA's different research centers.

2. Level of capacity of public crop breeding institutions

2.1. Scientific personnel

A survey done in 2014 showed that 79% of researchers were PhD level and 21% were MSc level (Table 10). Since 1999, a PhD is required to be considered a researcher. About 38% of ISRA's researchers work in the field of agriculture, followed by livestock (18%). Agricultural research represents 51% of ISRA's total activities but with only 38% of its scientists dedicated to it (Gaye et Sène, 2014). Women also represent only 12% of total researchers (Table 11).

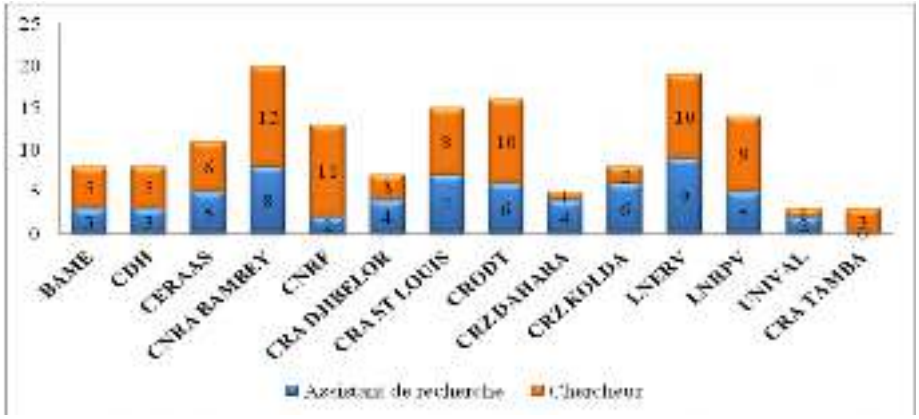
The institute also suffers from lack of researchers. Besides scientists retiring, some also leave for the private sector or for international organizations. The latest update in 2018 shows a net increase of researchers from 68 to 86 in total with 10 senior researchers compared to 5 in 2014 and 76 researchers of other categories compared to 63 in 2014 (Figure 8).

Table 10. Researchers classification according to degrees and fields

Field	PhD	MSc	BSc	Total
Rural Economy	3	1	0	4
Agronomy	15	0	0	15
Plant Breeding	7	4	0	11
Animal sciences	9	3	0	12
Biodiversity	0	0	0	0
Cropping systems	0	2	0	2
Ecology	1	0	0	1
Entomology	6	0	0	6
Extension	0	0	0	0
Fisheries	6	0	0	6
Food and nutrition	0	0	0	0
Forestry & Agroforestry	3	3	0	6
Molecular biology	1	0	0	1
Natural resources	0	0	0	0
Pedology	1	0	0	1
Water management & irrigation	1	1	0	2
Others	1	0	0	1
Total	54	14	0	68

Source: ASTI/IFPRI-CORAF/WECARD (2013-2014)

Figure 8: Scientific personnel



Source: CA ISRA, 2018

Table 11. Researchers classification according to gender, age, title and seniority

Variables	Modalities	Frequency	Percentage (%)
Gender	Women	8	12
	Men	60	88
	Total	68	100
Age	<31 years	1	1
	31-40 years	13	19
	41-50 years	19	28
	51-60 years	20	29
	>60 years	15	22
	Total	68	100
Title	Senior researchers	5	7
	Researchers	63	93
	Total	68	100
Seniority	<1 year	0	0
	1-4 years	19	28
	5-7 years	5	7
	8-10 years	8	12
	11-15 years	8	12
	>15 years	28	41
	Total	68	100

Source: ASTI/IFPRI-CORAF/WECARD (2013-2014)

2.2. Infrastructure

The institute counts a total of 15 research centers throughout the country equipped with laboratories (Table 12). Location of research centers in specific areas takes into consideration agro-ecologies as well local agricultural and cropping systems. There are also some important and strategic research centers, such as the National Agronomy Research Center of Bambey (CNRA for its French acronym) that carries research programs for the entire country.

In total, ISRA counts 40 laboratories for the various fields of agriculture, forestry, livestock, etc.

There are for instance, laboratories of entomology, phytopathology, weed sciences, genetics and

molecular biology, plant physiology, In-vitro, etc. Some old buildings are however deteriorating. This is the case for the CNRA of Bambey, the Horticultural Research Center of Camberene (CDH), the CRA of Saint Louis (Gaye et Sène, 2014).

Table 12. Infrastructures of ISRA

Research Stations	Location	No of Laboratories	Descriptions
CRA St Louis	Saint Louis	4	Soil, water analysis, weed sciences
ISRA	Dakar	3	Vaccine production (Senegal & neighboring countries)
PRH	Dakar	0	Headquarter of LNERV centers
BAME	Dakar	0	Research on economy and social sciences
CNRF	Dakar	3	Forestry program (seeds, nursery), microbiology
CRODT	Dakar	2	Fishery and chemistry laboratory
LNERV	Dakar	5	Microbiology, avian pathology, parasitology, livestock, livestock breeding & genetics
CRZ	Kolda	3	Entomology, agronomy, plant breeding, livestock
CDH	Dakar	4	Entomology, phytopathology, plant breeding (horticulture)
CNRA	Bambey	4	Plant breeding, entomology, phytopathology, weed sciences, soil/ water/plants
CERAAS	Thiès	3	Entomology, Genetics & molecular biology, agro-physiology, resilience
CRA Dahra	Dahra Djolof	1	Vaccine production
ISRA (Headquarters)	Dakar	0	Management and administration of ISRA
CRA Djibelor	Ziguinchor	4	Soil/water, entomology, phytopathology and seed production
LNRPV	Dakar	4	In-vitro, molecular biology, microbial ecology of soils and agro-systems

Source: ASTI/IFPRI-CORAF/WECARD (2014)

3. Nature of recent or ongoing crop improvement activities, by crop

The Institute has several crop improvement programs with a major focus on main staple crops such as groundnut, rice, millet, maize and sorghum for instance. In general, agricultural productivity, disease and pest resistance, climatic adaptation are some research thematics (ISRA, 2018). Some examples:

* **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 3895kg/ha, while 'ART 3-7-L9P8-1-B-1-B' yielded 3202 kg/ha compared to 'Nerica 6's 1433 kg/ha. These two 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 2018 to 2768 kg/ha were tested in Sahelian environment. Fifteen intermediate varieties (80-90 days) with a yield of 1359 to 2458 kg/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* for post-harvest contamination of aflatoxin. Three resistant accessions, '12CS_084', '12CS_037' and '12CS_106', show great potential and could help introgress resistance into elite cultivars. Ten new varieties with great yield and good climatic adaptation were released.

* **Sorghum**: Ten new varieties (5 for the North and 5 for the South) were developed. These hybrids yielded 10 to 60% more than the controls. Traits such as size of grain, yield, and losses due to fungi were taken into account. After multi-local and adaptation trials, four varieties showed great performance: 'Nguinthe', 'Faourou', 'Darou'and 'Nganda'. These varieties were issued 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 toimprove maize adoption with the creation of the 'HVB' series: 'HVB1' and 'HVB2' (Hybrides variétaux de Bambey for its French acronym) in the CNRA Bambey. In the years 2000s, open-pollinated varieties with better adaptation and high yield were released. Some interesting

varieties were: ‘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’, ‘LY 1001- 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 should help speed up the onion breeding program and seed production.

Many varieties have been developed by ISRA over these past decades. For a more complete list of varieties released by ISRA and characteristics, see ANNEXES I and II. For an updated list of current varieties of rice, groundnut, millet, sorghum, cowpea and maize and their performance, see ANNEXE III.

4. Current status of crop variety licensing arrangements for production of seed by third party entities

There are no licensing arrangements for production of seed by third party entities.

IV. STATUS OF SEED SUPPLY

1. History of crop breeding and seed supply in the country

Agricultural research in Senegal could be traced back to the early 19th century when the French botanist Jean Michel Claude Richard created the first "botany garden" in Saint-Louis and established some experimental trials in the town of Richard-Toll (town named after the same Richard, and "toll" meaning farm in the local language). Richard arrived in Senegal in 1816 and left the country in 1825. Under his direction, a number of new species were introduced in Senegal, including bananas, cassava, groundnut, oranges, sugar cane and coffee, for instance (Wikipedia). He is also credited for conducting for the first irrigated rice trials in Richard-Toll. Much later, in 1921, was established an experimental and trial station in the *Bassin Arachidier* in Bambey, mostly for groundnut. Groundnut was already an important cash and export crop. After the 2nd world war, several tropical research centers started to be established for Agriculture, livestock, forestry, fisheries, etc. (ISRA, 2005).

After independence in 1960, the Senegalese government, aware of the need to develop its science and technology sector in order to grow its economy, started to invest in it. With the 1965-1969 National Social and Economic Plan, a National Research Committee was born to develop national research occupied until then by french nationals. With the primary sector, especially agriculture at the heart of the government's preoccupations, and infrastructures inherited from the French, this led to the establishment of CDH in 1972 for horticulture research and ISRAin 1974 for all other crops.

Within ISRA, all major breeding programs are located in the CNRA of Bambey, within the Cereal and Legume Seed Production Unit (UPSEM- CL).

The history of the seed supply system could be summarized in three periods:

* From 1960 to 1989: With complete involvement of the National Government. The country's needs in certified seeds were in general completely covered with specific seed multiplication programs
* From 1989 to 1999: Coincided with the withdrawal of the National Government of seed multiplication and marketing programs and the establishment of the National Seed Union (UNIS) to help with the privatization of the seed sector. The results of this privatization did not

meet the anticipated expectations as national needs were no longer covered and there were quality concerns as well for cereals, groundnut, and vegetables seeds produced.

* From 1999 to present: Coincided with the development of more local initiatives and involvement of farmer-based organizations. A partnership between ISRA and ANCAR to help local seed producers and farmer-based organizations in general with extension and advisory services. This partnership also involves the DA/DISEM, CARITAS, POGV, RESOPP, ASPRODEB, UNIS, etc. Presently, all certified seeds of rice, millet, maize and sorghum for instance are produced through these channels. Improvements are noted in general but national needs are still not covered (DISEM, 2020).

2. Recent and ongoing activities aimed at release of improved crop varieties, by crop

Several research programs are ongoing for the different crops (section 3.3). There are no special activities destined for the release of improved seeds except for the normal procedures and breeding programs currently underway (sections 3.3 & 5.5).

3. Recent and ongoing activities aimed at increasing supply of improved seed

Over the past decades, The Senegalese government has made great efforts to improve the supply of certified seeds. However, since the 1990s, with the Government's withdrawal in national seed programs, seed shortages became more and more noticeable accompanied by a deterioration of seed quality. This led in the last decade to the decision by the government to the rebuilding of the National Seed Stock or *Reconstitution du Capital Semencier National*. The West Africa Agricultural Productivity Program (WAAPP), an ECOWAS program funded by the World Bank and FAO programs, for instance, helped with this seed initiative. The WAAPP program implemented by CORAF/WECARD has probably been the most important program that helped the seed sector in recent years (see chapter VI). Last but not least, the Senegalese government also helped with funding, subsidy programs and also allocated 2000 ha of land to ISRA to boost the production of breeder and foundation seed. As an example, potato that comes second behind cassava in tuber consumption saw a net improvement. The National Government, to improve the potato seed supply, injected 3.4 billions CFA in subsidies in 2018, compared to 130 millions in

2013. In agricultural terms, this translated as an increase from 500 tons of seeds in 2013 to 10,444 tons of seeds in 2018.

4. Private, non-governmental and farmer-based organizations involved in seed supply and their estimated annual supply

National seed productions are usually carried out by farmers organized into farmer-based organizations and co-operatives. There are major seed production organizations in the country and most farmers involved in seed production belong to these organizations: ASPRODEB, UNIS and RESOPP. ASPRODEB is an important one, counting 34 cooperatives, while RESOPP counts 6 cooperatives and UNIS 69 cooperatives. While ASPRODEB and RESOPP engage in various agricultural activities besides seeds, UNIS on the contrary is exclusively engaged in the seed sector. Unlike typical farmer-based organizations such as ASPRODEB, and RESOPP, UNIS was created in the wake of the Government withdrawal of the seed sector in the 1990s, and serves more as a union, point of contact and facilitator for all seed actors. 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. RESOPP has its own network and is exceptionally not a member of UNIS.

A list of private companies and cooperatives involved in the seed business are presented in Tables 13-15. Their activities are not restricted to seed but also involve inputs such as fertilizers, phytosanitary products, tools, etc. From this list, companies like TROPICASEM and SEDAB have their headquarters in Senegal. TROPICASEM is member of the international NOVALLIANCE group which is a network of 45 companies with a presence in 40 countries, and over 600 employees. In Senegal, TROPICASEM counts 90 employees with approximately 60% of its employees in the research department. SEDAB is also heavily in the production, distribution and sale of field crops such as maize, rice and groundnut and has an important presence in the country. Another important player is the group TOOLBAYE, based out of Kaolack, and also involved in the production of groundnut and cereal seeds. Groupe TOOLBAYE currently works with a network of over 500 seed producers exploiting over 1000 ha of land and produces an average of 1700 tons of certified seeds for crops such as groundnut,

millet, maize, sorghum and cowpea. Some other organizations not in this list are: TRAORE ET FRERES, TOP MOUNTAIN, SODISEM, SPIA, RMG, SOLEVO, etc. This list is not exhaustive. In 2016, for instance, 138 seed producers were registered by the Ministry of Agriculture and Rural Equipment (MAER) as producers of certified seeds for the four main crops (maize, rice, millet and groundnut). These seed producers could be grouped into four categories: seed companies, associations, co-operatives/farmer organizations and individuals. Annual seed production varies greatly and difficult to estimate due to large number of actors involved. Out of the 138, there were 13 farmer organizations, 25 seed co-operatives, and 85 individual seed producers, for instance (TASAI, 2017).

Table 13. List of private seed companies marketing seed in Senegal.

Companies	**Crops**		**Types of activities**					
Companies selected based on seed access index	Field crops	Vegetables	Breeding site	Experimental site	Seed production	Seed conditioning	Sales	Extension services
Bayer	X	X					X	
Bejo	X	X		X			X	X
Corteva Agriscience	X						X	
East-West Seed		X		X			X	
Faso Kaba	X						X	
Known-You Seed		X					X	
Limagrain	X	X					X	
NAFASO	X						X	
Nongwoo Bio		X					X	
Pop Vriend Seeds		X					X	
Rijk Zwaan		X					X	
Sakata		X					X	
Seed Co	X				X		X	
SEDAB	X			X	X	X	X	
Soprosa	X						X	
Syngenta	X	X	X				X	
Technisem		X	X	X	X		X	X
Tropicasem		X	X	X	X		X	X

Source: accesstoseeds.org

Table 14. List of other national seed companies

Companies	Crops		Types of activities		
	Field crops	Vegetables	Breeding site	Seed production	Sales
Cadre de Concentration des Producteurs d'Arachide (CCPA)	X			X	X
GIE Khaly Amar Fall	X			X	X
Coumba Nord Thiam (CNT)	X			X	X
Réseau des Organisations Paysannes et Pastorales (RESOPP)	X			X	X
Réseau National des Coopératives de Producteurs de Semences (RNCPS)	X			X	X
Société de Commercialisation et de Distribution de Produits Agricoles (SOCODISPA)	X				X
Etablissement Tambedou et Fils (ETB TAMBEDOU et Fils)	X				X
Niayes Sarraut (NS)		X			X

Source: accesstoseeds.org

Table 15. List of notable seed cooperatives

Companies	Crops		Types of activities		
	Field crops	Vegetables	Experimental site	Seed production	Sales
	X		X	X	X
Coopérative agricole de Kelle Guèye (COOPAKEL)	X		X	X	X
Coopérative agricole de Diendé (COOPAD)	X		X	X	X
Coopérative de Kahi	X		X	X	X
Coopérative de Paoskoto	X		X	X	X

Source: accesstoseeds.org

5. Facilities and equipment available for seed processing and packaging in the country

With the exception of Dakar, almost all regions are equipped with seed processing centers. Most of these processing centers, however, have old and out-dated equipment. Three seed processing centers were recently renovated: one located in the North in Richard-Toll, one in the Center in Kaolack, and one in the South in Kolda. The seed processing centers are fully equipped and the one in Kaolack is the latest one and inaugurated in 2015. The Kaolack center has a capacity of 1.5 tons/hour and a yearly production capacity of 3000 tons of certified seeds. Seeds of crops such as millet, maize and sorghum for instance could be processed there. The Richard-Toll processing center was also rehabilitated in 2015 and has a capacity of 3.5 tons/hour and is especially destined for rice processing. The Kolda new processing center also has a capacity of 3.5 tons/hour mainly for rice, millet, maize and niébé. The following types of packaging are usually available: 16 kg for maize, 40 kg for paddy rice, 50 kg for groundnut, and 4 kg for millet.

Drying

Seed separation (Vannage)

Sources: Enda Pronat, 2018

6. Tonnages of seed certified and marketed in the past five years, by crop

Tonnages of certified seeds for main crops is shown in Table 16 for the past three campaigns. As explained earlier, groundnut has historically been the most important cash and export crop, dating back the 19th century. It still is the number one crop and at the same time a strategic crop that greatly benefits from government subsidy programs. This largely explains the important

quantities produced (Table 16). It is to be noted that seeds of R3 generation ("semences ecremees") are also included in this total, 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, for the 2017/2018 campaign, out of the 142,969 tons produced for groundnut, there were 915.5 tons of G4, 8,613 tons of R1, 47,930 tons of R2, and 85,510 of R3 (RCSA, 2017). Annual needs for certified seeds for groundnut are estimated at 100,000 tons. Overall, there was a real improvement in production for most crops in the 2018/2019 season, especially for groundnut, rice and maize. An example of certified seeds produced by the private seed company SEDAB is shown in Annexe V. SEDAB specializes in groundnut, maize and rice.

Table 16. Production of certified seeds (tons)

CROPS	2016/17	2017/18	2018/19
Groundnut	92798	142969	168923
Millet	3997	2236	3775
Maize	21094	15212	28100
Rice	7414	7528	12420
Sorghum	5904	4187	9420
Niebe	1284	953	1150

Source: ISRA, 2020

7. Number of agro-dealers currently in operation, by region

Regarding agro-dealers, it is difficult to provide an exact number as they are very informal. These so-called agro-dealers can be found in most towns, villages and markets in the countryand therefore difficult to find an exact count. 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 agro-dealers, the country has a network of government-owned warehouses ("seccos"), which 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 inadvertently serve as agro-input distribution points. Currently, there are approximately 700 "seccos" across the country with capacities varying between 200 and 1000 tons. Generally speaking, there are limited availability of agro-dealers. A 2013 survey of farmers (Ndiaye, Audet-Belanger, & Gildermacher, 2015) confirmed that less than 5% of groundnut and millet farmers sourced their seed from agro-dealers. None of the maize or rice farmers in the sample sourced their seed from agro-dealers. Apart from farmer-saved seeds, the most important sources of seed were the direct sales from seed producers, informal market, "seccos", and friends and neighbors.

8. Level of importation of certified seed from neighboring countries, by crop

There are seed imports from countries like Burkina Faso (NAFASO) and Mali, for instance (SOPROSA, FASO KABA). For SOPROSA, the imports were mostly for rain-fed rice with around 600 tons of 'Nerica 4' and 'DKA-27' varieties and sometimes for maize hybrids. For FASO KABA, imports were also mainly for rice varieties such as 'Nerica 4', 'Wassa' and 'BG'. The most important import from FASO KABA was observed in 2015 with approximately 200 tons. To be noted, that there has been no imports from this group since 2017.

V. NATIONAL SEED POLICY FRAMEWORK

1. Documents which control the production and supply of seed

Seed production and marketing in Senegal is regulated by the 1994 law (Law 94-81 of December 23, 1994) and its subsequent application decrees (97-602, 97-603 and 97-616 of June 17, 1997).

*** Law N.94-81: For the registration, production, certification and marketing of seeds and plants.**

The law determines all requirements for the registration, production, certification and marketing of all seeds and plant materials. The Minister of Agriculture approves the registration of a variety in the National Catalog following the recommendation of the CNCSP. Entities willing to engage in the production and marketing of seed and plant materials need special government authorization and seeds must be certified prior to commercialization. For the application of this law, three decrees were voted:

- **Decree N.97-602:** For the establishment of the National Catalog that include all species and varieties grown in the country and a national variety map. Details of the registration procedures for new varieties and required experimentation protocols are also included in this decree.

- Decree N.97-603: For the establishment of CNCSP, in charge of reviewing variety registration applications, giving recommendations, and also the assessment of national seed and plant materials multiplication programs and marketing. The Minister of Agriculture is the chair of the committee and members of research, extension services, private sector and farmer-based organizations for instance have representation in this committee.

- **Decree N.97-616**: For the organization of seed multiplication programs, certification and marketing of all locally produced and imported seeds. Equally for the various requirements for certification, production of breeder seeds, foundation seeds, R1, R2, etc., During the multiplication phase, all plant and seed controls are under the responsibility of the Control Office (SOC).

This national seed law was reinforced in 2008 by the ECOWAS seed regulation C/REG. 4/05/2008 for a harmonization of national seed laws for quality control, certification, and marketing in ECOWAS countries. However, this regulation was not implemented in Senegal until January 25, 2014.

2. Process for the official release of improved crop varieties and seed actors

In summary, there are three key players in the seed sector: the National Government, the private sector, and farmer-based organisations.

The National Government through ISRA plays a major role with its breeding activities and is also at the beginning of the seed multiplication chain with the production of breeder seeds (G0, G1, G2, G3) and foundation seeds (G4). Breeder and sometimes foundation seeds are produced by ISRA's seed production unit (UPSE for its french acronym).

For registration, new varieties must undergo registration procedures with the National Seed Committee (CNCSP for its french acronym). This committee is managed by the DA/DISEM but also counts the different actors of the seed industry such as DRDR and SDDR. New varieties must also pass DHS and VAT tests such as uniqueness, homogeneity, stability and added value for instance. Seeds of G3 generation are then sold to private seed companies or other seed multiplications entities (farmer-based organizations, NGOs, etc) for production of G4 seeds before certified seeds can be produced (R1, R2).

The private sector is normally responsible for seed multiplication, processing, transportation and marketing. The various seed processing centers located throughout the country are usually managed by UNIS. The biggest client is the National Government who buys the seeds from these private seed companies and resell and distribute them to farmers at sometimes discounted rates in Government subsidies programs for crops such as groundnut, rice, millet, maize, sorghum, niébé, for instance. Seeds can also be sold directly to local farmers and other private companies.

Farmer-based organizations are also involved in the process especially with the seed multiplication programs but also in the marketing and services. Some organizations are:

* Members of ASPRODEB and RESOPP
* Members of UNIS (ASPRODEB and all major seeds producers being members of UNIS)
* Members of the SODEFITEX seed multiplication programs.

* Members of SAED seed multiplication programs

Three major farmer-based organizations (ASPRODEB, UNIS and RESOPP) are some key players and are involved in the entire seed value chain (multiplication, processing, storage and marketing), this especially after the withdrawal of the National Government in the 1990s (Faye- Mané, 2017).

3. Procedures for seed certification

According to decree N.97-616 in its articles 2 and 3, all farmers willing to engage in seed multiplication programs must obtain prior approval from the DA/DISEM. In order to be licensed for seed multiplication, farmers must therefore file an application with the DA/DISEM through the regional DRDR, in the region where seed multiplication will take place. Specific activities such as seed production, collection, processing and/or marketing should be indicated in the application. Prior to approval, the DRDR checks the following:

- Technical capacity
- Economic capacity
- Facilities (land, access, crop isolation, equipments, etc.)

Upon approval, seed producers will still need to comply with all DISEM technical guidelines and procedures (RTPs). Typically, three field visits will be performed by the DRDR (before flowering, during flowering for purity verification and after flowering for purity verification and phytosanitary status). A fourth visit could also take place during harvest (purity verification and phytosanitary status). Laboratory controls will also be performed to check for purity, diseases, germination, seed humidity for instance. Post-harvest requirements and guidelines will also need to be followed: full crop cycle and physiologic maturity of crops, seed drying, cleaning, calibration, conditioning and proper labeling, etc. (DISEM, 2020).

4. Current status of the regulatory agencies in charge of seed certification

DISEM is the agency in charge of seed certification but lacks human and financial resources to cover the entire country and effectively oversee all seed activities at the different stages of the value chain. As of 2016, DISEM had 21 seed inspectors to cover the 14 administrative regions (TASAI, 2017).

The agency also has a well-equipped national laboratory and trained personnel, allowing for all necessary seed tests to be done there. As a matter of fact, this national laboratory received the International Seed Testing Association accreditation (ISTA) in 2019, and Senegal being the first country in the ECOWAS/CILSS region with this accreditation. The ISTA accreditation comes with great benefits such as higher quality standards in seed testing, possibility of seed shipments in various parts of the world, and also a great tool for the other countries in the ECOWAS region.

5. Current status and procedures for production and supply of basic (foundation) and certified seed

ISRA is the main source of foundation seed in the country. Typically, breeder and foundation seeds are produced by ISRA's seed production unit (UPSE). However, if the needs for breeder seeds can be met by this unit, this is not the case for foundation seeds, which requires production by third entities such as UNIS, RESOPP and ASPRODEB through their strong farmers network and also by private farmers. 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 their order of G3 seeds to ISRA.

In the case of RESOPP for instance, agreements are signed between the network and ISRA for the supply of G3 and G4 seeds by ISRA, but this is in theory. In practical terms, ISRA due to lack of resources barely produces G3 seeds and 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 by these organizations or networks, members of the organization or network agree to sell at least 75% of their seed production back to the network (RESOPP in this case) since they often benefit from 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 network's certified seed stock is intended primarily (sold) to its other members (non-seed producers) in general 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. In this specific example, 25% of seeds were sold to

members and non-members farmers. The remaining 75% were sold to private companies and government as followed: *SEDAB* (32%), Government rice program-*Piriz* (18%), Agronomes et vétérinaires sans frontières-*AVSF* (13%), Catholic Relief Service-*CRS* (3%), *FEPRODES* (8%), Government-*ANCAR* (1%) (Bonnefin and Thiam, 2011). In summary, these key actors that are ASPRODEB, RESOPP and UNIS network among others, 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 in a limited percentage and in a large part to Government and private companies and NGOs. It is to be noted that many farmers obtain their 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 crops that the National Government gives current priority and wishes to promote, the percentages of subsidized seeds may vary. In general, the percentages range between 42 to 52% for R1 and R2 seeds and between 57 to 60% for R3 seeds (ANSD, 2016). Typically, crops such as rice, maize and groundnut benefit the most from these programs.

Input distribution committees (CC or Commissions de Cession its French acronym) are responsible of input distribution (seeds and fertilizers) at the CR level. All sales by seed companies such as UNIS members or private seed producers are registered by the CC upon seed delivery. Then farmers get seeds and fertilizers at discounted price and seed companies and private seed producers upon presentation of signed delivery receipts furnished by the CC, will get their payment from the Government.

VI. SUMMARY ANDCONCLUSIONS

Senegal has had a long history of agriculture and agricultural research dating back the early 19th century. Since 1974, all public research for major fields crops are being carried out by the public research institute ISRA. For Horticulture and especially for vegetables, CDH and the private company group Tropicasem-Technisem is the most notable one, having local headquarters, with complete activities such as breeding, extension and marketing services.

In this study, the focus was mostly on the formal seed system which made great strides over the years but still insufficient. From the independence in 1960 to 1989, and with complete involvement of the National Government, the country's needs in certified seeds were in general completely covered with specific seed multiplication programs. However, in the late 1980s-early 1990s, the Government decided to withdraw from several public programs, including agriculture. Many programs were then privatized and the seed sector did not escape. This era of a new national seed system with new actors such as UNIS, ASPRODEB, RESOPP, ANCAR, and an important involvement of farmers in general in the seed value chain did not come without issues. ISRA can be credited of having released several improved varieties over the past decades for crops of major importance in the country such as rice, millet, sorghum, maize, cassava, etc. The institute also maintains strong partnerships with other research institutes in the region as well as the CG centers such as Africarice or CIMMYT for instance to improve their germplasm but also to introduce improved and climate-smart varieties.

However, there are still major issues that are quantitative and qualitative in nature. Even with this new system in place with a strong involvement of farmers, via farmer-based organizations and co-operatives, the country's needs for certified seeds is still not met. For instance, ISRA, with all its efforts, still struggles to produce enough breeder seeds for all crops (ANNEXES IV and VI). There are usually less problems for crops with high seed multiplication rate such as millet and rice, which is not the case for a strategic crop such as groundnut for instance. Many times, the issues are to be found in the forecasting. This is a big issue in reality since with the different actors involved in the seed chain and different chains of communications, it is very difficult for ISRA to get reliable information from the seed producing networks and organizations for their real needs in G3 and G4 seeds. Since ISRA heavily relies on these organizations to receive feedback from the different seed markets, needs and get a reliable forecast for short and medium

terms seed production, it is a big challenge for ISRA to meet ever- changing demands.

The production of quality seeds is also a big problem, with many factors contributing to this. DISEM, the regulatory agency in charge of all seed certifications does a great job but is understaffed and lack resources. Another problem is farmers' reluctance to purchase new seeds, mainly for financial reasons. The RESOPP network, for instance, reports that once new varieties have been successfully introduced among farmers, demand for new seed goes down drastically the following two to five years because farmers start producing their own seeds in their farms without following required seed production protocols. As a result, issues such as low germination, genetic purity, seed-borne diseases, lower yields for instance start to arise. A study showed that besides groundnut seeds that are usually purchased, seeds can be inherited, exchanged, loaned, etc. It was estimated for example that 69% of seeds were purchased, 66% acquired as gifts, 44% as exchanges and 6% as loans (Enda Pronat, 2018). Of course the informal seed systems contribute to make the situation even worse.

Another issue is also the low level of adoption of improved and certified crops. We saw that only 16% of farmers use certified seeds (Table 7) and that the highest rate was found in cotton with 91% of farmers, followed by irrigated rice with 78%, and the lowest with rain-fed rice with 12%. Also around 9.1% of farmers declare not knowing the origin of seeds used. We also note a lower adoption rate in women compared to men. A study showed that for millet for instance, the adoption rate was at 14% for men and 7.5% for women. For sorghum, it was 19.6% for men and 8.6% for women (Faye-Mané, 2017). Lack of awareness can explain this but financial and social reasons are main causes.

Nowadays, more and more attention is given to the seed industry in general. Even though the government has withdrawn from this sector, it still continues to provide assistance. This assistance is evidenced by continuous funding for ISRA and for regulatory agency such as DISEM, and extension and advisory services such as ANCAR for instance. Recently, the government also allocated 2000 ha of land to ISRA to boost the production of breeder and foundation seed. In addition, for potato that comes second behind cassava in tuber consumption, the government injected 3.4 billions CFA in subsidies in 2018, compared to 130 millions in 2013 to boost potato production. This was a big jump from 500 tons of seeds in 2013 to 10,444 tons in 2018. The government is not alone in this battle but can also count on several bi and multi-lateral

partners, NGOs that now see seeds as the first agricultural input and the foundation for all sustainable agricultural systems and productivity in general.

With all these advances there are still plenty room for improvements. As an example, a network such as the RESOPP faces among other issues, some marketing problems since its members, due to financial difficulties often do not continue buying new seeds. As a consequence, seed production forecasts and consequently acreages are lowered with the risk of not covering the members' needs. This forecasting problem similarly affects ISRA and the entire seed chain as previously explained. This problem can be two-fold: financial and lack of awareness as some farmers still need to be convinced about the benefits of improved seeds and some are sometimes reluctant to changes.

Farmers who are not reluctant to changes also often complaint about the lack of organization of subsidized seeds, the timing of their distribution and the small quantities received. With the government's withdrawal, there are many actors now in the seed industry which often bring a lot of confusion as to who is who and who does what. Farmers involved in seed production programs also need more resources such as seeds, fertilizers and pesticides and more extension and advisory services to help them in this journey. Producing quality seeds is still an issue for reasons already mentioned, so providing DISEM with more resources will greatly help with field controls and in seed certification processes. Overall and for its overall improvement, the Senegalese seed system needs three things: more resources, better resources allocation and a better organization of the seed system.

The different challenges faced by the Senegalese Seed System can be summarized as followed:

- The main research institute, ISRA, responsible for all breeding activities for field crops, faces several challenges, the main one being financial, due to the withdrawal of the government. This translates to ISRA not being able to retain its senior and experienced scientists, but also its inability to produce enough breeder and foundation seeds. Although this is true for most crops, it is particularly true with the highly strategic crop, groundnut.

  Other crops (cereals) that have a high seed multiplication rate such as millet, rice, sorghum, maize, for instance, suffer less from this situation. Insufficient chain of communication from the different actors (ISRA, seed producers, extension services, etc.) often leads to forecasting issues for breeder and foundation seeds with repercussions down the entire chain. Seed actors

interviewed during this study stress the fact that besides this forecasting problem, ISRA seriously lack resources to produce basic seeds (breeder and foundation). The WAAPP program, funded by the World Bank and implemented by CORAF/WECARD, was of great help these past years with a comprehensive assistance. Besides its assistance to ISRA with seed multiplication units, this program also helped with storage and processing units. It is to be noted that the private seed sector is now collaborating more with ISRA and even started to provide some funding for basic seed production.

- Beyond the seed production issues, seed certification and control are other issues that hinder the production of quality seeds. DISEM does not have enough resources to properly perform its duties.
- The low level of adoption of improved seeds is still a major problem among the majority of farmers. Cultural and financial reasons are some of the main causes.
- Storage, processing and seed conditioning are still major issues. As mentioned earlier, the WAAPP program greatly helped with this, but still insufficient. The "seccos" system that have been used for several decades need to be revamped. They are very old and lack equipments.

In the light of this, some recommendations to help this sector that by the way, are already being implemented for the most part, need to be stressed again. And as mentioned earlier, it's about providing more resources, a better allocation of those resources and a better organization of the seed system. The reorganization is mostly the role of the government. Some recommendations:

- Provide more financial assistance to ISRA for the production and a steady supply of G0, G1, G2, G3 and possibly G4 seeds. Details to be defined with ISRA.
- Provide more training for ISRA's young scientists
- Provide more assistance to the private sector for storage, processing and seed conditioning by building new facilities and by renovating old ones such as the "seccos" and providing them with adequate equipment.
- Provide more assistance to DISEM for a better control and certification of seeds. This could include motorcycles for field workers at the CR level for instance and other field equipment. Details to be defined with DISEM. Since DISEM is a government entity and since personnel recruitment depends on the government's budget, some other options are possible. For instance, for DISEM to give agreements to other private entities so they can serve as DISEM's relays for seed certification. Such experiences were already tested in the *Fleuve* region with the

DRDR and a private company, a "GIE", that served as relays for DISEM for the control and certification of rice seeds. Discussions between UNIS and DISEM are now moving towards that direction for more private companies to be in the seed certification business and help DISEM.

- There are still low adoption rates of improved seeds among farmers, so providing more financial assistance to extension and advisory services such as ANCAR would help raise improved seed awareness.
- Provide assistance to private seed companies involved in the entire chain of seed multiplication, processing, storage and marketing.
- Crops in order of importance are groundnut, rice, cassava, millet, maize, sorghum, potatoes, cowpea just to name these. Groundnut is a strategy crop from the government and ISRA's major seed production issues for breeder and foundation seeds are with this crop. Other crops that also need attention with SSG''s program could include rice, millet, maize, cassava, sorghum and horticultural crops. There are new large foreign investments for potatoes, so potatoes could not be classified a priority and Senegal is now exporting potatoes in some neighboring countries.
- A cereal crop, that is second after rice in terms of national consumption is wheat. Wheat trials were performed in the country in the 1970s with some success, but there were no follow-ups. Recently, ISRA has acquired 8 new varieties of wheat (4 soft wheat for bread and 4 hard wheat for pasta) and has conducted successful trials. Given its strategic importance of meeting the cereal needs, wheat could also be a crop to be considered, even though this would be a very ambitious program.
- The idea of a partnership of future WAAPP program/SSG could also be entertained. WAAPP has been one of the most successful seed improvement program for the ECOWAS region these past years. It was funded by the world bank and implemented by CORAF. This program just ended and will possibly be renewed. SSG could partner up with World bank/CORAF for future implementation, considering that most of the WAAPP countries are also SSG countries.

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ANNEXE I. LIST OF VARIETIES RELEASED BY ISRA AND CHARACTERISTICS

Espèce	Variétés	Zones	. Durée cycle	. Rdt (t/ ha)	. Caractéristiques
Sorgho .	CE 196-7-2-1	DL, TH, Mbr	. 100 .	. 2,8- 5 .	. Clr grain jaune forte, Couche brune absente, résistant à la verse .
	Nginthe (nouvelle variété)	Kaolack, DL et Tamba	110	2-3	Semi compacte, Résitant à la verse et au moisissures, Clr grain blanc, sans tanin
	Faourou ou 621 B (nouvelle v.)	Kaolack, DL et Tamba	. 105 .	. 2,5 -3 .	. Clr grain blanc, sans tanin, résistant aux moisissures et a la verse .
	Nganda (nouvelle variété)	Dl, Kaolack, Kafrine	110	2-3	Semi compacte, sans tanin, résistant a la verse et aux moisissures
	. Darou ou 621 A (nouvelle v.)	Dl, Kaolack	. 105 .	2,5-3 .	Compacte, moyennement lâche, sans tanin, résistant a la verse et photosensible .
Arachid e ..	55-437	Thies-Diourbel	90	1,5-2	Port érigé, feuilles claires, forme grain ronde, résistance à l'aflatoxine et tolérante à la sécheresse. Très bon taux de germination lorsque les semences sont bien conservées. Une teneur en huile de 51% en fait une variété très appréciée par beaucoup de producteurs.
	69-101	Casa , sgl oriental et régions du Sud du Bassin arachidier	. 125	. 1,5-2,5	. Port érigé feuilles vertes foncées, forme arrondie, résistante à la rosette et cercosporiose, maladies endémiques de l'arachide dans les zones humides.
	. 73-33 .	Sud thies, Kaolack, Fatick, sgl oriental	105-110	2-2,5	Port érigé, feuilles vertes foncées, forme grain cylindrique, résistance sécheresse et aflatoxine, grande plasticité. Elle est largement cultivée au Centre du

Arachide			.	.	Bassin Arachidier et même au Sud du Bassin Arachidier. Bonne qualité de l'huile combinée à une forte teneur en huile (50%). .
	Fleur 11	F. Sgl, Thies, Diourbel, Fatick, Kaolack	90	3	Port érigé, Forme grain cylindrique, résistante a la sécheresse. Variété à cycle court et à graines relativement grosses. Elle est très riche en huile (50%). Particulièrement sensible à la bruche. Par conséquent, son stock requiert une attention pour préserver son pouvoir germinatif.
Arachide de bouche	GH 119-20	Casa, Sgl Oriental	110-120	1,5-2	Port érigé, couleur feuille verte foncée, forme grain cylindrique. Comme toutes les variétés à grosses graines, elle nécessite plus d'humidité pour germer (30 à 40 mm d'eau de pluie). Elle a un potentiel de 2 tonnes par hectare mais elle requiert plus de calcium pour le remplissage des gousses.
	H 75-0	F. Sgl, Casa, Sgl oriental	120	Irr 4, Hiv 2	Port érigé, forme cylindrique, résistant a la cercosporiose issue de la GH119-20, de laquelle elle se différencie de sa meilleure capacité à remplir ses gousses. Elle est cultivée dans la même zone que la GH119-20 et a un potentiel de rendement similaire ou équivalent.
Arachide d'huilerie	PC 79-79	Sud Tamba, Bakel, centre et sud bassin arachidier	. 120 .	. 2 .	. Port érigé, forme oblongue, résistant a la cercosporiose Elle est très résistante à la cercosporiose et de cycle long .
Niébé	Melakh	F. Sgl, Louga, Diourbel, Dpt Tivaoune	52-61	1	Semi rampant, couleur feuille vert foncé, couleur grain blanc crème, résistant à CPMV
	Y acine	F. Sgl, Louga, Diourbel, Thies	. 62	. 2,5	. Erige, couleur feuille verte, couleur grain marron, résistant au puceron, chancre bactérienne et CPMV
Mil .	Souna 3	Fatick, Kaolack, Tamba	. 85-95	. 2,4 - 3,5	. H: 2-2,5m, Compacte, Longueur épi: , Grain jaune olive, résistant a la verse et au charbon
	Thialack 2	Fatick, Kaolack	95	2-3	H: 2-2,5m, Compacte, Grain gris, résistant au charbon

Source : ISRA/CNRA, 2017

ANNEXE II. LIST OF LOCAL AND CERTIFIED VARIETIES IN SENEGAL

Spéculations	**Variétés paysannes/locales**	**Variétés certifiées**
Arachide	*Law* (47-16), *Yeugar, Fourré Diaobé*	*55-437*, *GC 8-35*, *55-33*, 73-33, *28-206, Fleur 11, H75-0, 69-101, GH 119-20, PC 79-79, SRV 1-19*
Riz	*Falandianké, Momo samsakhane, Momo Diate, Ndongodj wane*	*Nérica 1, Nérica 4, Nérica 5, Nérica 6, Nérica 8, BG 90-2, Sahel 108, Sahel 177, Sahel 201, Sahel 202, Wab 56-50, Rok 5*
Mil	*Khun*, *Makhaly, Souna traditionnel, Kolonding, Souna local O djigolé, Mil d'origine Inde, Suna Diappal, Souna traditionnel Keur Saloly, Souna traditionnel Thiakho, Souna traditionnel Thioupane, Souna Ndiongolor, CTP, Sosat C88*	*Souna 3*, *Thialack 2, Gawane*
Sorgho	*Goor Gatte blanc, Goor Gatte rouge, O Ndidj ongué blanc, O ndidj ongué rouge, Sorgho d'origine Inde, Nianiko, Diawdo, ,*	CE 145-66, CE 180-33, CE 196-7-2-1, Nguinthe, Darou, Faourou, Nganda
Maïs	*Danédio, Bodédio, Dokorano, Obatampa, Suwan, Synthétique 82.84*	*Early thaï*
Niébé	*Ndiaga aw*, *Baay ngagne*, *Ndout, Niaw a Sésék, Niébé Inde*	*Yacine, Pakau, Melakh*
Oignon	*Violet de Galmi, Orient, Yali*	*Gandiole*
Tomate	*Mboro Ovoide*	*Mongal, Xina*
Gombo	*Rouge de Thiès, Caretas*	*V olta*
Piment	*Tyson*	*Bombardier, Safi*
Chou	*Tropica cross, Tropicana*	---
Manioc	*Sooya local* et *Bant bu xonk*	---

Aubergine amère	---	.. *Keur Mbir Ndao, Soxna plus*
Aubergine doux	---	*Kalenda*
Poivron	---	*Nikita*

Source Enda Pronat, 2018

ANNEXE III. LIST OF CURRENT AND POPULAR VARIETIES

CROPS	YIELD	CURRENT VARIETIES
Niébé	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

SOURCE: SSTP-USAID, 2016

ANNEXE IV. QUANTITY OF BREEDER SEEDS FOR MAIN CROPS

Crops	Year	Quantity (kg)	Needs covered
Groundnut	2013	18350	No
	2014	64650	Yes
	2015	78500	Yes
	2016	103800	Yes
	2017	42000	No
	2018	28300	No
Millet	2016	20925	Yes
	2017	4327	Yes
	2018	5079	Yes
Sorghum	2016	9150	Yes
	2017	2976	No
	2018	2155	No
	2018	16185	No
Maize	2016	8750	Yes
	2017	5084	No
	2018	5185	No
Niébé	2015	9972	No
	2018	1289	No
Rice	2013	16433	Yes
	2014	21732	Yes
	2015	29394	Yes
	2016	52081	Yes
	2017	11875	No
	2018	8472	No

Source: ISRA, 2020

ANNEXE V. PRODUCTION OF CERTIFIED SEEDS SEDAB

RIZ				
VARIETE	NIVEAU			TOTAL PAR VARIETE (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
	MAÏS			
OBATAMPA	30,818	29,003		59,821
SWAN	26,154	26,381		52,535
EARLY TAÏ		51,175		51,175
GAWNA	11695			11,695
SOROOR	3449			3,449
EARLY TAÏ		4525		4,525
TOTAL	72,116	111,084	-	183,200
	ARACHIDE			

73-9-11	173		553	726
Rafeet car	568			568
28-206	986			986
55- 33	8733			8,733
Yakaar		797		797
55-437		217 5		2,175
55-437			32886	32,886
Fleur 11			20930	20,930
73 - 33			79690	79,690
GH 119 20		214428		214,428
H 75 0		31016		31,016
PC 79 79		69439		69,439
69,101		15000	1266376	1,281,376
TOTAL	10,460	332,855	1,400,435	1,743,750

ANNEXE VI. FORECASTS AND ANNUAL NEEDS FOR BREEDER SEEDS (ISRA)

	Semences prébases (tonne)								
Années	Arachide	Niébé graine	Niébé fourrager	Sésame	Mil	Sorgho	Maïs	Riz irrigué	Riz pluvial
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

Source: ISRA, 2020

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