



A LANDSCAPE ANALYSIS OF AGRICULTURAL SERVICE PROVISION AND BARRIERS FACED BY FARMERS IN ADOPTING AGRICULTURAL TECHNOLOGIES IN FOUR LOCATIONS IN SENEGAL

Enabling Farmers for Agricultural Transformation (EFAT) Project

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A Landscape Analysis of Agricultural Service Provision and Barriers Faced by Farmers in Adopting Agricultural Technologies in Four Locations in Senegal

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Contractor:	Winrock International
AOR:	John Peters
Project Director:	Soniia David

This report was written by Steven Franzel, Mercy Akeredolu, Amadou Ndiaye, Seydou Niaré and Soniia David.

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For further information, please contact Soniia David, EFAT Project Director at Soniia.David@winrock.org or visit www.winrock.org.

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ACRONYMS

AICCRA	Accelerating Impacts of Climate Research in Africa
ANACIM	Agence Nationale de l'Aviation Civile et de la Météorologie (National Agency of Civil Aviation and Meteorology)
ANCAR	Agence Nationale de Conseil Agricole et Rural (National Agency for Rural Advisory Services)
ARD	Agence Regional de Developpement (Regional Development Agency)
ARM	Agence de Régulation des Marchés (Market Regulation Agency)
CGIAR	Consultative Group on International Agricultural Research
CIFA	Centre Interprofessionnel pour la formation aux Métiers de l'Agriculture (Interprofessional Center for Training in Agriculture Professions)
CNAAS	Compagnie Nationale d'Assurance Agricole du Sénégal (The National Agricultural Insurance Company of Senegal)
CNRF	Centre National de Recherches Forestières (National Forestry Research Center)
CORAF	West and Central African Council for Agricultural Research and Development
CSP	Complementary Service Providers
DHORT	Direction Nationale de l'Horticulture (National Department of Horticulture)
DRDR	Directions Régionales de Développement Rural (Regional Directorate of Rural Development)
EAS	Extension and Advisory Services
EFAT	Enabling Farmers for Agricultural Transformation
FAO	Food & Agriculture Organization of the United Nations
FFS	Farmer Field School
FONGS	Fédération des Organisations Non-Gouvernementals du Sénégal (Federation of Non- Governmental Organizations in Senegal)
FPMN	Federation of Producers in the Niayes area (Federation des Producteurs Maraichers de la zone des Niayes)
GDP	Gross Domestic Product
ICT	Information and Communication Technology
IFAD	International Fund for Agricultural Development

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ILRI	International Livestock Research Institute
IPAR	Initiative Prospective Agricole et Rurale (Agricultural and Rural Prospective Initiative)
ISRA	Institut Sénégalais de Recherches Agricoles (Senegal Agricultural Research Institute)
ITA	Institut de Technologie Alimentaire (Institute of Food Technology)
JICA	Agence Japonaise de Coopération Internationale (Japan International Cooperation Agency)
LBA	La Banque Agricole (The Agricultural Bank)
MAERSA	Ministère de l'Agriculture et de l'Equipement Rural et de la Sécurité Alimentaire (Ministry of Agriculture and Rural Equipment and Food Security)
NGO	Non-Governmental Organization
NPK	Nitrogen-phosphate-potassium
PAFAO	Promotion de l'Agriculture Familiale en Afrique de l'Ouest (Promotion of Family Farming in West Africa)
PASAD	Programme Agricole pour une Souveraineté Alimentaire Durable (Agricultural Program for Sustainable Food Sovereignty)piesa
PASTTA	Partnership for Seed Technology Transfer in Africa
PCE	Project Croissance Économique (Economic Growth Project)
PIESAN	Projet d'Intensification Eco-Soutenable de l'Agriculture dans les NIAYES (Eco- sustainable Agricultural Intensification Project in the Niayes Area)
РО	Producer Organization
PRACAS	Programme de Relance et d'Accélération de la Cadence de l'Agriculture Sénégalaise (The Program for the Acceleration of Senegalese Agricultural Growth)
PROCASEF	Projet Cadastre et Sécurisation foncière au Sénégal Cadastral and Land Tenure Security Project
PSE	Plan Sénégal Emergent (Emerging Senegal Plan)
SAED	Société d'Aménagement et d'Exploitation des Terres du Delta du Fleuve Sénégal (Senegal River Development Agency)
SDDR	Sociétés Régionales de Développement Rural (Regional Rural Development Agencies)
SHEP	Smallholder Horticulture Empowerment Promotion
SMS	Short message service
SOCOPA	Société Coopérative des Femmes Productrices de Potou Guèye

Enabling Farmers for Agricultural Transformation (EFAT) A Landscape Analysis of Agricultural Service Provision and Barriers Faced by Farmers in Adopting Agricultural Technologies in Four Locations in Senegal

UFPRB	Union des Femmes Productrices de Ross Bethio (Union of Women Producers of Ross Bethio)
UGMD	Union de Groupement Maka Diama (Union of Maka Diama Groups)
URAC	Union de Radios Associatives et Communautaires du Séngal (URAC) Union of Community Radio of Senegal (URAC)
USAID	United States Agency for International Development
VC	Value Chain
WFP	World Food Program
WI	Winrock International

EXECUTIVE SUMMARY

In Senegal, The Enabling Farmers for Agricultural Transformation (EFAT) Project, led by Winrock International and funded by USAID, will facilitate local extension and advisory service (EAS) providers to develop three pilot EAS delivery models, that is, partnership arrangements to provide advisory and complementary services needed by smallholder farmers. This report identifies technologies for priority USAID value chains that have been disseminated in Senegal since 2015, identifies four candidate locations where EFAT could set up EAS delivery models, reports on landscape analyses conducted in each of them to identify and assess EAS providers and complementary services, and identifies barriers to adoption of agricultural innovations in each location. The report also proposes EAS delivery models that the project could test.

For the study, a team of four consultants conducted field work in Senegal for a duration of three weeks. The main methods were interviews with key informants from organizations and companies providing EAS and complementary services and focus group discussions to assess barriers to technology adoption with members of producer groups. In total, 26 organizations were interviewed as part of the landscape analysis, while the team met with a total of173 farmers to identify barriers to adoption of 14 technologies. Of the 39 key informants we interviewed, only 5 (13 percent) were women, highlighting the limited representation of women in managerial and technical positions within agriculture-related organizations. Furthermore, outside of Dakar, the gender imbalance was even more pronounced, with only 1 woman (4 percent) out of 27 key informants.

Between 2015 and 2022, a total of 93 agricultural technologies and practices were disseminated for the five priority value chains. Out of these, 71 percent were crop varieties or other forms of genetic improvement, while only 29 percent were management practices. It is worth noting that management practices are equally important as crop varieties improving productivity and adapting to climate change. Only 3 of the 93 technologies were postharvest technologies, reflecting the low priority that most research institutions and EAS providers give to postharvest problems.

The candidate locations selected were Louga, Saint-Louis/Dagana, Kaffrine and Rufisque Departments. The landscape analysis of agricultural service provision revealed some strengths common to all locations: strong producer organizations (POs), availability of digital services (including some operated by private companies) providing climate and marketing information, and the prevalence of farmer field schools and farmer trainers as key EAS methods. Weaknesses in agricultural services across locations were the lack of coordination and harmonization among EAS and complementary service providers, their silo mentality, limited capacity of EAS providers, particularly in entrepreneurship and post-harvest technology, the absence of private EAS providers except for those providing digital services and the lack of a feedback culture, that is, providers put little priority on obtaining feedback from farmers on technology adoption, their experiences using new technologies or on their innovations. Three additional common weaknesses were that organizations providing agricultural services generally have no specific strategies for targeting youth, lack capacity and strategies for tracking adoption when disseminating technology and that there were no available climate-informed, agro-advisory apps, though one, a private company (Jokolanté), was just starting to market one.

There were important differences between the locations in terms of agricultural service provision. These differences include the degree and ways in which organizations and projects targeted and worked with

women, the strength of research-extension linkages and the degree to which donors appeared to drive the development agenda.

Farmers identified key barriers to the adoption of improved agricultural technologies, prioritizing them as high costs/lack of credit, lack of information and skills, storage/processing constraints, security, pests, and land shortages. Women and youth face more acute resource constraints. To address their limited access to land, it is crucial to assist them in developing enterprises that do not rely on land ownership, such as processing or transportation.

Proposed EAS delivery models include assisting a women's horticulture cooperative in Louga and a producers' platform in Kaffrine testing climate smart agricultural practices to link with EAS providers and complimentary services; strengthening and improving linkages among actors in Saint-Louis/Dagana serving irrigated rice farmers and helping a federation of horticultural producers in Rufisque to strengthen their farmer-trainer program and assist the farmer trainers and federation members to access digital, climate-referenced agro-advisory services. Models at all four locations will improve farmers' uptake of improved practices and will emphasize programs for targeting women and youth and increasing their participation in and access to EAS and complementary services.

INTRODUCTION

The Enabling Farmers for Agricultural Transformation (EFAT) Project, led by Winrock International and funded by the United States Agency for International Development (USAID), strengthens agricultural extension and advisory services (EAS) and systems to raise agricultural productivity among smallholder farmers and help them diversify their enterprises and their ability to cope with adverse climate conditions (Winrock, 2022). In Senegal, the project will facilitate local EAS providers to develop three pilot EAS delivery models, that is, partnership arrangements between public and private organizations to provide advisory and complementary agricultural services such as financial services and inputs needed by smallholder farmers.

EFAT's focus will be on facilitating organizations to scale up agricultural technologies and practices for USAID's priority value chains in Senegal (rice, horticulture, maize, orange-flesh sweet potato and small ruminants) and on improving women's and youth's access to services. The project's activities will include facilitating and monitoring the implementation of the pilot EAS delivery models, strengthening the capacity of implementing staff and organizations and facilitating learning by partners and stakeholders. Working closely with them, EFAT will identify improved practices for fostering partnerships and collaboration, determine under what circumstances the practices work best, improve performance and scale up approaches to other regions and countries (Winrock, 2022).

This report presents the results of a series of consultations and assessments with local stakeholders to facilitate the start-up of EFAT's activities in Senegal. The objectives are to:

• Describe Senegal's agricultural innovation system, that is, the network of actors (individuals, organizations, and enterprises), together with supporting institutions and policies, that bring existing or new products, processes, and forms of organization into social and economic use. EAS and complimentary service providers will be highlighted in this section.

- Identify agricultural technologies and practices for priority USAID value chains that have been disseminated in Senegal since 2015 and document the degree to which they have been adopted. This information will be used by EFAT to identify technologies and practices for taking to scale through EAS delivery models.
- Identify four candidate locations where EFAT could set up EAS delivery models to promote agricultural innovations and conduct landscape analysis in each of them to identify organizations providing EAS and complementary services and assess their strengths and weaknesses.
- At the same four locations, identify and assess barriers to adoption of agricultural innovations available in the location but not widely used, particularly those faced by women and youth.
- Propose EAS delivery models that the project could test.

To complement the start-up assessment, EFAT undertook a separate analysis of women's and youth's access to agricultural services (Winrock, 2023).

The remainder of the report presents the methodology used and a list of technologies and practices being disseminated for USAID's priority value chains. Next, Senegal's agricultural innovation system is discussed, highlighting the EAS system and complimentary service providers. The results of the landscape analyses and barriers to adoption at each of the four candidate locations are also discussed. Finally, conclusions are drawn and recommendations are presented for EAS delivery models that the project could test at each location.

METHODOLOGY

The assessment was done in two stages: stage 1 involved collecting information on existing technologies while stage 2 involved fieldwork using multiple methods. The fieldwork in Senegal for the assessment was carried out during January-February 2023, by a team of four consultants.

CONCEPTUAL FRAMEWORK

The framework for the landscape analysis is adapted from a framework developed by Birner et al. (2009) for designing and analyzing agricultural advisory services. This framework helps to assess the state of an EAS system in a particular location and its strengths and weaknesses. Key elements are governance structures, partnerships, linkages, networks, organizational and management capacities, advisory methods, and the degree to which producers, particularly women and youth, participate in the system.

The framework for the barrier analysis draws on NEC (2013) and is shown in Appendix 1. The barrier analysis identifies four types of factors affecting uptake of agricultural innovations: (1) characteristics of the technology such as feasibility and profitability, (2) the system of dissemination including extension methods, (3) producers' characteristics such as labor and financial resources, and (4) contextual factors, such as the availability of credit and markets (Ndiaye, 2018).

INVENTORY OF DISSEMINATED TECHNOLOGIES AND PRACTICES

We focused the inventory of agricultural technologies and practices on USAID's five priority value chains in Senegal: rice, maize, horticulture, orange-fleshed sweet potato and small ruminants. We also focused on those technologies and practices released and disseminated since 2015 to identify recent ones that EFAT could target. The identification of technologies and practices proved to be a complex exercise, as no single organization has a list of them. To assemble such a list and to find out their degree of adoption, we conducted a literature review and consulted various research organizations, extension providers, NGOs and development projects. The interview forms we used for the inventory of technologies and practices is shown in Appendix 2. Most of the technologies and practices were given to us by representatives of organizations, while others were found on internet websites or in publications.

We encountered several problems conducting this exercise. It was surprising that no organization had a list of the technologies they had released or were disseminating. Rather someone in the organization had to go to the trouble to assemble this information for us. Also, except for the Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles (CORAF), no organization was able to give us information about the technologies, such as year of release, year of start of dissemination, or degree of adoption. It appears that the problems we encountered are indicative of the low priority given to dissemination of new technologies in many organizations.

AGRICULTURAL INNOVATION SYSTEM

To describe Senegal's agricultural innovation system, a literature review was the main method and was supplemented by interviews with key actors in the system representing extension providers, government agencies, private companies, non-governmental organizations (NGOs), development projects and producer organizations.

LANDSCAPE ANALYSIS

The four locations for conducting landscape analyses were selected based on interviews with key informants, including representatives of USAID Feed the Future projects and the Institut Sénégalais de Recherches Agricoles (ISRA). The criteria for selecting locations were:

- Producers in that location are engaged in at least one of the USAID priority value chains.
- The location is no more than a four-hour drive from Dakar.
- The location has a high potential for impact, that is, improved agricultural practices are available but have low adoption rates. Constraints limiting adoption should be ones that EFAT can potentially address through improving access to agricultural services.
- There be at least one effective partner organization (public sector, private sector or civil society organization) to lead EFAT activities at each location.
- there be someone who can help us to organize visits with groups of farmers and give us the names and contact information of representatives of EAS providers and complementary service providers.

It was also considered desirable that a USAID agricultural project be working in the area that EFAT could partner with for mutual benefit. The four locations selected are shown in Table 1.

	Departments			
	Louga	Saint-Louis/Dagana	Kaffrine	Rufisque
Agroecological	Niayes	Senegal River Valley	Groundnut Basin	Niayes
zone				
Rainfall (mm/year)	250-350	200-300	600-700	350-450
Cropping Seasons	Varies for	Irrigated rice:	June/July to	Varies for
	horticultural crops	June/July to Oct	Oct./Nov	horticultural crops
	but Nov-Feb is most	Nov.; a second crop		but Nov-Feb is most
	important	may be grown Feb		important
		June		
Main Agricultural	Horticulture	Rice, peanuts,	Millet, sorghum,	Horticulture
Enterprises	(onions, potatoes,	onions, potatoes,	maize, groundnuts,	(onions, okra,
	tomatoes,	tomatoes, cabbage	cowpeas, sheep,	cabbage), dairy
	cabbage), millet,		goats, cattle	cows, poultry
	maize, rice,			
	groundnuts, sheep,			
	goats, cattle			

Table 1. Characteristics of the departments visited

The four-person team spent about 1.5 days at each location conducting semi-structured interviews with extension providers, complimentary service providers, research centers and educational institutes. The interview forms we used for the landscape analysis are shown in Appendix 3. The numbers of individual extension providers interviewed per site ranged from 2 to 5 and the numbers of complimentary service providers ranged from 1 to 3 (Table 2). Out of 13 extension providers, 12 were public institutions while one was a producer organization. Among the complimentary service providers, eight were private firms and two, public sector organizations. The research centers and educational institute were public institutions.

	Organizations Interviewed with Key Informants				Composition of Producer Organizations in Focus Group Discussions	
Department	Extension Providers	Complimentary Service Providers	Research Centers	Educational Institutes	Men and Women	Women
Louga	5	1	0	0	1	1
Dagana/Saint	3	3	1	1	1	1
Louis						
Kaffrine	2	3	1	0	1	0
Rufisque	3	3	0	0	2	0

Table 2. Locations and numbers of interviews with extension and complimentary service providers

Of the 39 key informants we interviewed, only 5 (13 percent) were women, reflecting the low number of women in managerial positions in agriculture-related organizations. Outside Dakar, the proportion was even more skewed — only 1 (4 percent) of 27 key informants was female. The persons and organizations we met with in each location are shown in Appendix 3. Appendix 3 also includes a list of organizations and projects active in each location that we were unable to meet with.

A limitation of the landscape analysis was that it did not cover all agricultural service providers in each location. A second limitation was that respondents knew we were representing a new USAID project and may have conditioned their responses to support positions/issues that USAID champions such as gender inclusion.

BARRIER ANALYSIS

To assess the barriers to the adoption of technologies and practices, we dedicated one day per location to conduct focus group discussions (FDGs) with members of 1 to 2 producer organizations (Table 2). At each location, we asked key informants to identify two producer organizations that we could meet with for the FGDs.

We asked them to select a cross-section of men, women and youth members, including persons from different wealth groups, from different villages and persons who were not members of that producer organization. In Senegal, women and youth speak their mind less in the presence of men. Therefore, we sought to interview men, women and youth separately. We conducted 10 FGDs with 7 POs. Details about the producer organizations, the technologies and practices discussed, and the numbers of men, women and youth in each focus group discussion are shown in Appendix 4. Out of 10 FGDs, 5 were held with only women (young and older adults) attending, 3 with only men (young and older adults) attending and 2 with only youth. One of the FGDs with youth was with a mixed group of male and female youth, while the other FGD was exclusively attended by male youth.

In the FGDs, producers identified recommended practices/technologies that were not widely adopted, selected one to work on and analyzed barriers to adopting it and measures to overcome the barriers. For each location, following the presentation of the results from the farmers' barriers analysis, we discuss the broader set of factors impeding the adoption of agricultural technologies. A limitation of the exercise was that the selection of farmers was not random and may have been dominated by leaders and those members closest to the leaders of the producer organizations. A second limitation was that all or nearly all those participating in FGDs were members of producer organizations, so the views of non-members were left out.

INVENTORY OF TECHNOLOGIES AND PRACTICES DISSEMINATED

We contacted research organizations and extension agencies to find out the agricultural technologies and practices that they had released (research organizations) and disseminated (EAS providers) since 2015 for the five value chains of priority to USAID in Senegal: rice, maize, horticulture, orange-fleshed sweet potato and small ruminants. Table 3 shows the 93 innovations that have been disseminated since 2015. We were able to find information for all the priority value chains except orange-flesh sweet potato. A detailed inventory of the technologies appears in Appendix 5.

Value chain	Varieties/Genetic	Management Practices	Total
	Improvement		
Irrigated Rice	21	5	26
Rainfed Rice	7	0	7
Maize	22	2	24
Horticulture	11	5	16
Small Ruminants	1	3	4
Sustainable Land Management	4	12	16
Total	66	27	93

Table 3. Numbers of agricultural technologies/practices released and disseminated in Senegal since
2015 for rice, maize, horticulture, and small ruminants ¹

The data in Table 3 show some interesting patterns. About 71 percent of the technologies and practices were crop varieties or other types of genetic improvement as compared to only 29 percent being management practices. Yet, improving the management of crops and livestock is just as important for increasing productivity as is genetic improvement. Sustainable land management practices are particularly critical for adapting to climate change yet only 17 percent of the technologies and practices were in this area. Only 3 of the 92 technologies were postharvest technologies, reflecting the low priority that most research institutions and EAS providers give to postharvest problems. The three were a cereal steamer, a rice thresher and a rice processor.

About 62 percent of the available technologies and practices were on cereals, reflecting the importance that research institutions give to cereals as compared to other products. Rice alone accounted for 36 percent of the entries, reflecting the fact that it is Senegal's most important food staple. That irrigated rice accounted for 78 percent of rice entries reflects the priority given to irrigated over rainfed rice. Only one informant, CORAF, was able to rate the degree of adoption of practices. They rated 20 practices, 18 of which were varieties. Most (55 percent) were rated as having low adoption whereas 25 percent were rated high. The practices said to have high adoption rates were three irrigated rice varieties (NERICA L19, NERICA S44, Sahel 108) and two rainfed rice varieties (NERICA 12, NERICA 14)

That so few studies on adoption of new technologies and practices are available is also problematic and reflects the overall lack of interest in this area of study. Goundan et al. (2020) looked at adoption of rainfed practices in Senegal and were only able to find two previous adoption studies, both focusing on groundnuts. Most of the emphasis is on getting technologies and practices released rather than on facilitating their adoption and upscaling. This is unfortunate because feedback on performance of technology is important so that the ones doing well can be further upscaled and the ones underperforming can be modified and improved. Moreover, prompt feedback on technology performance is increasingly important in the context of a rapidly changing climate.

A further problem we noted was that many released technologies did not appear to be available to farmers. For example, an ISRA staff member told us that ISRA has released 64 rice varieties in recent years but only 5 are used by farmers. The most popular irrigated rice variety, Sahel 108, was released in 1994 and accounts for 70 percent of the cultivated area under irrigated rice in the Senegal River Valley

¹ In some cases, informants were unsure of the year of release (research organizations) or year when they started disseminating the practice (EAS providers).

(Faye et al., 2020). Another example of the gap between what technologies have been released and what is available concerns artificial insemination for improving sheep breeds. This technology has been released and is available for dissemination according to ANCAR but farmers we interviewed in Louga were unaware of it.

THE AGRICULTURAL INNOVATION SYSTEM IN SENEGAL

This section provides an overview of Senegal's agricultural innovation system. First, the country's agroecological zones and main farming systems are presented. Next, different EAS providers are discussed including government, donor-financed projects, producer organizations and private providers. Complementary service providers are also examined including those providing finance, insurance and material inputs (e.g., seeds and fertilizer). Finally, research and educational institutions and farmers' information sources are discussed.

AGRO-ECOLOGICAL ZONES AND MAIN FARMING SYSTEMS

The majority of Senegal's land mass lies within the Sahel region, which is arid and extremely prone to drought. The country is characterized by varying levels of rainfall and temperature, with conditions that gradually become increasingly dry moving north from Senegal's humid, high rainfall southern regions to its northern arid zones. The strong dependence of crop production on rainfall results in highly variable production, because of high variability in both rainfall amounts and the onset and cessation of the rains. Senegal is divided into six agro-ecological zones (Figure 1). Moving from north to south, they are:

- The Senegal River Valley characterized by alluvial plains and irrigated rice production.
- The Niayes on the Atlantic coast, with a temperate climate and horticultural production.
- The Sylvo-Pastoral zone of north-central Senegal with extensive livestock production.
- The Groundnut Basin of south-central Senegal, a zone of savannah dominated by groundnut and millet production.
- Eastern Senegal, characterized by savannah with trees, cotton and livestock.
- Casamance, characterized by forests, savannah and diverse crops.



Projection : UTM Datum : WGS 84 Z 28N

Figure 1. The agro-ecological zones of Senegal

Senegal is administratively divided into 15 regions, 45 departments and 133 sub-departments (arrondissements in French). The topography of the country is generally flat with elevations less than 100 m. Although Senegal has land area exceeding 19 million ha of land, more than half of it is undeveloped bush and arid land used for livestock grazing; about 3.9 million hectares is suitable for arable crops. Of this, 40 percent is regularly cultivated. However, less than 10 percent of cultivated land is under irrigation; the main irrigated areas are along the Senegal River and in Casamance. Most soils are vulnerable to degradation and fertility levels are declining as cultivation pressure increases (D'Allesandro et al., 2015).

The main crops cultivated are ground nuts and millet, which together account for almost 75 percent of the planted area. Maize, rice, sorghum, cowpea, and cotton make up about 25 percent and less than 1 percent is sown to other crops, including vegetables. Food crop production does not meet national demand, and the country imports substantial volumes of rice (1.6 million metric tons in 2022) (USDA, 2022). Livestock production is significant, involving 90 percent of the rural population and accounting for 30 percent of the agricultural gross domestic product (GDP) (D'Allesandro et al., 2015). Livestock types include cattle, sheep and goats and poultry which provide a range of products (e.g., meat, dairy, eggs) and services, such as draft power, which is used to plow 90 percent of cropped land.

Agricultural systems are significantly affected by climate change. For example, mean temperatures during the March to May dry season were 2.2 percent higher during the period 1991-2020 as compared to the period 1981-1990 (World Bank, 2023). Annual mean temperatures are anticipated to increase by 1.1 to 1.8 degrees Celsius by 2035, depending on the region (CIAT and BFS/USAID, 2016).

GOVERNANCE STRUCTURES AND POLICY ENVIRONMENT

A key foundational policy development for advisory services was the creation in 1997 of the Agence Nationale de Conseil Agricole et Rural) (ANCAR). ANCAR was designed to be a bottom-up organization, responding to the needs of the country's producer organizations and helping farmers improve their decision-making capacity and management, as well as increasing production. The Loi Sénégalaise d'Orientation Agro-Sylvo-Pastorale of 2004, traced a 20-year pathway for the development of agriculture in the country. The law envisaged ANCAR as not only a provider, but as a coordinator of EAS leading a National System of Agricultural, Forestry and Livestock Advisory Services. But ANCAR never took on the coordinator role, for reasons that are unclear but likely had to do with the entrenched power of other public sector agencies in the EAS domain who feared losing control over their EAS activities.

Two recent policies also guide the agricultural sector. The Programme de Relance et d'Accélération de la Cadence de l'Agriculture (PRCAS II), 2019-2023, prioritizes investments in irrigation, rural roads, access to finance and storage facilities. The program will invest \$4 billion in the agricultural sector (US Department of Commerce, 2023). The Programme Agricole pour une Souveraineté Alimentaire Durable (PASAD), 2022-2026, involves investment of \$1.7 billion and highlights expenditures in rice, rainfed cereals and horticulture (IPAR, 2022). Neither PRCAS II nor PASAD mentions EAS specifically, although the participation of EAS programs is implicit in that the programs promote the development and uptake of production technologies by farmers. Several reasons explain the absence of a national extension policy in Senegal. First, such policies are not common in Francophone countries. The lack of such a policy reflects the low priority given to EAS relative to other subject areas in the agricultural sector, such as input supply and research. Third, and related to the other two, there is little expertise in the country in agricultural extension, as departments of agricultural extension have only been recently created in Senegalese universities.

A unique feature of rural development in Senegal is the long history and strong role played by producer organizations (POs). The Conseil National de Concertation et de Coopération des Ruraux du Sénégal (CNCR), founded in 1993 and composed of 26 farmer associations, plays an important role in Senegal in promoting cooperation among and strengthening its members and lobbying for smallholder interests with the state.

EXTENSION AND ADVISORY SERVICE PROVIDERS

Four types of EAS providers and complementary service providers are described below: government, development projects, producer organizations and private sector. In addition, we present a brief section on radio and television.

Government

ANCAR has extension staff in each of Senegal's 45 departments and 190 counties. Its mission is
to provide a national system of rural and agricultural advisory services through improving
advisory service delivery, harmonizing advisory methods, and facilitating a network of public and
private advisory services. ANCAR is a parastatal directed by an Administrative Council composed
of representatives of the national government, local government, producer organizations and
the private sector. Its mandates, in addition to providing advisory services, are to provide inputs,
credit, marketing and processing services. However, it does not perform these functions; rather,
it helps link farmers to providers of these services (Franzel et al., 2018).

- With operations in all 15 of the country's administrative regions, ANCAR is quite decentralized, with its regional directorates given considerable autonomy in designing advisory programs appropriate for their areas and farmers. Staff at the regional directorates include a team of technical specialists (including in some cases a monitoring and evaluation specialist) to support the field teams (about three per region) based at the department level. The teams are composed of three to four extension staff, supported by two to three subject matter specialists of different disciplines. They conduct participatory diagnostic assessments of farmers to ensure that their program of work is demand driven. However, their grasp of participatory methods is sometimes weak (reported by a key informant).
- Key principles of ANCAR's approach are that it is holistic (e.g., considers rural non-agricultural activities, as well as agricultural ones), demand-driven, participatory, decentralized, interdisciplinary and pluralistic (involving a range of different actors). ANCAR also has gender focus points whose role is to ensure that the needs of women are considered in all activities. An important feature is that advisory services are offered through a contract between ANCAR and POs. The contract specifies the financial contribution that the PO will make. ANCAR uses its own funds to provide services to farmers not organized in POs.
- Services Régional de Développement Rural (SRDR) were established by the government to
 operate in certain zones and on particular themes (Franzel et al., 2018). In addition to extension
 services, SRDRs provide a range of support including infrastructural development and supply of
 inputs. There are four SRDRs but only one, described below, is operating in any of the four EFAT
 candidate locations.
- The Société d'Aménagement et d'Exploitation des Terres du Delta du Fleuve Sénégal (SAED) develops irrigation infrastructure and promotes irrigated rice in the Senegal and Falémé River Valleys. The Agency is also involved in input supply, processing, marketing and promoting youth and women entrepreneurship, the development of producer organizations and the cultivation of vegetables, such as onions and tomatoes. Extension activities include participatory diagnosis, needs assessment, implementing activities and monitoring and evaluation. SAED receives funding from the government, the African Development Bank and numerous foreign donor agencies.
- Directions Régionales de Développement Rural (DRDR) is a department of the Ministry of Agriculture and Rural Equipment (MAER), that has primary responsibilities of defining agricultural policies at the regional level, monitoring and evaluation and collecting and analyzing agricultural statistics. It also provides EAS to farmers and producer organizations. Most of the funding for provision of EAS activities comes from donor agencies.
- Agence Regional de Développement (ARD) of the Ministère des Collectivités Territoriales et de l'Aménagement du Territoire facilitates local planning, monitors, and evaluates local development programs, and contracts services for local government. It also implements agricultural EAS programs. Most of the funding for provision of EAS activities comes from donor agencies.

Development Projects

Development projects are usually funded by donor agencies and implemented by government agencies, national or international NGOs or private firms. Projects not administered by the Senegal government usually collaborate closely with government agencies in implementation. Development projects focus on a particular geographical area, theme or group of enterprises and are of limited duration, often three to five years. USAID Feed the Future projects with EAS components that are active at the locations visited are listed in Table 4.

Name, Time-	Project Description	Value	Areas Where	Extension Methods
frame	Highlighting Extension and	Chains	They Work	
	Advisory Services			
Doolel Mbay	Bolsters agricultural	Irrigated and	Senegal River	Project had not yet
(Senegal Value	productivity and access to	rainfed rice,	Valley, Southern	started extension
Chains Services	markets for smallholder	millet,	Saloum, and	activities as of
Activity), 2022-	farmers while integrating	maize,	Casamance	February 2023.
2027	climate from farm to markets.	sheep,	zones	
	Supports producer	goats,		
	organizations and private	mango, and		
	firms in improving sourcing of	horticulture		
	inputs, marketing and adding			
	value to produce			
Nafoore Warsaaji	Facilitates creation of virtual	Horticulture	Senegal River	Training sessions and
(Gardens of	hubs to provide horticultural		Valley, Southern	workshops, farmer
Abundance),	farmers and agribusinesses		Saloum,	field days, market
2020-2025	with greater access to inputs,		Casamance and	information (Systock
	support services, finance, and		Niayes zones	platform and app),
	post-harvest infrastructure so			radio, fairs, Local
	that more smallholders can			Market Facilitators,
	participate in commercial			video, leaflets,
	horticulture			coaching, on-line
				training, brochures,
				flyers
Dundel Suuf	Fertilizers and application	Rice, maize,	Casamance,	Training sessions and
(Nourishing the	methods developed and	millet,	Senegal Oriental,	workshops,
soil), 2019-2023	made available to farmers,	vegetables	Groundnut	demonstrations,
	disseminated and upscaled		Basin, Niayes	farmer field schools,
	while protecting the		and Senegal	on-line training, radio,
	environment		River Valley	video, brochures,
			zones	flyers

Table 4. USAID projects with EAS activities operating near the four candidate EFAT sites

Producer Organizations

Some producer organizations have EAS programs. For example, the Federation of Non-Governmental Organizations in Senegal (FONGS for its French acronym) is an umbrella group of 31 farmer associations with more than 150,000 members, covering 35 of the country's 45 departments (PPAFAO, 2017). Concerning EAS, FONGS' main activity is a program of 160 farmer trainers (paysan relais in French) operating in six departments, who advise farmers on farm management, including farm and household planning, balance sheets, accounting, and determining costs and returns.

Private Sector

There are few instances of private companies providing EAS to farmers in Senegal. The main ones are companies using digital platforms to provide agricultural advisory services, climate information and market information and services. Two companies doing so are Mlouma and Jokolanté:

Mlouma is a social enterprise specializing in digital services in agriculture (Mlouma, 2023). The service was started in 2012 by a local entrepreneur. Mlouma markets several applications for use by smallholders throughout Senegal:

- Météo mbay issues weather forecasts provided by the National Agency for Civil Aviation and Meteorology (ANACIM). The cost is \$2.50/year (\$1.00=600 CFA).
- Louma mbay is a platform for the marketing of agricultural products. Farmers can access price information for \$1.70/year/product and buy and sell produce on a virtual marketplace. Sellers pay a fee of 5 percent of the sale to Mlouma if transactions are successful.
- Louma du savoir gives producers lessons on good agricultural practices. The cost is \$3.50/year.
- Xam sa mbay is a free discussion platform open to all stakeholders.
- Jokolanté is a social enterprise with a mission to enable organizations and rural populations to access the information they need to improve their decision-making. Their activities to support agricultural producers include mobile phone apps that issue.
- Weather forecasts with information provided by ANACIM. Jokolanté sends information by short message service (SMS) but recently started sending voice messages, which are useful for farmers who are not literate.
- Market prices in partnership with the l'Agence de Régulation des Marchés (ARM).
- Agro-advisory information that empowers farmers to manage climate risks.

The app, called iSAT, was developed in partnership with the International Livestock Research Institute (ILRI), ANACIM, and ISRA. In 2022, its first year of operation, iSAT reached 2,720 registered users with weekly integrated voice response messages in two local languages (Joseph et al., 2022). Jokolanté plans to scale up use of the app in 2023. Jokolanté's business plan is for each producer to pay \$ 11.67 per year for iSAT in order to break even. But its studies show that farmers are only willing to pay about \$2.50 per year. Jokolanté expects that costs per user will decline as volume increases and that development partners will be willing to assist farmers to pay in the short term. Once farmers perceive the value of the information, they will be willing to pay full price.

Jokolanté claims 250,000 participants across all 14 regions of Senegal. Its messages are in six local languages and French (Jokolanté, 2023).

Radio and Television

Development projects often use Senegal's community radio stations for agricultural messaging. For example, the USAID Strengthening Partnerships, Results and Innovation in Nutrition Globally (SPRING) Project (2016-2018) partnered with six community radio stations to promote nutrient-sensitive agricultural production. But the project had to produce its own programming as there were no agricultural shows and little expertise in agriculture within Senegal's radio system (USAID, 2018). This has begun to change with the help of some assistance from development projects focusing on agricultural programming for radio. Farm Radio International, a Canada-based NGO that promotes agricultural radio programming opened an office in Senegal in 2018. They work with community radio stations in Matam, Saint-Louis and Kolda encouraging improved agricultural practices and transforming unequal gender norms (FRI, 2023). Accelerating Impacts of Climate Research in Africa (AICCRA), a program of the Consultative Group on International Agricultural Research (CGIAR), works with the Union of Community Radio of Senegal (URAC) to deliver climate information to farmers in 14 of Senegal's 15 regions. The shows are in local languages and utilize an interactive format to engage listeners. Some development projects also use television for messaging but less so than radio.

Complimentary Service Providers

Finance and credit

There is considerable evidence that agricultural credit plays an important role in boosting agricultural productivity (Seven and Tumen, 2020). In Senegal, while 46 percent of rural adults borrowed money in 2017, only 5.7 percent borrowed from a formal financial institution. The proportion of women borrowers was even lower, 2 percent, versus 8 percent for men. Proportions may have increased somewhat since 2017, but key constraints to lending for agricultural activities in Senegal include the high cost and risk of lending to farmers involved in rainfed agriculture, financial institutions lack knowledge of agriculture finance, microfinance institutions have exhibited weak performance and public interventions have been inefficient (World Bank, 2020).

The government of Senegal subsidizes loans issued to smallholders by covering the difference between market interest rates (about 13 percent in 2020) and the capped interest rate for farmers (7.5 percent). The subsidy is administered by the state-owned bank, La Banque Agricole (The Agricultural Bank). Farmers access subsidized credit through their Pos. Once a PO completes the formal process of obtaining a loan for its members, the bank transfers funds to the PO, which makes funds available to its members largely in the form of inputs or capital goods, such as irrigation equipment.

Microfinance institutions are also active in some areas, but their volumes of loans are low due in part to the high interest rates they charge (their rates are not subsidized and they access funds from banks). They only offer small loans for covering such items as certified seed and fertilizer. Four prominent microfinance institutions are Credit Mutuel du Senegal, Baobab, Pamecas and and Alliance de Credit pour l'Epargne et le Credit a la Production.

Disruptions due to the Covid 19 epidemic had minimal negative effects on loan repayment. The Agricultural Bank's non-performing loans increased by only 2-3 percent in 2020-2021 due to Covid-19 (African Business, 2021).

Agricultural Insurance and Climate Information

Agricultural insurance is an important means for smallholder farmers to stabilize their incomes, mitigate risk and break the cycle of poverty caused by adverse weather events (World Bank 2020). The Compagnie Nationale d'Assurance Agricole du Sénégal (CNAAS), founded in 2009, is the sole agricultural insurance company in Senegal. With 55 percent of its shares owned by private actors and 45 percent by the Senegalese government, CNAAS has seven regional agencies and insures farmers throughout the country. In recent years, the numbers of farmers having insurance policies has risen rapidly, from 200,000 in 2018 to 612,529 in 2022 (CNAAS, 2023). In 2019, about 30 percent of policy holders were women (World Bank, 2020). Various options are available to farmers for insuring their crops and livestock against different types of threats including drought, flooding, pests and diseases. Most policies are index-based, that is, compensation payments are made based on an index of climate data. The government subsidizes insurance premiums by 50 percent and in 2020, average premiums were about \$ 8.70 per year and insured capital averaged about \$ 350 per year (CNAAS, 2021). The Agricultural Bank includes insurance costs in its loans to smallholders, making insurance more attractive to them. The insurance contract is between the company and the individual farmer but sometimes the transaction is conducted through the PO, as when insurance is bundled with credit for PO members from the Agricultural Bank.

Access to insurance products is constrained for several reasons: reliable, granular data on weather and yields are limited, the current insurance products cost more than many farmers can afford, and producers have limited financial awareness and understanding of insurance. Digitization of the underwriting process is currently underway as it offers an important opportunity to reduce costs of providing insurance and compensating farmers for loss (CNAAS, 2021).

Climate information is a key element of insurance programs because, as mentioned above, compensation payments are usually based on an index of climate data. These data are collected by satellite images and meteorological stations and include rainfall, humidity, and temperature. Climate information in Senegal was first collected by ANACIM and distributed to producers by MANOBI, an e-commerce firm in the early 2010s. Information was first distributed by SMS but is now available by voice, which is preferred, particularly by persons who are illiterate. As mentioned above in the section on radio, climate information is now available on the radio throughout the country and through digital apps supplied by Mlouma and Jokolanté. Chiputwa et al. (2020) found that the acquisition of climate change.

Seed, Fertilizer and Pesticides

Farmer-saved seed is the most important source of seed for most crops followed by direct sales from certified seed producers, informal markets, government depots, and friends/neighbors (Seed Systems Group, 2020). Irrigated rice is the only crop for which most farmers (74 percent) use certified seed. The proportions using certified seed are 12 percent for rainfed rice and 17 percent for maize. For vegetables, only about 12 percent of seed used is produced in a formal and traceable way.

Production of certified seed is organized and regulated by the government. Production of certified seed is far greater than demand so much of it is sold for consumption (Seed Systems Group, 2020). Low usage of certified seed can be attributed to low quality and awareness (Seed Systems Group, 2020). Research and extension organizations appear to have had little influence over the crop varieties that farmers use. As mentioned earlier, even though many new varieties have been released, 70 percent of the rice area in the Senegal River Valley is still planted to a single variety released in 1995 (Faye et al., 2020).

Farmers are able to access limited quantities of fertilizer from the Ministry of Agriculture at subsidized prices. Any additional quantities desired are only available at unsubsidized prices from the private sector. The importation and distribution of subsidized fertilizer is controlled by the Ministry of Agriculture. The cost of fertilizer to farmers is subsidized by 50 percent and subsidized fertilizer is distributed using a quota system among areas. DRDR offices of the Ministry of Agriculture prepare lists of farmers who want to buy fertilizer and allocate quotas to areas and farmers. Farmers pay for the fertilizer at Treasury offices and take the receipts to DRDR depots where they obtain their fertilizer. Demand outstrips supply so many go without or must buy at unsubsidized prices, according to key informant interviews. The subsidy system has many problems; USAID (2022) reported that of the 13 principles for applying smart fertilizer subsidies, Senegal was using only three of them but had plans to use nine others. Some key problem areas are timeliness of deliveries, appropriateness and poor quality of products, low participation of the private sector, poor efficiency and targeting, and a lack of transparency and accountability.

Unsubsidized fertilizer is generally available from private agrodealers. There are agrodealers with retail outlets across the country (e.g., SEDAB SARL) while others operate locally. About 85 percent of fertilizer sellers are private enterprises whereas 15 percent are associations or cooperatives (IFDC, 2020). Some

programs, such as Syngenta Foundation's Farmer Hub project, support entrepreneurs to supply agricultural services, enabling farmers to benefit from fairer prices for agricultural inputs (Syngenta, 2023). Other NGOs, such as MyAgro, help farmers get and pay for inputs through a layaway financing application that they access through their mobile phones (MyAgro, 2023).

Goundan, et al. (2020) reported that in 2017, 45 percent of farmers used mineral fertilizer on at least one of their crops. The proportion may have declined since then, as farmers reported a reduction in access to inputs during the pandemic (Jha et al., 2023). Moreover, fertilizer prices have increased substantially in recent years. For example, the retail price of nitrogen-phosphate-potassium (NPK) fertilizer more than doubled and that of urea tripled between the first quarter of 2021 and the first quarter of 2022 because of supply disruptions caused by the war in Ukraine (Gajigo, 2022). In response to the price increases, development practitioners are helping Senegalese farmers to improve fertilizer use efficiency through such practices as microdosing and deep placement of urea.

Pesticides are commonly used in horticulture in Senegal but less so in other crops. Some rice farmers in the Senegal River Valley use herbicides to ensure timely weeding and to avoid paying laborers to weed. Pesticides are not subsidized. They are distributed through private agrodealers and producer organizations, such as Coopérative de Production de Semences (COOPROSEM), a producer's cooperative. The USAID project Nafoore Warsaaji puts considerable emphasis on training for the safe use of pesticides including safe use of equipment (such as backpack sprayers), the use of protective clothing during phytosanitary treatments, and the non-use of prohibited chemicals (Connexus, 2022).

Research and Educational Institutions

The Institut Sénégalais de Recherches Agricoles (ISRA) creates scientific knowledge and develops technological innovations, tools and approaches for improving the nation's agricultural sector. ISRA is under MAER but has its own autonomous administration. Other actors in agricultural research include the Institut de Technologie Alimentaire (Institute of Food Technology) and the Universities of Dakar, Thies, Saint-Louis and Ziguinchor. Some private companies also conduct research. For example, TROPICASEM, a private seed company, conducts research on improved vegetable varieties and produces and markets seed. ISRA and Senegalese universities partner with many international research organizations (e.g., Africa Rice Centre) and advanced research institutes and universities in Europe and North America to conduct agricultural research in Senegal (Franzel et al., 2018).

Three Senegalese universities offer undergraduate degrees in agricultural extension: Université Amadou Mahtar Mbow (UAM) (Dakar), Institut Supérieur de Formation Agricole et Rural (Bambey) and the Université du Sine Saloum (Kaolack). Université Cheikh Anta Diop (Dakar) is launching the country's first master's program in agricultural extension in 2023. The Centre Interprofessionnel pour la Formation aux Métiers de l'Agriculture (Interprofessional Center for Training in Agriculture Professions) (CIFA) strengthens the skills of farmers and professionals in the agricultural sector, including providing inservice training in extension for extension agents of SAED and other EAS providers. CIFA is discussed further in Section 5.

Farmers' Sources of Information on Agriculture

We were unable to find any published information on farmers' information sources on agriculture. We asked members of two producer organizations in Potou, Louga District, one a women's horticultural cooperative and the other, a men's livestock group, to list their most important sources of information

and to rank them (Appendix 6). Farmers from both groups relied heavily on training and seminars (mostly conducted by projects) and social media, particularly WhatsApp groups, set up by farmers or agencies (e.g. projects). Men obtained information from fairs, visits to other farmers and a livestock society to which some were members. Women were more likely to source information from the manager of their cooperative society and television.

LANDSCAPE AND BARRIER ANALYSES

LOUGA DEPARTMENT

Landscape Analysis

Table 5 shows the five EAS providers and one CSP the team met in Louga Department. Our interviews with EAS providers were in the city of Louga, while an interview with a complimentary service provider took place in Potou, about 15 km west of the city of Louga (Figure 2). Other organizations active in the Department but not visited are listed in Appendix 2.

Table 5. Extension service providers and other stakeholders interviewed in Louga Department

Name and Type of Service Provider	Category
Extension and advisory providers	
Agence Nationale de Conseil Agricole et Rural (ANCAR)	Public
Service élevage de Louga of the Ministry of Livestock and Animal Production	Public
Directions Régionales de Développement Rural (DRDR)	Public
Smallholder Horticulture Empowerment Promotion (SHEP) Project focal point in DRDR	Public
Projet d'Intensification Eco-Soutenable de l'Agriculture dans les NIAYES (PIESAN) Project focal point in DRDR	Public
Complementary Service Providers	
Binta Ba (agro-chemical supplier)	Private

A Landscape Analysis of Agricultural Service Provision and Barriers Faced by Farmers in Adopting Agricultural Technologies in Four Locations in Senegal



Figure 2. Louga Department in Louga Region

Extension and Advisory Service Providers

ANCAR's main function is to promote the transfer of improved practices, working along entire value chains, not only concerning field production. ANCAR has 24 field agents in Louga Department, including five (21 percent) women. In partnership with Mlouma, a private information service provider discussed in Section 4 above, ANCAR has set up a digital platform, Louma mbay, which gives producers market prices and opportunities to buy and sell produce (Mlouma, 2023). ANCAR also promotes the digital platform SAIDA, in partnership with FAO's Agricultural Services and Digital Inclusion in Africa project. SAIDA offers farmers advice on weather, crop and livestock management (FAO, 2021). The Technical Officer indicated there is growing disinterest of young people in agriculture, hence ANCAR's strong and continuous awareness-raising and training to encourage them to return to the land.

ANCAR highlighted its work promoting crop varieties for millet, cowpea and peanut adapted to climate change, such as short-cycle varieties and varieties with improved water-use efficiency and tolerance to heat. ANCAR uses demonstrations, farmer field schools and training sessions. The ANCAR representative mentioned that if the goal is to simply show producers how to implement a practice or technology, then a proof-of-concept demonstration will suffice. However, if the goal is to demonstrate that a new practice is superior to the standard practice, then replicated field trials are more effective. Farmer field schools (FFS) are a participatory education approach that brings together a group of small-scale producers to solve agricultural problems. The approach involves hands-on group discovery learning and improving skills for observation, critical analysis and decision-making (Gammelgaard et al., 2023). There has been some criticism that the term FFS is sometimes used for field training that does not incorporate the participatory, hands-on, discovery- and group-learning techniques that define it (Franzel et al., 2018).

ANCAR also uses farmer trainers (called *relais* and also referred to as farmer-to-farmer extension). The farmer trainer approach involves farmers training other farmers, often through the creation of a structure of farmer-trainers created by an EAS provider (Franzel et al., 2019). A farmer trainer working with ANCAR generally serves three villages. They are nominated to serve as farmer trainers by their village or farmer group and are not paid but sometimes given items to motivate them. For example, farmer trainers may get extra kilograms of fertilizer when it is distributed to villagers. Other EAS methods

that ANCAR use include giving farmers management advice, holding training sessions, using radio for messaging and participating in and displaying at fairs. ANCAR also assists producer organizations to register with the government which enables them to access credit from the Agricultural Bank.

The Livestock Service of the Ministry of Livestock and Animal Production disseminates technologies (mainly artificial insemination but also fodder crops) and information to farmers. The Livestock Service has 10 agents in the field in Louga Department, but only 1 (10 percent) is a woman. The low rate of representation of women can be explained by the fact that in the zone and in general, few women are interested in livestock. The Livestock Service helps farmers improve their breed improvement techniques so as to ensure successful artificial insemination. It also encourages farmers to use the Mlouma phone app for getting livestock prices and for arranging sales and purchases of livestock.

The Livestock Service uses demonstrations and training sessions in its work. The Livestock Service mentioned that a team from its headquarters conducted an FFS in Louga Department some time ago. The Livestock Service also uses farmer trainers (called auxiliaires). Other extension methods that the Livestock Service use include giving farmers management advice, holding training sessions, using radio for messaging and participating in and displaying at fairs.

The DRDR plans, coordinates and implements rural development policies and provides advisory services to strengthen the skills of producers. DRDR manages activities for two donor financed projects in the Department: The Eco-sustainable Agricultural Intensification Project in the Niayes Area (PIESAN) financed by the Government of Italy and the Smallholder Horticulture Empowerment Promotion (SHEP) Project financed by the International Fund for Agricultural Development (IFAD). PIESAN contributes to the achievement of food security and rural development through the adoption and strengthening of sustainable and profitable agriculture in the Niayes eco-geographical zone in a gender-sensitive way. The SHEP project aims to improve production and yields of horticultural products with a focus on product quality and meeting market demand. The SHEP approach is used by the Japan International Cooperation Agency (JICA) and IFAD in several countries to transform farmers' mindset from "grow and sell" to "grow to sell," helping them increase their income with adequately supported technical and marketing competencies (JICA, 2023). The DRDR contact person for the SHEP project reported that the SHEP approach adopted by producer groups in the area has helped to change their mindset as they now produce based on market demands and preferences. The producer groups have gained the knowledge and skills to conduct market analysis and are now basing their production on the results of the market analysis. Producers are able to identify market and consumer preferences in terms of vegetable varieties and types for household consumption which informs their production activities. The SHEP approach has helped producers to curb wastage as they produce to sell rather than simply producing and selling.

In partnership with USAID-funded Dundel Suuf Project, DRDR promotes the deep placement of urea technology on rice and microdosing in millet, sorghum and some vegetable crops, such as okra, tomato, onions, pepper and eggplant. Both technologies increase fertilizer use efficiency and improve yields while minimizing input and investment costs for producers. PIESAN focuses on eco-sustainable interventions such as reducing soil degradation and water erosion as well as improved crop production and reforestation. The project trains farmers to make and apply "Bokashi compost" an organic fertilizer using crop residues, ash and other readily available ingredients that is ready to be applied 12 days after preparation. DRDR uses demonstrations, farmer field schools, and training sessions in its EAS work. DRDR also assists producer organizations to register with the government.

New digital advisory approaches, such as Louma mbay and SAIDA are being implemented in the Niayes area and are becoming more and more important. The difficulty of this type of advisory system is obtaining feedback from producers and determining how to take care of their (men, women, youth, etc.) varying needs. Public actors such as ANCAR feel the need for field technicians to supplement the digital systems.

All five EAS organizations and projects we interviewed target women and youth, but it was not clear how successfully they are in reaching and benefiting these groups. The PIESAN project offers small grants to producers and women are given preferential terms. They must contribute 20 percent of the cost of the item purchased, whereas men must contribute 40 percent.

Complementary Service Providers

We interviewed one female input supplier in Potou who sells seed, fertilizer, phytochemical products, and bags for produce. She sells on a cash basis and provides credit to producers who pay for their purchases after harvest. She receives loans from the microfinance institution Union des Institutions Mutualistes Communautaires d'Epargne et de Crédit (U-IMCEC) started by the NGO Christian Children's Fund Senegal. Her main problems are lack of finance, not having enough space to store products, lack of time to participate in training opportunities and the unavailability of products at certain times of the year. Poor performance of products is sometimes a problem which according to her is mainly caused by customers not following the instructions given. Part of the problem is illiteracy or low literacy; some of her customers cannot understand the directions written on the packaging.

Partnerships and Platforms

The main form of partnership between agricultural service providers appears to be between public sector EAS providers and donor financed projects. For example, DRDR has written agreements with SHEP, PIESAN and the USAID Dundel Suuf projects. ANCAR partners with FAO and with Mlouma to promote and assist farmers to use digital apps for accessing agricultural advice and market information. No platform exists for coordinating activities or exchanging experiences. The EAS providers gave multiple examples of referring farmers to different service providers such as CNASS for insurance or LBA for credit.

EAS and CSP Representatives' Views on Constraints Faced by Producers

The main technologies promoted in the area concerning the USAID priority value chains are irrigation methods (bore-hole solar pump and drip irrigation) for vegetables, micro dosing for vegetables, the deep placement of urea for rice, Bokashi compost for improving soil fertility for all crops and improved health practices for sheep and goats.

Four of the five EAS providers noted the differences in constraints affecting women, men and youth. The major constraints faced by female farmers are insufficient labor, the high cost of hiring labor and the limited time to work on the farm due to household responsibilities. Women's lack of time for farm work results in a high dependence on seasonal laborers. Other key constraints for women are inadequate access to funds, land, and inputs.

Men generally face problems of means, including land and inputs due to competing family commitments. They also lack time because of involvement in off-farm activities. Youth have a general

lack of interest in labor-intensive work, hence, according to one EAS representative, the need for awareness-raising and training to return to the land.

Regarding specific technologies, representatives noted producers' difficulty in applying fertilizer using micro dosing and the deep placement of urea due to poor knowledge and high labor requirements. Also, for the deep placement of urea, machinery costing about \$6,700 is needed for the manufacture of super granulated urea and so the product is often not available. The representative of the Livestock Service noted that the main constraints for livestock owners are the high cost of inputs, unavailability of sufficient fodder, access to finance and land and lack of knowledge, particularly regarding animal health.

Barrier Analysis

The team conducted barrier analyses in Potou with three producer groups: Société Coopérative des Femmes Productrices de Potou Guèye (SOCOPA), a women's cooperative focusing on horticultural crops, and two groups of farmers (one of men and one of women) representing several different livestock producer organizations (Appendix 2). SOCOPA members' most important horticultural crops are onions, potatoes and carrots. Some women have their own fields obtained through their families. The cooperative also has a community field of 2 hectares that 16 groups of 300 women cultivate. Some are using borehole solar pumps and drip irrigation, supplied on credit, and others use the traditional method of watering by buckets. The livestock farmers owned cattle, sheep and goats but were more interested in discussing cattle than sheep and goats, hence their choice of cattle technologies for the barrier analysis. Some key problems that the horticulture farmers face include absence of storage and processing technology, salinization of irrigation water, low water table, difficulty in accessing credit, and lack of technical support from extension services. Livestock farmers' main problems included lack of means and awareness concerning agricultural insurance, lack of credit, and difficulty in accessing technical information about agriculture.

The barrier analysis was done on four technologies: irrigation methods (bore-hole solar pump and drip irrigation), nursery and transplanting for vegetables (e.g., onions and carrots), artificial insemination of cattle and maralfalfa (*Cenchrus purpureus*), a forage grass for cattle.

The main barriers farmers face in adopting irrigation technologies are the cost of installing and operating the system, the skills required for operating the system, and salinization of water and the cost of treatment (Table 6). The solutions women foresee are capacity strengthening for improving their skills, enhancing their access to credit and financial support from partners, such as projects. Establishing a nursery and transplanting seedlings had big yield advantages over direct seeding of vegetable crops but requires more labor. Borrowing money was seen as a way of paying the extra labor costs. Concerning artificial insemination in cattle, the main problem was that it was not always successful and there was no refund if it did not result in a pregnancy (Table 7). Barriers limiting uptake of forage grasses included unavailability of land and lack of knowledge. Producers' views on advantages and disadvantages of the technologies assessed in the barrier analysis are presented in Appendix 7.

Table 6. Barriers identified by farmers in adopting new irrigation methods and nursery/transplanting practices.

Barriers

Potential Solutions

Enabling Farmers for Agricultural Transformation (EFAT)

A Landscape Analysis of Agricultural Service Provision and Barriers Faced by Farmers in Adopting Agricultural Technologies in Four Locations in Senegal

Irrigation Methods ² for Vegetables (e.g., onions and carrots)			
Cost of installing and maintaining system Credit, financial support from partners			
Lack of skills required for operating systems Training, more extension staff			
Low water table None			
Salinization and cost of treatment Credit			
Nursery and Transplanting For vegetables (e.g., onions and carrots)			
Lack of labor Credit for hiring labor			
Table 7. Barriers identified by farmers in adopting artificial insemination and forage crops for cattle.			

Barriers	Potential Solutions		
Artificial Insemination (AI) for Cattle			
Expensive, \$83/session	Financial support from partners, credit		
Ai not always successful so risk of losing the money	None		
spent on it			
Insufficient number of livestock agents for follow-up	Increase number of agents		
Lack of security, cross-bred animals can be stolen			
Forage Grass: Maralfalfa (Cenchrus Purpureus) for Cattle			
Land availability	No easy solution		
Lack of knowledge	Training, technical support from agents		

Observations and conclusions on the barrier analysis are presented in Table 8. Socio-cultural and institutional barriers are the most important ones limiting producers from adopting new technologies, particularly for women and youth (Table 8). Social mores and inheritance laws limit women and youth's access to land and the only solutions appear to be long-term, such as changing social mores and laws. Short-term ways around the problem could involve finding ways for women and youth to earn incomes from enterprises that do not require land, such as providing services such as transport or adding value to products, e.g., processing and marketing. The main institutional barriers are lack of credit for investing in irrigation equipment and livestock and lack of training opportunities for strengthening farmers' capacities. Solutions involve livestock groups registering with the government to access subsidized loans and facilitating links to EAS providers for training.

² Bore-hole solar pump and drip irrigation.

Technologies	Socio-cultural Barriers	Institutional Barriers	Technological Barriers	
Irrigation methods	Women's and youth's limited	Lack of credit for	Salinization and cost of	
(bore-hole solar pump	access to land	installing and maintaining	treatment	
and drip irrigation) for		system		
vegetables.		Lack of skills required for		
		operating systems		
Nursery and	Women's and youth's limited	None identified	None identified	
transplanting for	access to land			
Artificial insemination	Animals can be stolen	Insufficient extension	Not always successful	
for cattle	Have not heard of A L for	staff for follow up	Not always successful	
	sheep			
Forage grass for cattle	Women's and youth's limited	Lack of knowledge	None identified	
	access to land			
Solution(s)	Long term: Change laws so	Help get producer	None identified	
	women and youth can access	organizations registered to access subsidized loans		
	more land. Short term: find			
	them income earning	from Agricultural Bank.		
	opportunities that do not	Facilitate links to EAS		
	require land, e.g., in processing	providers for training.		
	and transportation			
General observations	 Farmers depend on microfinance structures for loans which come with high interest. Subsidized loans are not available to farmers who are not in registered producer organizations. Registration process is tedious. Whereas extension approaches used (farmer field schools, SHEP approach) encourage farmers to innovate, there are no mechanisms to take advantage of farmers' experimentation, and test and scale up these innovations. Marketing constraints are not critical and do not limit adoption. Lack of capacity among all stakeholders to monitor and assess adoption of technologies. 			

Table 8. Barrier analysis, observations, and conclusions, Louga.

Strengths and Weaknesses of the Extension and Advisory Services System

Table 9 summarizes strengths and weaknesses of the EAS system in Louga in two parts. The first part lists strengths and weaknesses that we found to exist at all four sites, including Louga. Next, we list ones that are specific to Louga. Main strengths at all four sites are strong producer organizations, the introduction of digital services on climate information and marketing, the widespread use of farmer field schools and farmer trainers as extension methods and the existence of numerous programs targeting and working with female producers. System weaknesses include the low capacity of public EAS in entrepreneurship, post-harvest technology, processing and tracking adoption; lack of coordination and a silo mentality prevailing among EAS providers; and a lack of a feedback culture, that is, organizations disseminating technology lack the capacity to monitor and assess adoption and get feedback from farmers on their innovations. EAS providers have little to offer concerning processing and adding value and no private companies, aside from digital services, offer EAS.EAS providers have few activities targeting youth.

Table 9. Strengths and weaknesses of extension and advisory services in Senegal and those specific to Louga Department

EAS system throughout Senegal

Strengths

Strong producer organizations are common, and they are often federated into unions, giving them greater voice and impact

Digital services on climate information and marketing have been introduced and are increasing in use

Farmer field schools and farmer trainers are commonly used by EAS providers

Numerous examples of EAS providers targeting and working with female producers

Weaknesses

The focus of existing extension agencies is on disseminating new technologies. More emphasis is needed on other critical roles such as brokering, facilitating, and strengthening entrepreneurship and business skills among farmers. Limited capacity of public sector EAS staff, particularly in entrepreneurship, post-harvest technology, processing and value addition

Lack of coordination and harmonization among EAS providers. Each operates in relative isolation and a silo mentality prevails

Lack of a "feedback culture" No organization is trying to identify, test and disseminate improved practices that farmers have devised on their own. Little understanding of the causes of non-adoption of improved practices and no strategies for tracking adoption numbers when disseminating. Organizations lack the capacity to monitor and assess adoption. Identifying successful practices and scaling them up does not appear to be high priority

Limited range of extension methods. Not clear that quality of FFS is high

Except in digital services, no private companies offering EAS

Few examples of EAS providers targeting and working with youth

EAS system in Louga

Strengths

Numerous projects (SHEP, *Nafoore Warsaaji, Dundel Suuf* and PIESAN) with EAS components operate in the area, are well resourced and may be interested in partnering with EFAT

Considerable success facilitating development of profitable horticultural enterprises

Considerable engagement with female producers by targeting women's producer organizations

Weaknesses

Donor-financed projects appear to drive the agenda of public EAS providers. Once a project exits, there is no incentive to continue working on the activities associated with it. Rather, staff look for or are assigned to another project to work with

Limited use of digital methods for agro-advisory services

Strengths specific to Louga are that numerous development projects work in the area and support EAS, and the successes in promoting successful horticultural enterprises and the considerable engagement with women, particularly through working with women's organizations. Main weaknesses are that donor projects appear to drive the agenda of agricultural development in Louga and the limited use of digital methods for agro-advisory services.

SAINT-LOUIS AND DAGANA DEPARTMENTS



Figure 3. Map showing Saint-Louis and Dagana Departments of Saint-Louis Region

Table 10 shows the EAS, CSPs and research institutes we met with in Saint-Louis and Dagana (Figure 3). Other organizations active in the area but not visited are listed in Appendix 2.

Table 10. Extension service providers and other stakeholders interviewed in Saint-Louis and Dagana Departments

Name and Type of Service Provider	Category
Extension and advisory providers	
Directions Régionales de Développement Rural (DRDR)	Public
Société d'Aménagement et d'Exploitation des Terres du Delta du Fleuve	
Sénégal (SAED)	Public
Agence Régional de Développement (ARD)	Public
Complementary Service Providers	
La Banque Agricole (LBA) (financial services)	Public
SEDAB SARL (input supplier)	Private
LOCAFRIQUE (Leasing and sale of equipment)	Private
Research and Educational Institutes	
Institut Sénégalais de Recherches Agricoles (ISRA) (research)	Public
Centre Interprofessionnel de Formation aux Métiers de l'Agriculture	
(CIFA) (training/education)	Public

Extension and Advisory Service Providers

We visited three public EAS providers: SAED, a parastatal, DRDR of MAER, and the Agence Regional de Développement (ARD) of MCTADT. SAED is the largest of the three; its mission is to develop irrigated agriculture in the Senegal River Valley. In addition to providing EAS, it also develops and maintains irrigation infrastructure, supports produce marketing and facilitates formation and management of producer organizations. The main value chains it promotes are rice and horticulture, the two most

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important ones in its domain. DRDR and ARD are both smaller and EAS is less important for them relative to their other activities. DRDR's main activities are policy development, seed certification and monitoring and evaluation, while ARD facilitates local planning and monitors local development programs.

All three organizations finance many of their EAS activities through contracts with donor organizations. SAED has projects with six donors including the World Bank and the French Agency for Development. ARD is helping the Network of Female Agriculturalists of the North (REFAN) (16,000 members) set up a digital platform that members can use to access climate information and climate smart production practices from their telephones, with financing from Spain. ARD also helped establish farmer field schools and demonstrations at five sites with financing from South Korea.

ARD uses a "territorial approach" (Suttie and Hus, 2015) to its EAS activities. The territorial approach is a holistic, multi-sectoral approach to integrated rural development, while SAED and DRDR, like most actors in the agricultural sector, use sectoral and value chain approaches, which have a narrower focus. The advantage of the value chain approach is that it permits development practitioners to focus on a particular value chain and propose interventions from input supply through production, transformation, and marketing (Donovan et al, 2017). The disadvantage, as pointed out by the ARD representative, is that most farmers work in several value chains at the same time and too much emphasis on one can cause problems in the other value chains the farmer is trying to manage.

SAED uses a wide range of extension methods in its work including training programs for farmers and farmer field schools. They also use radio and television for messaging and organize fairs to facilitate exchange and showcasing good agricultural practices. SAED also helps producer organizations to register with the Senegal government so they can access financial services. DRDR's EAS methods include farmer field schools, demonstrations, and training sessions. ARD uses similar methods and as mentioned above, is also helping develop digital EAS tools.

SAED also appears to have the strongest in-service training program of the three, organizing conferences and workshops for their staff and partners to strengthen capacities, strengthen networks and advance knowledge-sharing. Their staff receive in-service training through the Interprofessional Center for Training in Agricultural Professions (CIFA), a center that they support financially. Other services rely mainly on donor projects for training their staff.

All three organizations stated that they give considerable attention to serving women and youth though it was difficult to assess the degree to which that is true. None were able to quantify the number or proportions of youth and women they worked with. SAED and ARD prioritize helping to strengthen women's producer organizations and were able to provide specific examples of work in this area. They also talked about specific problems that women and youth producers face and propose solutions. For example, the SAED representative mentioned women's' problems getting access to credit and efforts they make to help women to strengthen their organizations so as to be able to access credit. Overall, all three EAS providers gave more emphasis to targeting and helping women than to targeting and helping youth.

Research and Training Institutes

Senegal Institute of Agricultural Research (ISRA). ISRA's research center in Saint-Louis focuses on improving the productivity and quality of irrigated rice, wheat, horticultural crops and maize. It works in

close partnership with Africa Rice, which also has a research center near Saint-Louis. As mentioned above, ISRA has released 64 varieties in recent years but only 5 are used by farmers.

It is difficult to explain the low uptake of improved varieties by farmers. One hypothesis is that many of them do not meet farmers' or the market's needs and preferences. In the past, researchers had little exposure to farmers and information on market demand. In recent years, researchers have started involving farmers in evaluating breeding trials to ensure that their needs are met. Researchers also now consider the needs and preferences of the market. But there appears to be little effort to find out the specific needs and preferences of women or youth. Another hypothesis is that weak research-extension linkages are partly responsible for low adoption; researchers and EAS do not partner in diagnosing farmers' problems, in proposing solutions, conducting on-farm trials and demonstrations, or assessing adoption, according to our contacts at ISRA. A further problem concerns incentives; while crop breeders are strongly motivated to release varieties, they have little incentive to see that their varieties are taken up by farmers. Finally, very few adoption studies have been conducted. These could help guide practitioners on how to improve adoption rates.

Interprofessional Center for Training in Agriculture Professions (CIFA). CIFA's mission is to strengthen the skills of professionals in the agricultural sector, including extension agents, managers, and leaders of organizations such as producer organizations. CIFA has six full-time professional staff (all male) and relies on consultants for much of its training courses. For extension agents, CIFA conducts short-term (15 day) refresher training courses on topics such as communication with producers, monitoring and evaluation. Courses include both field and classroom work. CIFA also conducts training courses on specific issues when the need arises, such as a 2-day course on addressing tomato pests. The center has accommodation for 48 students.

CIFA's board of directors includes representatives of producer organizations, educational institutions, NGOs, and private companies. About three-quarters of its budget comes from organizations paying CIFA to train their staff; about 20 percent is from SAED. We noted several weaknesses of CIFA's EAS training. First, its offerings are not accredited in any way. Second, there is no process for developing or updating curricula. Rather, staff do these when they feel the need to do so. CIFA does not offer any e-training, nor does it have plans to do so. Finally, CIFA's EAS training is narrow; little or no emphasis is given to such topics as entrepreneurship, EAS methods and approaches, monitoring technology adoption, climate change or targeting and involving women and youth in EAS programs.

Complementary Service Providers

La Banque Agricole (LBA). LBA's major focus is to enable producers both as individuals and groups to access loans to finance their production, processing, and marketing. It also provides funds to individuals, groups and firms along agricultural value chains to finance input provision, processing, and marketing. Repayment is generally made in cash, but contracting arrangements for farmers producing irrigated rice are a promising development and have increased in recent years. Under this system promoted by the USAID *Naatal Mbay* project, loans are made to farmers producing irrigated rice through their producer organizations, rice in storage serves as collateral and repayments are deducted from sales of rice (Poublanc, 2018; RTI International, 2019).

Major constraints limiting farmers' access to credit are lack of resources to serve as collateral and lack of time, resources, and knowledge of the process to apply for loans. Women and youth face further

problems because they often do not own land and their groups are often not formally registered, a process that requires considerable time, expertise, and resources.

SEDAB SARL. SEDAB SARL sells fertilizers and other agro-chemicals and produces and sells maize, rice and groundnut seed. The company representative claims that MAER's system for distributing fertilizer functions poorly as quantities supplied are not related to demand; some areas receive more than they need but most receive less or far less. Unsubsidized fertilizer is available but is too expensive for most farmers to find attractive.

The SEDAB SARL representative we interviewed felt that the biggest problem irrigated rice farmers face is following the cropping calendar. For example, if a farmer plants late, rain spoils the rice crop at harvest time. The problem is further compounded by climate change, which has made rainfall more unreliable. Moreover, many farmers plant two crops per year on the same plot, making timely operations even more critical. The representative also felt that there has been a decline in the quality of extension staff over time and that they spend less time than previously in the field working with and training farmers.

LOCAFRIQUE. LOCAFRIQUE is a financial company specializing in leasing agricultural equipment for the rice value chain. In partnership with the USAID project Naatal Mbay, LOCAFRIQUE received credit for providing large farmers and companies with rice combine harvesters on credit. In 2023, LOCAFRIQUE is starting a credit program for smallholders offering loans of \$8,300 or more for purchase of such items as motor pumps and threshers. They have created financial literacy materials and fliers tailored to youth and women entrepreneurs and are advertising on Facebook.

Partnerships and Platforms

Partnerships among EAS providers for the purpose of conducting or coordinating EAS activities are rare in the Saint-Louis-Dagana area. We found that EAS providers sometimes had formal partnerships with other EAS providers, but the purposes were not related to EAS. For example, SAED and DRDR have a formal partnership concerning seed production because DRDR is the agency authorizing and monitoring private and public agency seed producers. SEDAB SARL also partners with DRDR for seed production. We also noted that there is no mechanism for SEDAB SARL to provide feedback on fertilizer distribution that would be useful for improving EAS programs, such as informing MAER of problems of too much or too little fertilizer being available at particular places. No platform exists in the Saint-Louis-Dagana area for EAS providers, research institutes and CSPs to coordinate, exchange information or partner on activities.

EAS and CSP Representatives' Views on Adoption Constraints Faced by Producers

Some of the main technologies being promoted by EAS providers in Saint-Louis and Dagana are rice varieties, more efficient methods for applying fertilizer (micro dosing in horticulture and the deep placement of urea in rice), the ASI rice thresher and a small rice processing machine for smallholders.

Principal constraints to adoption of new practices by farmers, according to key informants, are lack of resources, particularly land and finance, lack of knowledge and skills, lack of labor and the high cost of equipment and inputs such as fertilizer. The most important constraint for women and youth is land. Even when women can get land, they are often apportioned small, infertile parcels and parcels subject to flooding.

The SAED representative believed that adoption of improved rice varieties is low because of the high cost of certified seed (prices are set by government) and farmers' lack of knowledge about the varieties

and their characteristics. Another possibility not mentioned by the SAED representative is that some released varieties may have characteristics that farmers do not prefer. The DRDR representative believed that the adoption of micro dosing was low because it requires too much labor and that the adoption of deep placement of urea is low because of the low availability of fertilizer briquettes because of the high cost of the machine for manufacturing super-granulated urea (\$6,670). An entrepreneur could buy a machine and sell the super-granulated urea but there is little if any demand for such machines.

The SEDAB SARL agent believed that a main cause of low adoption of certified rice seed was that extension agents' skills were low and that they interacted less with farmers than in the past. Availability of subsidized fertilizer is limited because public funds for the subsidy are limited. The cost of unsubsidized fertilizer is too high for farmers to afford. When households do get fertilizer, the head of household allocates most to his plots, leaving little for women and youth.

Social norms grant land rights and inheritance to men. When women marry they move to their husbands' home and therefore have to rely on their husbands to access land. A possible solution is to assist women and youth to develop enterprises that do not require land, e.g., processing and transportation.

An additional problem that farmers face is that plots are uneven causing irrigation problems. A possible solution is to petition SAED to repair the plots as it is their responsibility to do so.

Barrier Analysis

We conducted a barrier analysis with three groups: women of the Union des Femmes Productrices de Ross Bethio (UFPRB), female members of the Union de Groupement Maka Diama (UGMD), and male members of UGMD. Ross Bethio and Diama are in Dagana Department and both are about 20 km from Saint-Louis. UFPRB is a union of 12 women's group, comprising 1,821 members, including 177 young women. UGMD is a mixed group (men and women) and has 416 members. Both POs' main interest is in irrigated rice production. The men also mentioned their interest in horticulture (onions, tomatoes, and eggplant), while the women were interested in sheep and goat rearing. There are few female landowners in these locations. The plots where youth and women farm are small (less than 0.25 ha) and belong to the head of the household. Women and youth generally have a low level of access to quality inputs, financial services, and new production technologies. Not all women cultivate their own plots; others help their heads of households or become agricultural workers on other farms. Women are mainly solicited at harvest time to work on family plots. Youth are often involved in tilling the soil or in other operations.

Table 11 presents farmers' analysis of barriers to adoption of two improved, aromatic rice varieties, Sahel 177 and Sahel 210, and mineral fertilizer for irrigated rice cultivation (NPK compound fertilizer is used as a basal application and urea as a top-dress). The main problems limiting adoption of the two varieties worked on are their low degree of water absorption and attraction to birds. Men's groups and women's groups discussing these varieties both recognized these limitations. Both groups' solution is to keep growing their traditional variety, Sahel 108. Fertilizer use is widespread but at much lower rates than recommended. Producers' reason for low rate of fertilizer application is that only small quantities of fertilizer are available at the subsidized price; fertilizer at unsubsidized prices is too expensive. Measures to economize on fertilizer such as micro dosing, are not used because they are too laborious.

Aromatic Rice varieties		Mineral Fertilizer for Irrigated Rice (NPK and Urea)		
Barriers	Potential Solutions	Barriers	Potential Solutions	
Sahel 210 and Sahel 177 do not swell (absorb as much water) compared to Sahel 108, farmers' preferred variety Therefore, a larger quantity of rice is needed to feed families relative to quantity of Sahel 108 needed	Continue growing Sahel 108 as main variety	Recommended rates not used because quantity available at subsidized price is small and unsubsidized fertilizer is expensive	Government needs to increase quantity of subsidized fertilizer Farmers request subsidized credit to buy fertilizer.	
Easily attacked by birds	Continue growing Sahel 108 as main variety	Subsidized fertilizer sometimes arrives late, reducing its potential to increase yields	Government needs to improve timeliness of fertilizer delivery	

Table 11. Barriers i	dentified by	farmers in	adopting ric	e varieties and	fertilizer
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Observations and conclusions on the barrier analysis are presented in table 12. The table includes technologies mentioned by EAS and other service providers as well as those noted by farmers. Land rights and inheritance are key socio-cultural problems facing women. There are no short-term solutions. Rather, farmers proposed that EAS providers should help women and youth earn incomes from enterprises, such as processing and transportation that do not require land ownership. The main institutional constraint is lack of access to credit; helping farmers register their producer organizations can help them to access subsidized credit. Technological constraints include expensive machinery to produce fertilizer briquettes for the deep placement of urea technology and land preparation, and high labor requirements for micro dosing. Solutions involve identifying or developing appropriate technology and making it available.
Technologies	Institutional Barriers	Technological Barriers	
Fertilizer on rice (NPK and urea)	None identified	Expensive and sometimes inputs	
		arrive late, reducing yields.	
Rice varieties Sahel 177 and 210	None identified	Attractive to birds, low water	
		absorption (see Table 11)	
Deep placement of urea on rice	None identified	Machines for making super-	
		granulated urea is expensive and	
		rare. Applying urea by hand is	
		laborious. Only tool available for	
		application does not work well,	
		according to <i>Dundel Suuf</i> Project	
Micro dosing on horti- cultural crops:	None identified	Not done because it is laborious	
Equipment (e.g., tractors, rice	Access to credit is difficult because	High cost of machinery, e.g.,	
processors)	producer organizations are not	tractors. Producers would prefer	
	registered. Women also lack surety	machines that are within their	
	for obtaining loans	means in terms of cost, size, and	
		mobility	
Solutions	Get producer organizations	Petition SAFD to repair plots	
	registered to access subsidized	Identifying appropriate technology	
	credit for inputs, equipment and	and making it available.	
	processing and marketing.	Improve availability of machines for	
	Increase pay-back period for loans	super-granulating urea. Develop	
		tool for applying it	
General constraints to adopting	Several problems explain why ISRA's e	fforts to disseminate new varieties	
new technologies	have not had much success. Extension	n and advisory approaches and	
	methods are top down in orientation.	There is little emphasis on	
	technology transfer. Agricultural advis	ors play a greater role in supporting	
	POs than in transferring technologies. Training sessions organized by SAED		
	through CIFA are more oriented towards imparting soft skills (e.g.,		
	leadership and communication) than skills to promote and disseminate		
	agricultural practices and technologies. In addition, extension training		
	sessions are mainly aimed at leaders of producer organizations who do not		
	necessarily share what they learn with other producers.		
	rew producers nave access to subsidized loans and the lack of financing for		
	agricultural finance system is diverse but dominated by the LBA. LBA has a system that is very bureaucratic and focuses on lending to organizations rather than to smallholders. There are alternative financing options such as with Credit Mutuel du Sénégal (CMS) or <i>Alliance de Credit et d'Epargne</i> <i>pour la production</i> (ACEP), but interest rates are higher		

Table 12. Barrier analysis, observations, and conclusions.

Strengths and Weaknesses of the Extension and Advisory Services System

The strengths and weaknesses of the EAS system in Saint-Louis and Dagana Departments are shown in Table 13 (see Table 9 for a list of strengths and weaknesses of EAS system at national level). Strengths specific to Saint-Louis and Dagana include the presence of SAED, a well-funded EAS provider, strong producer organizations, active USAID projects having EAS components with which EFAT could partner, considerable engagement with women, mostly by working with women's producer organizations, and

availability of EAS in-service training for extension agents through CIFA. Weaknesses include weak linkages between ISRA and EAS and low use of digital apps in EAS.

Table 13. Strengths and weaknesses of extension and advisory services system.

Strengths
Well-funded public sector EAS organizations have the basic resources that they need to conduct their work
Strong producer organizations with the potential to increase farmers' voice in influencing research and EAS. They also
have the potential, as some are doing, to aggregate and thus lower input costs and get higher prices for produce
through bulking
Several USAID FtF projects (Doolel Mbay, Nafoore Warsaaji, and Dundel Suuf) are active in the area. Partnering with
them may help them achieve their objectives as well as improving impact of EFAT activities
Considerable engagement with women, mostly by working with women's producer organizations
In-service training for public sector extension agents is available through CIFA
Weaknesses
Lack of linkages and partnerships between ISRA and EAS providers in : identifying farmers' problems, planning
solutions to problems, conducting participatory on-farm trials to test improved technologies and assessing the uptake
of improved technologies and constraints farmers face in adopting them
Low use of digital apps in providing EAS

KAFFRINE DEPARTMENT

Landscape Analysis

In Kaffrine Department, we met with two agricultural advisory structures: ANCAR and the Water and Forests Department of the Ministry of the Environment and Sustainable Development (Figure 4 and Table 14). We met with one administrative structure, the Sub-prefecture, which is responsible for managing the various governmental services operating in the Sub-department of Mabo. In this case, the Sub-prefecture can be considered a complementary services provider because of the services it provides as an initiator and member of the managing committee of the village platform described below. We also conducted Interviews with two private input suppliers in Kaffrine. Other organizations active in the area but not visited are listed in Appendix 2.



Figure 4. Map showing Kaffrine Department

Table 14. Extension service providers and other stakeholders interviewed in Kaffrine Department.

Name and Type of Service Provider	Category
Extension and advisory providers	
ANCAR	Public
Water and Forests Department of the Ministry of the Environment and	Public
Sustainable Development	
Complementary Service Providers	
Sub-prefecture office of Mabo Sub-department	Public
COOPROSEM (input supplier)	Private
Cheikh Diagne & Frères (input supplier)	Private
Research and Educational Institutes	
ISRA	Public

Extension and Advisory Service Providers

ANCAR aims to promote, facilitate, and manage agricultural and rural advisory services to enable smallscale producers to sustainably improve productivity, food security and income. The Water and Forests department oversees the management and protection of the country's natural resources. It also implements sustainable development policies and programs, with a view to improving livelihoods while protecting the environment.

The sub-prefecture, ANCAR and the Water and Forests Department currently assume key roles throughout the department in the promotion of resilient agricultural technologies (particularly crop varieties, crop management practices and tree species), and the sharing of information with and training of producers. These organizations work with all rural communities and across all agricultural value chains.

The ANCAR field officer claimed that ANCAR emphasizes strengthening of technical, organizational, and management of producers through training, information sharing, awareness raising and creating linkages between the producers and complementary service providers such as the banks, insurance, climate and market information service providers and other development partners. ANCAR also promotes rural entrepreneurship and the marketing of agricultural products. It works with members of POs as well as those who are not members. In collaboration with ISRA, ANCAR is promoting a climate-resilient technology package on millet that includes a drought and disease tolerant variety (ICMH177111), climate information from ANACIM, tillage methods and fertilizer use.

Also, in collaboration with ISRA, ANCAR is promoting a suite of agroforestry trees to improve livelihoods and food security, focusing on women. The trees include the following species : Gola jujube (*Ziziphus mauritiana*), which produces a fleshy fruit that is consumed raw, tamarind which produces seeds that are used in sauces and juice, and baobab which supplies many products including the leaves, which are an important food. Women plant the trees in their gardens. ANCAR's extension methods include demonstrations, farmer field schools, and training sessions.

The Water and Forests Department promotes reforestation, the sustainable management of natural resources and the fight against deforestation, desertification, and soil degradation. They have introduced the assisted natural regeneration practice to producers, which involves encouraging the natural growth of new plants and trees by promoting the germination of seeds present in the soil and the growth of existing plants. This method restores biodiversity to degraded areas, protects the soil from erosion and

regulates the water cycle. The Water and Forests Department uses demonstrations, farmer field schools, and training sessions.

Complementary Service Providers

The sub-Prefecture office. The sub-prefecture's mandate is the administrative management of the subdepartment including economic development and EAS. It also plays an important role in resolving conflicts among actors and different communities in the area. Its role in assisting a local platform promoting climate smart agriculture in the sub-department is described in the next section on partnerships and platforms.

Seed Producers' Cooperative: COOPROSEM. Created in 2009, COOPROSEM is a producer cooperative specialized in the sale of certified seeds (mainly vegetables), tools and agrochemicals for its members. The main crops for which seeds are sold are rice, onions, tomatoes, okra, and pepper. COOPROSEM provides members with watering cans, rakes, and shovels as well as fertilizer, insecticides (malathion and deltamethrine), fungicides (mancozebe) and herbicides (glyphosate). COOPROSEM has 800 members, including 150 women, representing of 19 percent of members. Farmers can obtain half of the seed they want on credit, that is, they can pay for half at the time of purchase and the other half in kind after harvest, which facilitates access to seeds. Seed is first sold to cooperative members before addressing demand from NGOs, projects or other producers in the area. The cooperative has a technical team that serves its members by providing advice on input use. To finance its activities, COOPROSEM takes out bank loans from the Agricultural Bank (LBA), Mutual Credit of Senegal (CMS) and microfinance institutions. The interest rate is 17-18 percent. COOPROSEM's main perceived problems are its lack of financial means to have enough certified seed to sell, that some of its members are unable to repay seed loans and that its technical team has limited mobility to follow up with members. Its proposed measures for addressing these problems are to seek assistance from partners who can help strengthen COOPROSEM's capacity to raise funds for scaling up activities and strengthen the capacity of members in entrepreneurship and financial management.

Cheikh Diagne & Frères. The main products sold by this company are certified seeds, fertilizers, and plant protection products. The range of products sold is similar to what was reported under COOPROSEM above. Staff give explanations and advice to customers when they buy products, but no other outreach activities are carried out. According to the Manager, there is high demand for inputs at the onset of the production season. Beyond this period, the company notes a drop in sales. According to the owner, the company has high patronage from women and youth. Constraints experienced by the company include difficulties in selling inputs outside of the production periods, the high cost of renting stores and the high variability in the quality of available inputs and their lack of standardization.

Partnerships and Platforms

In Kaffrine, the technical agents of ANCAR and the Water and Forests Department work closely with the administrative and technical authorities (Sub-prefecture and Departmental Service of Rural Development representatives of the DRDR at the Departmental level). In 2019, ISRA helped producers establish the Village Platform of Seko Keur Sawely, a platform across 12 villages, that helps producers adapt to climate change by introducing resilient crop and tree varieties and sustainable land management practices. A specific focus of the platform was training women on how to establish kitchen gardens cultivating vegetables, fruits and forest herbs for food security and improved livelihoods. According to our informants, the activities of this platform were suspended due to a conflict among the villagers related to

management of subscription funds and the addition of new members which caused frustration within the community. The sub-prefecture office helped the village platform to reactivate itself and the subprefecture became a member of the platform. The Sub-prefecture and all the twelve villages are represented in its management committee. Main activities of the platform include information sharing, capacity strengthening and helping producers access improved agricultural technologies. The platform promotes market gardening, agroforestry, processing, improved crop and livestock practices and natural resources management with funding from AICCRA and the African Development Bank (Sanogo et al., 2020)

The strong partnership that exists between ANCAR and the Water and Forests Department at the village level, as well as their proximity to producers, is a major strength of the EAS system. However, both organizations wish to be represented in the Village platform of Seko Keur Sawely for better planning and synergy of activities. They also want to see better coordination of activities with other providers of advisory services (e.g., NGOs and development projects) for technology upscaling so as to reach out to producers in the various communities. The technical agents of ANCAR and the Water and Forests Department also partner with financial partners such as CNAAS, which provides agricultural insurance.

EAS and CSP Representatives' Views on Adoption Constraints Faced by Producers

According to agricultural service providers, the problems affecting producers include the frequent theft from trees and crop fields, lack of laborers available at wages that producers are willing to pay and limited access to information and training. The EAS and CSP representatives claim that youth lack interest in agriculture in general, mainly due to the drudgery inherent in the use of traditional implements and methods and do not have the time to devote to agricultural activities.

The representatives propose several solutions to the above problems: more training, particularly using farmer field schools and especially for women and youth; use of demonstrations; need to formalize producer organizations to ensure access to bank loans; need for awareness raising and training for young people to increase the attractiveness of the agricultural profession; and improvement of logistics and transportation for technical agents working in the field.

Barrier Analysis

In Mabo Arrondissement of Kaffrine District, we facilitated 45 women and 28 men, all members of the Village platform of Seko Keur Sawely, to carry out barrier analyses of four technologies introduced by ISRA. Men have primary responsibility for land preparation, planting and weeding of field crops such as millet, sorghum, and cowpeas whereas women manage gardens and lead in fruit production (Sanogo et al., 2020; AICCRA, 2022). Male producers mentioned as problems their insufficient training in agriculture and the lack of labor to hire at wages they were willing to pay. Women mentioned lack of time to engage in field work due to many household tasks, limited access to information and training on how to respond to climate change and insufficient access to inputs and mechanization.

The women and men met separately and evaluated barriers to different technologies. The women assessed barriers to three technologies: *Gola jujube* (an improved variety of the fruit tree *Ziziphus mauritiana*) a grafted tamarind tree (women were trained to graft an improved variety onto the traditional variety) and assisted natural regeneration. The men assessed the barriers to a climate smart technology package which includes a drought tolerant millet variety (ICMH1777111), fertilizer and climate information received by phone (Table 15 and 16).

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The Gola jujube produces a fleshy fruit with a ready market but the main constraints limiting its adoption are that it takes two years to fruit and that insects and rodents attack its fruits. The main constraints to the adoption of tamarind are the length of time it takes to fruit, the lack of processing equipment and difficulties in conserving it in storage. An additional constraint common to both trees is that they take up land that could otherwise be cultivated with annual crops.

While increased fruit production can have important nutritional benefits for rural households, producing for the market requires careful planning by those promoting it. An important consideration is the thinness of the market and whether large increases in production can be absorbed. Market analysis is needed before widescale promotion gets underway to assess demand for fruit and the effect of increases in production on prices. While women are interested in processing, packaging and labeling fruit products, the potential for successful cottage production must also be assessed. In other countries, producer organizations have benefitted more from supplying raw products to manufacturers than trying to compete with them in processing and marketing retail products for consumers (Faulkner et al., 2009).

A main constraint limiting the adoption of assisted natural regeneration is the difficulty of keeping livestock off the field. Farmers requested financial help in fencing their fields and noted that this could also help prevent thieves from stealing produce. Farmers had difficulty describing and assessing the climate smart technology millet package and suggested that EAS providers need to be more involved in explaining, promoting and getting feedback from producers on its components. Farmers lack cash and credit for acquiring needed crop inputs such as fertilizer. They lack knowledge on how to access credit and insurance.

Gola jujube		Grafted Tamarind Trees	
Barriers	Potential Solutions	Barriers	Potential Solutions
	Find varieties with less		Find varieties with less
Takes 2 years to fruit	time to fruiting	Takes 2 years to fruit	time to fruiting
	Use treatment against	No processing equipment	
Insect attacks on fruits	insects	available	None identified
		Difficult to conserve in	
Rodents eat fruits	None identified	storage	None identified
Takes up land that could		Takes up land that could	
be under crops	None identified	be under crops	None identified
	Put up fencing, which		Put up fencing, which
	may require financial		may require financial
Theft of fruits	assistance	Theft of fruits	assistance

Table 14. Barriers identified by farmers in adopting gola jujube and grafted tamarind trees.

Table 15. Barriers identified by farmers in adopting assisted natural regeneration and climate smart technology millet package.

Туре	Barriers	Potential Solutions
	This practice is complex and involves	
	tradeoffs between competing priorities,	
Climate-Smart	particularly when combined with	Stronger extension involvement in
Technology Package for	agroforestry ³	promoting the practice
Millet Production	Farmers lack cash and credit for	
	acquiring needed crop inputs. They lack	
	knowledge on how to access credit and	EAS providers can help them link to
	insurance	credit and insurance services
Assisted Natural	Difficulty of keeping livestock out of	Put up fencing, which may require
Regeneration	fields	financial assistance

Strengths and Weaknesses of the Extension and Advisory Services System

The strengths and weaknesses of the EAS system in Kaffrine Department are shown in Table 17; refer to Table 9 for a list of strengths and weaknesses of EAS systems throughout Senegal. Strengths include the presence of a village platform, ISRA's experience introducing climate smart practices, considerable targeting, and participation of women in development activities, strong relationships between some EAS providers, numerous development projects having EAS components with which EFAT could partner, and a strong seed cooperative.

Weaknesses are the weak linkages between the platform and EAS providers, little targeting, or participation of youth in EAS activities, low use of ICTs and poor coordination among most EAS providers.

Table 16. Strengths and weaknesses of extension and advisory services system.

Strengths
Strong village platform exists in the area and has the potential to increase producers' voice to influence research
and EAS.
Experience by ISRA CNRF introducing climate-smart agricultural practices and building a strong relationship with
the village platform
Considerable targeting or participation of women in development activities particularly in the climate smart and
agroforestry practices targeting women's gardens.
Strong collaboration between some EAS providers (Water and Forests Department of the Ministry of the
Environment and Sustainable Development and ANCAR)
Several agricultural projects are active in the area, including USAID's Nafoore Warsaaji. Partnering with them
may help them achieve their objectives as well as improving impact of EFAT activities
Existence of a functioning seed cooperative
Weaknesses
Weak linkages between public EAS providers and village platform
Few examples of targeting and participation of youth in development activities.
Low use of ICTs in extension
Poor coordination between EAS providers as a whole

³ Farmers had difficulty describing the practice and identifying its limitations. Only two farmers in the group were trying it.

RUFISQUE DEPARTMENT

Landscape Analysis



Figure 5. Map showing Rufisque Department of Dakar Region

In Rufisque Department, we visited three EAS providers and in nearby Dakar, three complimentary service providers (Figure 5 and Table 18). Other organizations active in the area but not visited are listed in Appendix 2.

Extension and Advisory Service Providers

We interviewed three EAS providers: the Direction Nationale de l'Horticulture (NHORT) under the MAER, ANCAR and a producer organization (Federation des Producteurs Maraichers de la zone des Niayes) (FPMN) that provides EAS.

NHORT works along entire horticultural value chains from input supply through to marketing and is responsible for improving the productivity of horticultural producers. The Senegal government adopted the National Horticulture Recovery Program in 2020 to increase horticultural production, ensure food sovereignty, substitute for imports, and facilitate the growth of the agricultural sector. Being a public structure, NHORT is partly financed by the State. It engages with several external donor agencies to get funding and technical assistance. For example, it leads efforts to increase horticultural production and marketing through the Strengthening the Capacity of Small-scale Horticultural Producers Project financed by JICA and IFAD and using the SHEP approach.

Name and Type of Service Provider	Category
Extension and advisory providers	
ANCAR	Public
Direction Nationale de l'Horticulture (NHORT)	Public
La Fédération des Producteurs Maraîchers de la Zone des Niayes (FPMN) de Sangalkam	Public

Table 17. Extension service providers and other stakeholders interviewed in Kaffrine Department.

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Complementary Service Providers	
Mlouma (climate and market information)	Private
Compagnie Nationale d'Assurance Agricole du Sénégal (CNAAS) (crop insurance)	Private
Jokolanté (climate, market, and agro-advisory information)	Private

NHORT works with the producers to:

- Diversify horticultural production to secure the growth and income of producers.
- Increase the volumes of exported products (bananas, sweet potatoes, watermelon, bissap).
- Facilitate access to inputs and other materials and equipment, such as irrigation kits.
- Reinforce the capacity of horticultural farmers through SHEP, which as mentioned earlier is an approach for the empowerment of small horticultural farmers through market-oriented production.
- Disseminate good agricultural practices, including conservation, storage, and marketing, especially for associations of youth and female producers.
- Engage in monitoring and evaluation of these activities in coordination with DRDR.

NHORT also helps producers to organize into POs to enable them to proceed with formalization which helps them to access finance from the Agricultural Bank and to market their products. NHORT has developed a virtual platform and system of warehouses so that farmers are able to preserve their production after harvest and sell later at higher prices.

In terms of access to EAS, NHORT stated that there is no discrimination or barriers to women and youth. They also emphasized that there is a strong presence of women and youth in the horticultural value chains through the many small plots made available to them. In the same vein, the NHORT representative pointed to the importance of a new project, Projet Cadastre et Sécurisation Foncière (PROCASEF) which helps women and youth gain access to agricultural land. Through this project, women and youth use digital technology to contact land offices and apply digitally for access to land for cultivation.

Concerning EAS methods, NHORT uses demonstrations, group meetings, training sessions and farmer field schools. NHORT also interacts with farmers using telephones and radio and periodically organizes fairs to showcase good practices and results.

ANCAR is less active than NHORT in Rufisque, partly because some of their activities in this area are assigned to ANCAR's office in Thiès, which is 30 km away. Demonstrations, group meetings, training sessions and farmer field schools are among the methods used by the ANCAR technical agents to promote good agricultural practices. ANCAR also provides producers with agricultural technologies and information through a mobile application, SAIDA, developed in partnership with FAO. Digital apps are also used for monitoring irrigation and promoting good agricultural practices, communicating climate information and for online marketing. ANCAR also helps producers to organize into POs to enable them to register with the government and thus access credit through the agricultural bank.

FPMN is a producer federation with 2,723 members, 15 percent who are women. FPMN members produce and market potatoes, tomatoes and onions and the federation employs 6 farmer trainers. The farmer trainers advise farmers on improved practices, such as fertilizer applications, irrigation techniques, disease and pest management and marketing. They also conduct demonstrations and link closely with produce buyers to help ensure that the products that FPLM members sell are of high quality. The farmer trainers are all male youth and have qualifications (some are degree holders) and experience in agriculture. They are selected based on their knowledge and experience. FPMN's farmer trainers work closely with NHORT and ANCAR but there is no formal agreement for them to do so.

Complementary Service Providers

The interviews with Mlouma and Jokolante, both digital providers of marketing, climate, and agroadvisory information, are presented in section 4 above. The interview with the National Agricultural Insurance Company of Senegal (CNAAS) is also presented in section 4.

Partnerships and Platforms

No formal platform exists in the area where EAS providers and complimentary service providers meet to share experiences or coordinate their activities. NHORT is currently in partnership with ANCAR, the Projet de Valorisation des Eaux pour le Développement des Chaîne de Valeur (PROVALE-CV), and ISRA to support its advisory activities to producers. Jokolante and Mlouma are in partnership with ANACIM to distribute climate information and with ARM to distribute market information. Jokolante initiated a partnership with URAC to disseminate climate information by radio.

EAS and CSP Providers' Views on Adoption Constraints Faced by Farmers

The main technologies and practices promoted by EAS providers are sprinkler and drip irrigation technology, solar energy for powering irrigation, improved horticultural crop varieties, fertilizer, and phytochemical products to control pests and diseases. EAS and CSP providers noted several problems limiting adoption. Most seeds are imported at high cost and the issue of seed quality and availability is of high concern. The level of fertilizer use is low, and farmers need access to more subsidized fertilizer. Post-harvest losses are high; possible solutions are improved storage and marketing infrastructure and crop varieties that are less perishable.

Women's lack of time, due to household responsibilities, is a key constraint limiting adoption. Though women's groups exist, they are not formally registered so they cannot access credit, make their demands known or partake in formalized markets.

Farmers claimed that the lack of training opportunities was a key problem. Producers cannot access training on horticultural production, processing, value addition or other topics. Another gap mentioned by service providers is field agents' lack of skills and training on product transformation.

Barrier Analysis

In Sangalkam and Diamniadio communes of Rufisque Department, we facilitated two POs to analyze barriers to adoption of selected agricultural technologies. One was the Association de Ngondigal Ndoyenne, a group of 200 citrus producers, and the others were members of FPMN, a group of 2,723 producers focusing on horticultural crops (mainly potato, tomato, and onions). Citrus producers' main problems included access to irrigation water and marketing issues related to competition with citrus fruit imports from Morocco. Horticultural farmers cited as problems the availability and quality of seeds,

fertilizer and agrochemicals, lack of equipment for field operations, high postharvest losses and problems storing their produce so as to be able to sell at times when prices are high. Women and youth also cited lack of access to land, particularly because of urbanization.

The citrus producers assessed barriers to adopting organic strawberry production and digital marketing of fruit products through different apps and platforms (Table 19). Horticultural farmers assessed irrigation systems (drip and sprinkler) and solar energy as an energy source for irrigation (Tables 19 and 20).

Organic Strawberry Production		Digital Marketing for Fruit Products	
Barriers	Potential Solutions	Barriers	Potential
			Solutions
Packing materials	Import or find local	Difficulties documenting quality and	None
unavailable	manufacturer	presenting product using text and images	identified
Lack of technical support,	Petition ISRA and	No transportation infrastructure for	Arrange
no available local	DHORT to work on	delivery of product	transportati
research	strawberries		on
			separately
Dispersed demand	Identify buyers, e.g.,	Harassment in some apps (Facebook).	None
	bakeries, groceries	Persons with no interest in purchasing	identified
		pretend to be interested and waste a lot	
		of the seller's time	
Unavailability of credit	None identified	After sale offer is posted, continuous	None
		monitoring needed to respond to offers	identified
Perishable product	None identified		

Table 18. Barriers identified by farmers in adopting organic strawberry production and digital marketing.

Table 19. Barriers identified by farmers in adopting sprinkler/drip irrigation and solar energy.

Sprinkler/Drip irrigation
High cost of installation, operation, and maintenance
Salinization a problem in some wells; cost of water treatment is high
Solar Energy
High cost of access to solar grid
Maintenance can be complex even though operation costs are low
Dependence on sunlight problematic at times

Strawberry is a relatively new crop for Senegalese farmers. To qualify as organic, producers are using poultry manure instead of mineral fertilizer and neem extracts and other natural insecticides instead of products from agro-dealers. One of the barriers to adoption is that there is little available research or expertise in Senegal on the crop. Other constraints are the unavailability of packaging materials, dispersed demand, unavailability of credit and the high perishability of the product. Potential solutions are to petition ISRA and DHORT for technical assistance, find a local manufacturer to produce packaging materials and identify buyers, such as bakeries and groceries, that will be regular customers. Producers are also starting a part-time private EAS business to train producers who want to start producing strawberries.

Some farmers are starting to use digital marketing apps for selling their produce. They have tried using Facebook, Twitter, WhatsApp, and Instagram. Main constraints are the difficulty in presenting the product electronically including images and documenting its quality. Once an offer to sell produce is made, the seller needs to closely monitor the app as responding late to a request for a purchase or for more information may mean losing a sale. Other constraints that sellers face when using digital marketing apps are harassment by persons not interested in buying (particularly a problem on Facebook) and lack of transportation options through the app once a sale is completed.

Constraints to the adoption of sprinkler and drip irrigation, according to producers, are mainly the high cost of installation, operation, and maintenance. Salinization is also sometimes a problem, and the cost of treating water is high. Solar energy is cheaper than relying on petroleum but the cost of accessing the solar grid is high, maintenance of equipment can be challenging and dependence on sunlight can be problematic during cloudy periods.

Observations and conclusions on the barrier analysis are presented in Table 21. Lack of access to subsidized credit from LBA for horticultural production is a key problem; helping producer organizations with the registration process is a means towards getting credit from LBA. Lack of technical support from EAS providers in storage, processing, and other means of adding value limits farmers' ability to earn more from their produce.

Technology	Institutional Barriers	Technological Barriers	Others	
Organic strawberry	Lack of technical support	Packing materials unavailable	Perishable	
production	Lack of credit		product;	
			Dispersed	
			demand	
Digital marketing of	None identified	Difficulties documenting quality	No transportation	
fruit		and presenting product using	infrastructure, on-	
		text and images	line harassment	
Drip and sprinkler	Lack of subsidized credit to cover	Salinization sometimes a	None identified	
Irrigation systems	high costs problem			
Solar energy for	Lack of credit to cover high costs	Complex maintenance;	None identified	
irrigation	of accessing solar grid	dependence on sunlight		
General	Women have difficulty getting their organizations registered so cannot access credit			
observations	and other services.			
	Field agents have little to offer on storage, processing			

Table 20. Barrier analysis, observations, and conclusions.

Strengths and Weaknesses of the Extension and Advisory System

The strengths and weaknesses of the EAS system in Rufisque Department are shown in Table 22; refer to Table 9 for a list of strengths and weaknesses of EAS systems throughout Senegal. Strengths specific to Rufisque are that digital agro-advisory services are becoming available. FPMN has an active system of farmer trainers to serve its members and that there are active, donor-financed projects with EAS components operating in the area. Weaknesses include the lack of means for innovative farmers to share their innovations with others, digital advisory and information apps are not well integrated into EAS systems and EAS providers have little to offer farmers concerning post-harvest technologies, such as in storage, processing or adding value. These are particularly important to women and youth, who often lack access to land, because they may be able to use them to earn income and improve their livelihoods.

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A Landscape Analysis of Agricultural Service Provision and Barriers Faced by Farmers in Adopting Agricultural Technologies in Four Locations in Senegal

Table 21. Strengths and weaknesse	es of extension and	d advisory services system.
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Strengths	Weaknesses
Digital advisory and information apps beginning to be popular	No means for innovative farmers to share their innovations. This is an important issue in Rufisque where farmers are highly innovative, due to higher levels of education and more commercialization than in other areas of Senegal
Active system of farmer trainers in FPMN training other farmers	Digital advisory and information apps not well integrated into EAS systems
Several donor-financed projects are active in the area: Nafoore Warsaaji, PIESAN, <i>Dundel Suuf</i> and Projet de Renforcement des Capacités des Petits Producteurs Horticoles. Partnering with them may help EFAT meet its objectives	EAS providers have little to offer on storage, processing or adding value to horticultural products

CONCLUSIONS AND RECOMMENDATIONS FOR EXTENSION AND ADVISORY SERVICE DELIVERY MODELS THAT EFAT COULD IMPLEMENT

The inventory of technologies and the landscape and barrier analyses highlighted several gaps, weaknesses, and challenges in Senegal's agricultural innovation system but also some opportunities for an EAS initiative such as EFAT. In this section we first draw conclusions from the assessment of the inventory of technologies and the landscape and barrier analyses conducted in Louga, Saint-Louis/Dagama, Kaffrine and Rufisque. We propose extension delivery models for each of the four locations that can help improve the uptake of improved agricultural technologies.

CONCLUSIONS

Inventory of Technologies Disseminated

The inventory of technologies and practices disseminated in Senegal since 2015 revealed patterns that cast light on research and extension priorities. The difficulty in assembling the list of disseminated practices — no Senegalese organization appeared to have such a list — was indicative of the low priority given to dissemination of improved technology by many organizations in this sector. This low priority also extends to research on adoption as there are surprisingly few publications on the adoption of improved agricultural technologies in Senegal.

The composition of technologies listed in the inventory provides further insights. More than 71 percent were crop varieties or other forms of genetic improvement, with only 29 percent on management practices, whereas the latter are at least as important for improving productivity and adapting to climate change. About 62 percent of the technologies were for cereals, reflecting the lower priority given to other types of agricultural commodities, such as legumes, livestock, fruits, and vegetables. Finally, that only 3 of the 92 were on post-harvest technologies reflects the low priority given to this area, an area that women and youth, who lack access to land, could benefit from.

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That some rice varieties released by ISRA appear not to have been disseminated to farmers offers an opportunity for EFAT to try to identify such technologies, investigate the reasons they were not disseminated and where appropriate, help farmers to access them.

Landscape Analyses

The landscape analysis at the four sites revealed that there are some strengths and weaknesses in EAS that are common to all sites, while others are site specific. The first common strength across sites is the presence of robust producer organizations which have the potential to lobby EAS providers to meet their members' needs and to make EAS provision more effective and efficient through farmer trainers. The availability and spread of digital services providing climate and marketing information is another important strength. Smallholders' use of climate information has been demonstrated to be associated with uptake of improved practices (Chiputwa et al., 2022). The widespread use of farmer field schools and farmer trainers, two effective EAS methods, can also be considered a strength, although there is some concern as to whether the principles on which these methods are based are adhered to.

Numerous organizations and projects at each site mentioned that they target and work with women. Some do so by targeting women's producer organizations (e.g., in Louga and Saint-Louis/Dagana) and others by targeting women's gardens and enterprises (e.g., in Kaffrine). Some ensure they reached women by stipulating a proportion of their beneficiaries that must be women, such as the USAID *Nafoore Warsaaji project*, which had a target that 60 percent of its beneficiaries be female. It is difficult to ascertain the degree to which organizations are committed to promoting gender equality or are simply responding to donor requirements. The extremely low proportion of women among key informants we interviewed is discouraging, only 13 percent were female and outside Dakar, the proportion was only 4 percent.

Weaknesses that are common across the four sites are the lack of coordination and harmonization among EAS providers and CSPs; each EAS provider tends to operate independently with a silo mentality. The result is competition for resources, gaps in coverage, overlapping activities and a failure of organizations to share experiences and learn from each other. We also found that EAS providers, while skilled in certain areas, lack expertise in entrepreneurship, processing, and other post-harvest technology. These are particularly important areas for youth and women, because they lack access to land for growing crops and can use information on entrepreneurship and processing for starting or improving small businesses.

Another common problem in EAS systems is a lack of a feedback culture, that is, low priority is given to obtaining feedback from farmers on their experiences devising innovations or using new technologies. Concerning their own innovations, we did not find or hear of any organization identifying, testing, or seeking to spread farmers' own innovations. Also, EAS providers lack the capacity when disseminating technologies to track their uptake and find out how farmers are modifying them. Identifying successful practices and scaling them up does not appear to be a priority.

Few if any organizations or programs target youth to help them improve their livelihoods. EAS providers spoke about youth's problems, but we did not hear of any specific programs or even project components targeting youth. Another system weakness is the absence of private EAS providers except for those providing digital services. Agro-advisory apps are not common, though Jokolante is just starting to market one and scale up its use.

Concerning strengths and weaknesses which varied across locations, there were important differences in the performance of EAS providers among the locations. The use of digital apps for accessing market and climate information appears to be more common, especially among youth, in Rufisque, Louga and Kaffrine than in Saint-Louis/Dagana. Research-extension linkages were strong in Kaffrine but weak in Saint-Louis/Dagana. In Rufisque producer organizations are engaging farmer trainers to train farmers in improved practices. Donors appeared to drive the development agenda more in Kaffrine, Louga and Rufisque where EAS services appeared to be relatively weak. This was less of an issue in Saint-Louis/Dagama, where the financial strength of SAED, perhaps, allows them to control the development agenda more than EAS providers in other places.

Barrier Analyses

Table 23 summarizes the barriers to technology adoption identified by farmers across the four locations. Farmers assessed 14 technologies in barrier analysis: three on fruits, three on irrigation technologies, two on cereals, two livestock technologies and one each on horticulture, fertilizer, marketing, and sustainable land management. Farmers identified 44 barriers, about three per technology. The two main barriers were financial (lack of cash or credit) and lack of information or skills. Other important barriers included storage/processing constraints, lack of security against theft, pests, land shortages, riskiness, and marketing/transportation.

Туре	Number of Technologies with Mentioned Barriers
Financial (lack of cash or credit)	9
Lack of Information or Skills	8
Storage/Processing	5
Security	4
Pests	4
Lack of Land	4
Riskiness	3
Marketing/Transportation	3
Lack of Labor	2
Quality of Input	1
Other	1
Total number of Technologies Assessed	14

Table 22. Barriers to adoption identified by farmers across the four locations.

Women's constraints varied somewhat from men's as they are affected more by resource constraints, namely land, finance, and labor. Women are often allocated small plots, usually less than 0.25 hectare, from the head of household and often, of low fertility. Even though their plots are small, women still lack labor, particularly at peak periods, because they have so many household duties and often must provide labor on their husbands' plots. Youth face similar resource constraints but they are less likely than women to cultivate their own plots and more likely to work off farm. Both women and youth may be called to work with the head of household on family plots, especially during peak periods.

Several insights can be drawn from the barrier analyses. High costs and lack of credit are the main barriers producers face in adopting new technology. This is not surprising, given that so few Senegalese farmers have access to financial services despite the expansion of these services in recent years. Lack of information or skills is the second most important barrier. This finding demonstrates the high potential

that improved EAS services have for improving technology adoption rates. More knowledge and skills may not be sufficient means for improving adoption, but the data suggests they may often be necessary ones. Surprisingly, storage/processing problems were the third most important barrier according to farmers and ranked higher than pests or lack of land or labor. This finding is in stark contrast to the low emphasis that research and extension give to storage and processing, as noted above in the discussion of the inventory of disseminated technologies. Moreover, improved technologies in these areas could directly benefit women and youth. Post-harvest barriers (storage, processing, marketing, and transportation) accounted for 18 percent of the total number of barriers identified by farmers (Table 23).

RECOMMENDATIONS FOR EXTENSION AND ADVISORY SERVICE MODELS THAT EFAT COULD IMPLEMENT

Based on the landscape and barrier analyses presented in the preceding sections, we propose recommendations for EAS delivery models that EFAT could implement in each location. For each model, we describe the problem that it addresses and its objectives.

Louga Department

In Potou, the Cooperative Society of Women Producers of Potou Guèye helps its 300 members grow horticultural crops, mainly onions, potatoes, and carrots. It receives some funding from development agencies. For example, it received a grant of \$10,800 in 2022 from the NGO ICCO Cooperation to help its members buy inputs. The cooperative members' key problems are getting financing for their activities, poor uptake of services such as insurance due to a lack of awareness and means, and limited access to training and advisory services. The proposed model addresses each of these.

The objective of the model is to help the cooperative to develop partnerships and help its members to access services that, in turn, will help them adopt improved technologies. EFAT can help cooperative leaders to get training in partnership development and link members to EAS providers, projects, and service providers that can help them access training and financial services and improve agricultural performance (Figure 6). We propose that the Cooperative be the lead organization implementing the model with backstopping from ANCAR.

EFAT can help cooperative leadership get leadership training from CIFA. EFAT can also help the cooperative develop young leaders by forming a youth advisory council within the cooperative that can help ensure that young women are involved in the planning and implementation of activities. Another objective of the model can be to facilitate access of cooperative members to digital agro-advisory services and climate and market information by linking them to Jokolanté and Mlouma and providing training to members in use of the apps and information. Apps are also available for training in farm management and marketing strategies. EFAT and ANCAR can help ensure the integration of digital agro-advisory services with the various EAS providers working in the area.

EFAT can help the cooperative to mainstream gender and youth awareness into their action plans. It can also improve the negotiation and lobbying skills of leaders especially on land related issues for women and youth. It can also link the cooperative to various media, e.g., radio, for exposure and coverage of activities.

A Landscape Analysis of Agricultural Service Provision and Barriers Faced by Farmers in Adopting Agricultural Technologies in Four Locations in Senegal



Figure 6. Extension delivery model for Louga Department

Saint-Louis and Dagana Departments

SAED is the biggest EAS provider in the area and receives funding from several development agencies such as the African Development Bank. The focus of SAED's field staff is on assisting farmer organizations to obtain financing and access to equipment and services within the framework of a regulated agricultural credit and subsidy system. There is some interest in introducing new technologies but SAED's EAS staff lack the skills to do so, both the technical knowledge about available new practices as well as EAS methods for introducing them to producers. Moreover, SAED's links with ISRA on technology transfer are weak and many released technologies, such as rice varieties, are not being used by farmers. CIFA, the training organization associated with SAED focuses on soft skills such as leadership when providing inservice training to EAS staff.

We propose that SAED be the lead organization in an EFAT extension delivery model to improve the introduction and uptake of improved technology to irrigated rice farmers, particularly women and youth (Figure 7). The model aims to elevate the profile of irrigated rice technology adoption/upscaling among actors, including EAS providers and POs and improve research-extension-farmer linkages. EFAT can help facilitate and organize a meeting on technology introduction, adoption, and scaling for partners. At the meeting, partners can reaffirm their interest in improving the flow of information and new practices to farmers, promoting adoption, and scaling and obtaining feedback from farmers on technology performance. ISRA can present technologies available for dissemination and partners can select ones they would like to try out. Partners would include EAS providers and representatives of producer organizations, including women and young producers. Stronger linkages and flows of information and technologies among actors can help farmers increase adoption of improved technology.

An additional objective would be to strengthen the capacity of actors in dissemination approaches and methods and monitoring adoption and scaling. Here CIFA can play a lead role. EFAT can help them to build their capacity to train SAED and other organizations' EAS staff in improved rice production practices and EAS methods. EFAT can help CIFA with curriculum development and staff training.

The model can also help strengthen gender and youth awareness and action among partners in implementing the model.



Figure 7. Extension delivery model for Saint-Louis and Dagana Departments

Kaffrine Department

The Village Platform of Seko Keur Sawely helps its 194 members (110 are women) adapt to climate change by introducing resilient crop and tree varieties and sustainable land management practices. Main enterprises include millet, peanuts, sorghum, cowpeas, horticulture (vegetable and fruits) and agroforestry. The platform receives funding from the African Development Bank.

The platform has strong linkages to ISRA-CNRF but its connections to other EAS and complimentary service providers in the area are limited. The platform leaders lack skills needed for mobilizing their members, planning, forming partnerships and accessing financial and other services. The objective of the model is to strengthen the platform by helping it improve in these areas. EFAT can help platform leaders access training in leadership and planning from CIFA and CGIR. EFAT can also help the platform to develop partnerships and access financial services including credit and insurance (Figure 8). The Village Platform and ISRA-CNRF could co-lead implementation of the model.

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Figure 8. Extension delivery model for Kaffrine Departments

EFAT can help the platform to facilitate knowledge sharing and link to other platforms in the area to exchange technologies and experiences. Later, perhaps in the second year of the project, EFAT can facilitate the creation of a network of innovation platforms in Kaffrine.

EFAT can facilitate training in gender mainstreaming and gender inclusivity into the activities of the platform. EFAT can also help the platform develop young leaders by forming a youth advisory council within the platform that can help ensure that youth are involved in the planning and implementation of activities. It can also help publicize the activities of the platform in the villages where its members reside and can facilitate media houses, e.g., radio, television, and newspapers, to publicize their activities.

Rufisque Department

FPMN helps its 2,723 members (15 percent women and 30 percent youth) to produce and market horticultural crops, especially potato, tomato, and onion. The federation's six farmer trainers and members need training in horticultural practices and information about the weather and climate change and how to market their produce. Jokolante is scaling out its mobile-based, climate-informed agro-advisory service (iSAT) and is eager to get feedback from users on how to improve its services. Mlouma has a mobile based marketing app (Louma mbay) that gives prices of products and links buyers and sellers to make transactions through the app. They are also interested in users' feedback.

The objective of the model is to help farmer trainers and members to access digital services on climate, agro-advisory and markets from Jokolante and Mlouma and to access face-to-face EAS from EAS providers (Figure 9). A second objective is to help ensure the sustainability of FPMN's farmer trainers system and help them improve the advisory services that they are providing. EFAT can also help FPMN to institutionalize the farmer trainers system in FPMN by strengthening capacity of farmer trainers, help them link to EAS providers for technical backstopping, and help them find ways to earn income through the services they are providing.



Figure 9. Extension delivery model for Rufisque Department

EFAT can also help strengthen gender and youth awareness and action in FPMN and particularly among the farmer trainers. This includes helping to ensure that women and youth (both male and female) are recruited as farmer trainers, that women and youth are served by the farmer trainers and that women have access to the use of digital tools.

REFERENCES

African Business. 2021. Senegalese agricultural bank targets smallholder revolution *African Business October 15th, 2021.* Available at: <u>https://african.business/2021/10/energy-resources/senegalese-agricultural-bank-targets-smallholder-revolution/</u>

AICCRA. 2022. AICCRA Senegal: Building resilient crop-livestock farming systems in Senegal. Accelerating Impacts of CGIAR Climate Research for Africa.

Birner, R. K. Davis, J. Pender, E. Nkonya, P. Anandajayasekeram, J. Ekboir, A. Mbabu, D. Spielman, D. Horna, and S. Benin. 2009. From Best Practice to Best Fit: A Framework for Analyzing Agricultural Advisory Services Worldwide. *Journal of Agricultural Extension and Education 15*(4): 341-355.

Chiputwa, B., et al. 2020. Transforming climate science into usable services: the effectiveness of coproduction in promoting uptake of climate information by smallholder farmers in Senegal. *Climate Services.* 20:100203.

CIAT and BFS/USAID. 2016. Climate-smart Agriculture in Senegal. CSA Country Profiles for Africa Series. International Center for Tropical Agriculture (CIAT); Bureau for Food Security, USAID.

CNAAS. 2021. Agricultural insurance and digital payments. Challenges of payment digitalization in rural areas of Senegal. CNAAS, World Food Program, Sofrecom.

CNAAS. 2023. Memorandum sur la situation de l'assurance agricole). The National Agricultural Insurance Company of Senegal (CNAAS), 2023.

Connexus. 2022. FY22 Annual Report: USAID Feed the Future Senegal Nafoore Warsaaji, October 1, 2021 to September 30, 2022. Connexus Corporation.

D'Alessandro, S. F.; Fall, A. A.; Grey, G.; Simpkin, S. P.; Wane, A. 2015. Senegal - Agricultural sector risk assessment. Agriculture global practice technical assistance paper. Washington, D.C.: World Bank Group. Available at:

http://documents.worldbank.org/curated/en/238261468184467370/Senegal-Agricultural-sectorrisk-assessment

Donovan, J. Franzel S. Cunha M. Gyau A. and Mithofer, D. 2015. Guides for value chain development: a comparative review. Journal of Agribusiness in Developing and Emerging Economies. Vol. 5:1:2 – 23.

FAO. 2021. Information and advice on good agricultural and animal husbandry practices in real time and local languages. FAO. Available at: https://www.fao.org/senegal/actualites/detail-events/es/c/1392483/

Faulkner L, Harrington J, Levy D, The K. 2009. Commercial Opportunities for Fruit in Malawi. ICRAF Working Paper no. 86. Nairobi, Kenya: World Agroforestry Centre..

Faye, O. N. et al. 2020. Status of Rice Cultivation and Breeding in Senegal. *Journal of the Korean Society of International Agriculture* 32(4):381-389

Franzel, S., Degrande, A. Kiptot, E., Kirui, J., Kugonza, J., Preissing, J. and Simpson, B. 2018. Farmer-tofarmer Extension. In: Davis, K., Bohn, A., Franzel, S., Blum, M., Rieckmann, U., Raj, S., Hussein, K. and

Franzel, S.; Ndiaye, A., and Tata, J. S. 2018. Senegal: In-depth Assessment of Extension and Advisory Services . Developing Local Extension Capacity Project. USAID, Washington D.C.

FRI. 2023. Our work in Senegal. Farm Radio International. Available at https://farmradio.org/senegal/

Gajigo, O. 2022. The Impact of Fertilizer Prices on Africa. Africa Policy Research Institute. Available at http//The Impact of Fertilizer Prices on Africa - Africa Policy Research Institute (APRI) (afripoli.org)

Gammelgaard, J., Franzel, S., Salcedo du Bois, R., Kumar, A., Davis, K., Preissing, J. & Pankowska, K. 2023. *How to invest in farmers? A guide for agriculture human capital investment projects.* Investment Toolkits. FAO and IFPRI. https://doi.org/10.4060/cc4381en

Goundan, A; Sall, M.; Henning, Christian H. C. A. 2020.Modeling interrelated inputs adoption in rainfed agriculture in Senegal, Working Papers of Agricultural Policy, No. WP2020-05, Kiel University, Department of Agricultural Economics, Kiel, Germany.

https://nbn-resolving.de/urn:nbn:de:gbv:8:3-2021-00194-7

IFDC. 2020. Cartographie et Caracterisation des Fournisseurs D'Engrais au Senegal. USAID Feed the Future Dundel Suuf Project. International Fertilizer Development Center

IPAR. 2022. Programme Agricole pour une Souveraineté Alimentaire Durable (PASAD). Initiative Prospective Agricole et Rurale. Available at: <u>https://www.ipar.sn/Feed-the-Future-Senegal-Projet-d-Appui-aux-Reformes-et-aux-Politiques-Agricoles-2021.html?lang=fr</u>

Jha, P.K., Middendorf G., Faye, A., Middendorf, J., and Prasad, V.V. 2023. Lives and Livelihoods in Smallholder Farming Systems of Senegal: Impacts, Adaptation and Resilience to COVID-19. Land. 12:1: 178.

<u>JICA. 2023.</u> Smallholder Horticulture Empowerment & Promotion (SHEP) Approach and Its Expansion <u>Available at: https://www.jica.go.jp/english/our_work/thematic_issues/agricultural/shep/index.html</u>

Jokolanté. 2023. Available at https://Jokolante.com

Joseph E.J., Worou N., Diedhiou L., Dhulipala R., Houessionon P., Whitbread A. 2022. iSAT, the new generation digital agro advisory tool that empowers farmers to manage climate risks. aiccra. Dakar.

Mlouma. 2023. Available at www.mlouma.com

MyAgro. 2023. Available at www.myagro.org

Ndiaye, A. 2018. Système d'Innovation Agricole : Guide Stratégique et Pratique de Conseil Agricole », Dakar, Harmattan, ISBN : 978-2-343-14501-3, 209 pages.

National Environment Commission (NEC). 2013. Technology Needs Assessment and Technology Action Plans for Climate Change Adaptation. Royal Government of Bhutan

Poublanc. C. 2018. Lets Get Digital: Un-blocking Finance for Farmers in Senegal. Available at: <u>https://agrilinks.org/post/lets-get-digital-how-new-rice-tracking-system-un-blocking-finance-farmers-senegal</u>

PPAFAO. 2017. Pour que l'agriculture familiale nourrisse les villes! Entretien avec Pape Assane Diop (FONGS) Programme promotion de l'agriculture familliale en afrique de l'ouest. Available: http://www.fongs.sn/IMG/pdf/entretien_avec_pape_assane_diop_fongs.pdf

RTI International. 2019. Final Report. Feed the future Senegal *Naatal Mbay*. RTI International, Research Triangle Park, NC.

Sanogo, D., Sall, M., Camara, B.A., Diop, M., Badji, M., Ba, H.S. 2020. The Climate Smart Village Approach: Putting Communities at the Heart of Restoration. Tropenbos International.

Seed Systems Group. 2020. Strategy for the Development of Sustainable Seed Supply Systems in Senegal. Available at https://seedsystemsgroup.org/resources/

Seven and Tumen. 2020. Agricultural Credits and Agricultural Productivity: Cross-country Evidence. IZA Discussion Paper No. 12930. IZA Institute of Labor Economics.

Suttie, D. and Hussein, K. 2015. Territorial Approaches, Rural-Urban Linkages and Inclusive Rural Transformation. International Fund for Agricultural Development.

Syngenta Foundation. 2023. Rural Youth Empowerment through Farmer Hub. Available at: <u>https://www.syngentafoundation.org/agriservices/wherewework/senegal</u>

USAID. 2018. SPRING/Senegal Partners with Six Local Radio Stations to Promote Nutrition, Hygiene, and Gender Best Practices. Available at: <u>https://www</u>.spring-nutrition.org/about-us/activities/springsenegal-partners-six-local-radio-stations-promote-nutrition-hygiene-and

USAID. 2022. West Africa Fertilizer Business Information Guide.

US Department of Agriculture. 2022. Grain and Feed Annual. Foreign Agricultural Service.

US Department of Commerce. 2023. Senegal: Country Commercial Guide. Dowloaded from <u>https://www.trade.gov/country-commercial-guides/senegal-agricultural-sector</u>

Winrock. 2023. A gender and social inclusion analysis of smallholder farmers' access to agricultural services in Senegal. Enabling Farmers for Agricultural Transformation (EFAT). Arlington, Virginia.

Winrock. 2022. Enabling Farmers for Agricultural Transformation. Project flyer. Arlington, Virginia.

World Bank. 2020. Program appraisal document on a proposed IDA scale up facility credit to the Republic of Senegal for an agriculture and livestock competitiveness program. World Bank.

7200AA22LA00001

A Landscape Analysis of Agricultural Service Provision and Barriers Faced by Farmers in Adopting Agricultural Technologies in Four Locations in Senegal

World Bank. 2023. Climate Change Knowledge Portal. Available at: https://climateknowledgeportal.worldbank.org/country/senegal/climate-data-historica I

APPENDICIES

APPENDIX 1. FRAMEWORK FOR IDENTIFYING BARRIERS TO UPTAKE OF IMPROVED PRACTICES



Source: NEC, 2013

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APPENDIX 2. FORMS USED FOR (A) COLLECTING INFORMATION ON PRACTICES AND TECHNOLOGIES DISSEMINATED AND FOR (B) INTERVIEWING EXTENSION AND COMPLEMENTARY SERVICE PROVIDERS FOR THE LANDSCAPE ANALYSIS

(a) Form used for collecting information on practices and technologies disseminated Innovations (technologies and practices) that your organization has disseminated since 2017

Instructions: The EFAT Project is collecting information from various stakeholders in Senegal in order to compile an inventory of agricultural innovations that have been disseminated in Senegal since 2015. With CORAF, our focus is on the following commodities: rice (irrigated and rainfed), orange-fleshed sweet potato, sheep, goats, and horticulture. Under each commodity please also list soil fertility management and natural resource management practices being promoted.

Please provide information on the following in the tables below:

- 1. Description of innovation (crop variety, livestock species, agronomic practice, etc.):
- 2. Which partner organizations have/are you working with to disseminate this innovation?
- 3. In which agroecological zone(s) have you disseminated this innovation? 1=Senegal River Valley; 2=Niayes; 3=Groundnut basin; 4=Sylvo-pastoral zone; 5=Eastern Senegal; 6=Casamance
- 4. In which specific locations have this innovation been disseminated?
- 5. Which categories of producers is innovation targeted to? Codes: 1=all smallholder farmers; 2semi-commercial farmers, 3=commercial farmers, 4= smallholder women farmers, 5=youth (male and female) producers; 6=Producer organizations 7-other
- To what extent has these innovations been adopted in the target location: Codes: 1=high, 2=medium, 3=low
- What are the major constraints to adoption? Codes: 1=Constraints related to characteristics of the technology 2=labor requirements; 3=lack of market/marketability; 4=Lack of access to credit; 5=lack of access to inputs (seed, fertilizer, pesticides etc); 6=lack of access to equipment/machinery (e.g., irrigation); 7=problems with post-harvest processing/packaging; 8=difficulties accessing land; 9= others (specify)
- 8. What specific constraints do women and youth face in adopting these innovations? Use the above codes

Value chain_____

AEZ

Source of funding for activities (gov, donor or other) _____

Innovation	Department/ arrondissment	Target group: Subsis-tence, semi- commercial, Comm., women, youth	Level of adoption (high, med. Low)	Inputs available and accessible?	Other constraints to adoption	Specific constraints women face in adoption

When asking the next questions, note any differences among value chains or AEZs.

1 What approaches/methods does your organization use to provide information, knowledge and skills to farmers?

2 Has your organization tried/used any innovative financial arrangements to support adoption of agricultural technologies? Which organizations did you work with? Which location did you work in?

3 Has your organization used other types of institutional innovations or services that enhance the adoption of agricultural technologies (for example, services that take plot measurement to encourage access to credit, telephone apps)?

Institutional Innovations form (e.g., services to measure plots to facilitate access to credit, telephone apps, bulk marketing)

What is needed to take these innovations to scale? In terms of priority, in which locations do you think effort should be made to take these innovations to scale

(b) <u>Forms for interviewing extension and complimentary service providers for the landscape</u> <u>analysis</u>

Form for extension and advisory services (public, private, PO, etc)

Name of provider:

Type of provider: public, private, PO

Activities/Services carried out (provide details broken down by the following categories of activities and value chains):

Activities:	Check if yes
Technology dissemination	
Knowledge sharing	
Information sharing	
On-farm problem solving	
Collective action/organizing farmers	
Marketing (aggregation, value-adding, certification etc),	
Facilitation (Innovation platform)	
Other (specify)	

FOR PRIVATE COMPANIES ONLY: Do clients pay for your services?

How and how much? Do they pay cash or is cost of services built into the prices paid by clients?

Target groups

	Men	Women
Producers		
Youth		
Producer organization members		
Other(s)		

Main Innovations promoted/disseminated: Provide details on specific technologies, practices, and other types of innovations disseminated and degree of application of innovations: High, middle, low

Innovation	Details	Degree of adoption H, M, L

Extension/advisory methods/tools used) radio, training and visit, e-extension etc)

Farmers' preferred methods by gender:

Meth ods/t		Men	Women	Youths (below 35 years old)
OOIS				
	Demonstration			
Individ ual	showcase			
	Farm management			
	Demonstration			
	Training session			
	Farmer Field School			
Group	Farmer trainers			
Mass	E-extension (specify)			
	Radio			

Mass approach		

Number of beneficiaries (households) ______

Specify by area _____

If possible, break down by gender (men, women, youth)_____

What year did the organization start operated in this locality ?_____

Are there other locations served by your organization? (Yes or No)

Source(s) of funding_____

Are there other organizations in this (arrondissment/department) that provide agricultural extension/advisory services to smallholder farmers? Please name them ASK ONLY TO FIRST ONE OR TWO RESPONDENTS

Which organizations do you partner or collaborate with (e.g. extension, research, private companies, Pos, projects etc) ? Nature of the partnership/collaboration (activities carried out etc)?

Organization	Degree of partnership (check the box)		
	Common activities (trainings, meetings, etc.)		
	With agreement Without agreement		

Do you have an agreement which is not implemented yet ? If so with who?

Does your organization link farmers to other organizations/service providers? Which organizations and what activities do they carry out (financial, climate information, agricultural inputs, other segments of the value chain etc)?

LET RESPONDENT CHOOSE ONE OF THE IMPORTANT PRODUCTION OR POST-PRODUCTION TECHNOLOGIES FROM ABOVE

Technology:

AND THEN ASK:

What are the main constraints producers face in adopting the technology and maximizing benefits from it?

How does your organization address these constraints to adoption? What interventions not currently used could help to address these constraints?

Do women farmers face specific constraints in adopting it because they are women?

How does your organization address these constraints to adoption? What interventions not currently used could help to address these constraints?

Do young farmers (male and female) face specific constraints in adopting it because of their age?

How does your organization address these constraints to adoption? What interventions not currently used could help to address these constraints?

Are there any platforms that bring together EAS providers in this area (arrondissement/department?) to share information, and coordinate as well as plan activities? Describe. Is this platform useful? What are some of its strengths and weaknesses?

What would you say are the strengths/limits/constraints of your organization in the provision of advisory services?

How could you improve your provision of advisory services? What is needed to make that happen?

What could factors or events could retard progress in your provision of advisory services?

SWAT analysis:

Strengths	Weaknesses

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1	1
2	2
3	3
Opportunities	Threats
1	1
2	2
3	3

Form for complementary service providers or others

Name of provider :

Type of provider (public, private, PO or others):

Services/products provided- provide details on what value chains are involved?

Who are your target group of clients

Target groups of clients	Men	Women
Producers		
Youth		
Producer organization members		
Other(s)		

About how many clients do you service (month/year)? By Gender?

What methods, channels, approaches do you use to reach your clients? By Gender?

Do clients pay for your services? How and much? Do they pay cash or is cost of services built into the prices paid by clients?

Where else in the country does your organization operate?

How long have you operated in this locality ?

FOR PUBLIC/NGO: Sources of funding

Are there other organizations/companies operating in this location (arrondissment/department) that provide the same services/products? Please list them

Do you partner or collaborate with other organizations/companies (e.g. research, private companies, Pos, projects etc) to support smallholder farmers? Nature of the partnership/collaboration (activities carried out etc)? How long have you been working together? How does this partnership help you?

Does your organization/company link farmers to other organizations/service providers? Which organizations and what activities do they carry out (financial, climate information, agricultural inputs etc)?

What are the main constraints producers face in using your services/products? How do you address these constraints? What interventions not currently used could help to address these constraints?

Do women farmers face specific constraints in using your services/products because of their gender? Do you do anything specifically to address these constraints? What other interventions would help to address these constraints? Ask same question for youth.

APPENDIX 3. PERSONS AND ORGANIZATIONS INTERVIEWED AND ORGANIZATIONS ACTIVE IN THE AREA BUT NOT INTERVIEWED

Table A3.1. Persons and organizations interviewed

Organization	CONTACTS	Telephone	Meeting Date
National Agency for Rural Advisory Services (Agence Nationale de Conseil Agricole et Rural ANCAR)	Fatou Binta Diouf, Director	77 651 20 69	19/01/2023
Senegal Agricultural Research Institute (Institut Sénégalais de Recherches Agricoles UNIVAL)	Malick Leye, Director	77556 82 96	23/01/2023
DUNDEL SUUF/USAID Feed the Future Project	Saer Sarr, Coordinator South zone	785953203	26/01/2023
Naafoore Wasadji Project, USAID Feed the Future	Amadou Souaré, Assistant Coordinator	77 656 73 54	31/01/2023
National Agricultural Insurance Company of Senegal (Compagnie Nationale d'Assurance Agricole du Sénégal) : CNAAS	Omar Cissé Sow, Technical Director	773561491	17/01/2023
Senegal Agricultural Research Institute (Institut Sénégalais de Recherches Agricoles ISRA CNRF	Dr Diamilatou Sanogo, Researcher	775599285	27/01/2023
Livestock Service of Louga	Aya Ndiaye, chief of service	aya.ndiaye@univ-	07/02/2023
		thies.sn	
ANCAR Louga	Chérif Diawara, Technician	77 509 18 30	07/02/2023
Directions Régionales de Développement Rural (DRDR)(Regional Directorate of Rural Development) Louga	Baye Ndiaga Thiam, Chief of division. Mouhamadou Makhtar Mbaye, Chief of seed office Lamine Dabo, Chief of office	77 810 61 24	07/02/2023
ISRA Saint Louis	Omar Faye, Director ISRA- CRA	77 454 03 23	08/02/2023
The Agricultural Bank Saint Louis	Massaer Diop, Chief of network	massaerdiop@la ba nqueagricole.sn	08/02/2023
DRDR Saint Louis	Hamidou Baldé, DRDR	oubalde@yahoo.f r	08/02/2023
Senegal River Development Agency SAED	Amadou Thiam, Ass. Director	773339779	09/02/2023

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Organization	CONTACTS	Telephone	Meeting Date
	Khaly Fall, Program officer	770992410	
Interprofessional Center for Training in Agriculture professions, CIFA, Saint- Louis	Assane Ndiaye, Director Mansour Fall, Trainer, Cheikh Tidjane Diagne, Trainer	andiaye2000@ya hoo.com baayourokhaya1 @gmail.com cht_diagn@yaho o.fr	10/02/2023
Sub-Prefecture of Mabo_Kaffrine	Bara Diéye Ndome, CBEF/MABO	77 431 66 61	13/02/2023
Water and Forest Department, Kaffrine	Elhadj Mbacké Gningue, Technician MABO	77 529 08 47	14/02/2023
National Agency for Rural Advisory Services ANCAR Kaffrine	Lamine Diallo, CAR MABO	77 389 99 25	14/02/2023
National Department of Horticulture (DHORT)	Macoumba Diouf, Director DHORT		16/02/2023
Jocalanté Ltd.	Ndeye Amy Kabe, Director	<u>77 578 77 37</u>	

Table A3.2. Agricultural service organizations/projects not interviewed

Department	Organizations/Projects
LOUGA	 PIESAN (Projet d'Intensification Eco-Soutenable de l'Agriculture dans les Niayes), Louga USAID Naafore Warsaaji project PASA LOUMAKAF (Projet d'Appui à la Sécurité Alimentaire dans les régions de Louga, Matam et Kaffrine), Louga PROMISE (PROgramme de développement de la Microfinance Islamique au Sénégal) Gandiol Distribution Omar Sow (Produce buyer, Potou) 77 548 54 50 Mariama Production Marie Sow (Produce buyer, Potou) 77 854 54 50 Mourite KA (Produce buyer, Potou) 77 627 23 40 Elhadji Omar BA (Produce buyer, Potou) 77 867 79 41 BONERGIE (Input supplier, Louga) Mouhamed Ndoye 77 309 30 34 IBRIZ (Input supplier, Dakar) Bou Diarra 77 7242 02 58
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Department	Organizations/Projects
Saint-Louis	USAID <i>Naafore Warsaaji</i> project USAID <i>Doolel Mbay</i> project PROVALE CV (Projet de Valorisation des Eaux pour le Développement des Chaîne de Valeur) Conseil de Gestion pour les Exploitations Agricoles (CGER). (Assists Producer organizations and others in improving finance and management) Africa Rice Center (CGIAR research institute)
Kaffrine	PRAPS (Projet régional d'appui au pastoralisme au Sahel) PDEPS (Programme de Développement Durable des Exploitation Pastorales au Sahel) PASA LOUMAKAF (Projet d'Appui à la Sécurité Alimentaire dans les régions de Louga, Matam et Kaffrine) PROVALE CV (Projet de Valorisation des Eaux pour le Développement des Chaîne de Valeur) SEEN SUUF (Projet d'Appui à l'Amélioration de la Gestion foncière au Sénégal) Trees for the Future (US-based NGO)
Rufisque	USAID <i>Dundel Suuf</i> project USAID <i>Naafore Warsaaji</i> project PIESAN (Projet d'Intensification Eco-Soutenable de l'Agriculture dans les Niayes) SHEP (Projet de Renforcement des Capacités des Petits Producteurs Horticoles)

APPENDIX 4. INFORMATION ON PRODUCER GROUPS THAT CONDUCTED BARRIER ANALYSIS AND NUMBERS OF MEN, WOMEN, AND YOUTH WHO PARTICIPATED

Name of producer organization	No. members	No Men	No. Women	No. Youth⁴	Value chains they focus on	Technologies discussed in barrier analysis
Louga	1		1			
Société Coopérative des Femmes Productrices de Potou Guéye	300	1	299	Unknow n	Horticulture (onions, potato, carrots etc.)	Irrigation methods (bore-hole solar pump and drip irrigation) Nursery and transplanting
Livestock Breeders Cooperative (incl. members of 3 other livestock groups)	571	342	143	86	Sheep and goats, cattle	Artificial insemination Maralfalfa fodder grass
Saint-Louis						
Union des Femmes Productrices de Ross Bethio	1821	0	1644	177	Irrigated rice	Rice varieties Sahel 1210, 177
Union de Groupement Maka Diama	416	250	104	62	Irrigated rice	Rice varieties Sahel 210
Kaffrine						
Plateforme Villageoise de Seko Keur Sawely	194	84	110	Unknow n	Millet, peanuts, sorghum, cowpeas, vegetables, fruits, agroforestry	Gola jujube (<i>Ziziphus mauritiana</i>) tree -Tamarind trees -Assisted natural regeneration Climate resilient technology package including millet variety, climatic information, and fertilizer.
Rufisque						
La Fédération des Producteurs Maraîchers de la Zone des Niayes (FPMN)	2723	1498	408	817	Horticulture (potato, tomato, onion)	Drip and sprinkler irrigation Solar energy
Association Ngonidgal Ndoyenne 1	200	130	40	30	Fruits (mandarin, oranges), citrus	Strawberries Digital selling of produce

Table A4.1. Summary information about producer groups who took part In barrier analyses

⁴ In cases where numbers of youths are not known, the young male have been included with the men and the young females with the women.

	Men	Women	Young	Young women	Total
			men		
Société Coopérative des Femmes	0	16	0	4	20
Productrices de Potou Guéye					
Association des Eleveurs (incl.	0	4	0	0	4
members of other livestock groups)					
Association des Eleveurs (incl.	15	0	3	0	18
members of 3 other livestock groups)					
Union des Femmes Productrices de Ross Bethio	0	14	0	4	18
Union de Groupement Maka Diama: men	10	0	0	0	10
Union de Groupement Maka Diama: women	0	10	0	0	10
Plateforme Villageoise de Seko Keur Sawely (men)	18	0	10	0	28
Plateforme Villageoise de Seko Keur Sawely (women)	0	40	0	5	45
La Fédération des	0	1	8	5	14
Producteurs Maraîchers de la Zone des Niayes (FPMN)					
Association Ngonidgal Ndoyenne 1	0	0	6	0	6
Total	43	85	27	18	173

Table A4.2 Number of producers participating in barrier analysis

APPENDIX 5. INVENTORY OF SELECTED AGRICULTURAL INNOVATIONS DISSEMINATED IN SENEGAL FROM 2015

Note: Source organization indicates the organization that provided the information

Innovation (variety or	Source organization in bold, others	Other information
practice/year of dissemination)	are partner organizations	
SBI (System of Rice Intensifi-	CORAE Researchers some SAED	
sation) (2016)	staff Producors' organizations	
	stan, Floudcers organizations	
Isriz 10 (2021-22	CORAF, UNIS, ISRA	122 days growth duration, not
		aromatic
Isriz 12 (2021-22)	CORAF, UNIS, ISRA	110 days growth duration, not
		aromatic
Loria 15 (2021-22)		
15112 13 (2021-22)	CORAF UNIS, ISRA	
Isriz 7 (2021-22)	CORAF, UNIS, ISRA	(110 days duration) aromatic
Nerica L19 (2016)	CORAF, ISRA, UNIS,	
	CNCR/ASPRODEB - WAAPP Senegal	
Norica 17 (2015)		
	CURAF, ISRA, UNIS,	
	CNCR/ASPRODEB	
Nerica S44	CORAF, ISRA, UNIS,	
	CNCR/ASPRODEB	
	WAAPP Senegal	
Arica 2 (2017)	CORAE ISRA LINIS	
/		
Arica 4 (2017)	CORAF, ISRA, UNIS,	
	CNCR/ASPRODEB	
SAHEL 108 (2015)*	CORAF, ISRA, UNIS,	
	CNCR/ASPRODEB	
ISBIZ	CORAE ISRA	01 (90 days duration) (aromatic)
ISRIZ 02	CORAF, ISRA	(90 days duration) (aromatic)
16217.02	600.05 (60.4	
ISRIZ 03	CORAF, ISRA	(90 days duration) (aromatic)
ISRIZ 04	CORAF. ISRA	92 days duration) (not aromatic)
ISRIZ 05	CORAF, ISRA	(104 days duration) (not aromatic)
ISKIZ UD	CUKAF, ISKA	(110 days duration) (not aromatic)
ISRIZ 08	CORAF. ISRA	(100 days aromatic)
		(==== 0.0,0 0.0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

Irrigated rice/Lowland rice

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Innovation (variety or practice/year of dissemination)	Source organization in bold, others are partner organizations	Other information
ISRIZ 09	CORAF, ISRA	(110 days aromatic)
ISRIZ 11	CORAF, ISRA	(110 days not aromatic)
ISRIZ 13	CORAF, ISRA	(115 days not aromatic)
ISRIZ 14	CORAF, ISRA	115 days, not aromatic
Deep placement of urea)	DRDR	
NPK 15-15-15 150 kg/ha; Urea	International Fertilizer	Apply NPK at start up, apply 50
200kg/ha	Development Center	percent of urea at tillering and 50 percent at panicle initation
ASI rice thresher	Africa Rice	
Small rice processor	SAED	

* ISRA researcher told us that this variety was released in 1995

Rainfed rice/upland rice

Innovation (variety or practice/year of dissemination)	Source organization in bold, others are partner organizations	
Isriz 10 (2021-22)	CORAF, UNIS, ISRA	
Isriz 12 (2021-22)	CORAF, UNIS, ISRA	
Isriz 15 (2021-22)	CORAF, UNIS, ISRA	
Isriz 7 (2021-22)	CORAF, UNIS, ISRA	
Nerica 12 (2015)	CORAF, ISRA, UNIS, CNCR/ASPRODEB	
Nerica 14 (2016)	CORAF, ISRA, UNIS, CNCR/ASPRODEB	
Nerica 5 (2015)	CORAF, ISRA, UNIS, CNCR/ASPRODEB, WAAPP	

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Maize

Innovation (variety or practice/year of dissemination)	Source organization in bold, others are partner organizations	Other information
Kabamanoj (2020) ⁵	Syngenta/ Partnership for Seed Technology Transfer in Africa Project, Kane & fils (seed company)	
Espoir	ISRA	
Komsaya	ISRA	
Suwan1	ISRA	Open pollinated
Tieba	ISRA	
Tzee-Y	ISRA	Open pollinated
Across-pool-16-DR	ISRA	Open pollinated
Tzee-W	ISRA	Open pollinated
Early Thai	ISRA	Open pollinated
Suwan	ISRA	Open pollinated
1109-21 STR	ISRA	Hybrid
1113-5 STR	ISRA	Hybrid
LW-1120-41	ISRA	Hybrid
LW-1120-19	ISRA	Hybrid
LY-1101-23	ISRA	Hybrid
1113-5STR	ISRA	Hybrid
PAN 12	ANCAR	
PAN 53	ANCAR	
Obatane	ANCAR	
Quality Protein Maize	ANCAR	
SWANN	ANCAR	
Microdose	ANCAR	Fertilization
SNK2772	ANCAR	
NPK 15-15-15 200 kg/ha; Urea 200kg/ha	International Fertilizer Development Center	Apply NPK at sowing, apply 50 percent of urea 27 days after

⁵ https://www.syngentafoundation.org/news/recent-news/new-corn-variety-could-lift-whole-region

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Innovation (variety or practice/year of dissemination)	Source organization in bold, others are partner organizations	Other information
		sowing and 50 percent, 41 days after sowing

Tomato

Innovation (variety or practice/year of dissemination)	Source organization in bold, others are partner organizations	Other information	
Grafting techniques	CORAF, SAED, AGROINDUSTRIES,	To fight Ralstonia solanacearum	
(From 2015 to 2016)	Producers	(bacterial wilt)	
MONGOL -(2016)	CORAF, SAED, AGROINDUSTRIES,	a new variety resistant to	
	Producers, Researchers	Ralstonia solanacearum	
Lindo	ANCAR		
Nadira	ANCAR		
Torgal	ANCAR		

Onion

Innovation (variety or practice/year of dissemination)	Source organization in bold, others are partner organizations
Sirocco	ANCAR
Frouge	ANCAR
Alizé	ANCAR
Gao	ANCAR
Goldor	ANCAR

Pepper

Innovation (variety or dissemination)	practice/year of	Source organization in bold, others are partner organizations
Nikita		ANCAR
Granada		ANCAR

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Mango

Innovation (variety or practice/year of dissemination)	Source organization in bold, others are partner organizations	Other information
Introduction of mango trees into rice fields	ANCAR	
Grafting	ANCAR	
Fruit fly control	ANCAR	Elimination of males
Success Appat	ANCAR	Bait compound to control fruit fly
Soil treatment with neem (<i>Azadiracta indica</i>) meal	ANCAR	Apply at base of tree to control fruit fly

Sheep

Innovation (variety or practice/year of dissemination)	Source organization in bold, others are partner organizations
System of intensive management	ANCAR
	ANCAR
Sheep fattening	
Genetic improvement through artificial insemination	ANCAR
Treatment of pasteurellosis	ANCAR

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Sustainable land management

Innovation (variety or practice/year of dissemination)	Source organization in bold, others are partner organizations	Other information
Village trees	ANCAR	
reforestation	ANCAR	
Contour plantings	ANCAR	Shrubs/grasses along contour
biodigester	ANCAR	
Dune management	ANCAR	
Improved shrub fallows	ANCAR	Improve soil fertility
Phosphate application	ANCAR	Improve soil fertility
	ANCAR	
Protection dikes	ANCAR	digue de protection
Stone lines	ANCAR	cordons pierreux
Formula of mineral fertilizer (NPK) 19-30-20	ANCAR	
Improved compost with organic matter	ANCAR	
Biopesticide preparation using plant extracts	ANCAR	
Bokashi compost	ANCAR	
Microdose fertilizer for horticultural crops	ANCAR	
Cereal steamer	ANCAR	
Assisted natural regeneration	Water and Forest Dept., Min. of Environment,	Also called Farmer managed natural regeneration
Millet variety ICMH1777111	AICCRA	Drought tolerant
Millet variety	AICCRA	Dual purpose (also a livestock
Thialack 2,SL28,SL169		
Grafted tamarind trees	ISRA	
Gola jujube (Ziziphus mauritiana) trees	ISRA	Gola is the variety, Jujube is the local name for the tree species

APPENDIX 6. FARMERS' SOURCES OF INFORMATION

We asked members of two producer organizations in Potou, one a women's horticultural cooperative and the other, a men's livestock group to list their most important sources of information on their enterprises and to rank them. The frequency with which sources appeared among the top three of each group is shown in Table A4.1.

Table A4.1. Farmers' sources of information

Information source	Women members of cooperative horticulture society, Potou	Male members of livestock groups, Potou
Enterprise	Horticulture	Livestock
	Number of producers ranking source among top three	
Trainings/seminars mainly organized by projects	11	6
WhatsApp groups/social media	10	9
Visits to other farmers (either through an EAS provider or on one's own)	0	7
Fairs	0	7
Manager of the Cooperative Society	6	0
Television	6	0
Livestock Professional Society agents	0	6
Telephone sur le prix (Coxeur de marche)??	2	0
Meteo message on mobile phone app? Telephone	0	0
Livestock Services extension agents	0	2
DRDR extension agents	0	1
Total number of producers	12	13