Ministry of Foreign Affairs

Developing agricultural cooperatives in Senegal through the development of a profitable agricultural operation

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Postbus 7001
6700 CA Wageningen
Agro Business Park 65
6708 PV Wageningen

Telefoon 0317 49 15 78
Fax 0317 46 04 00

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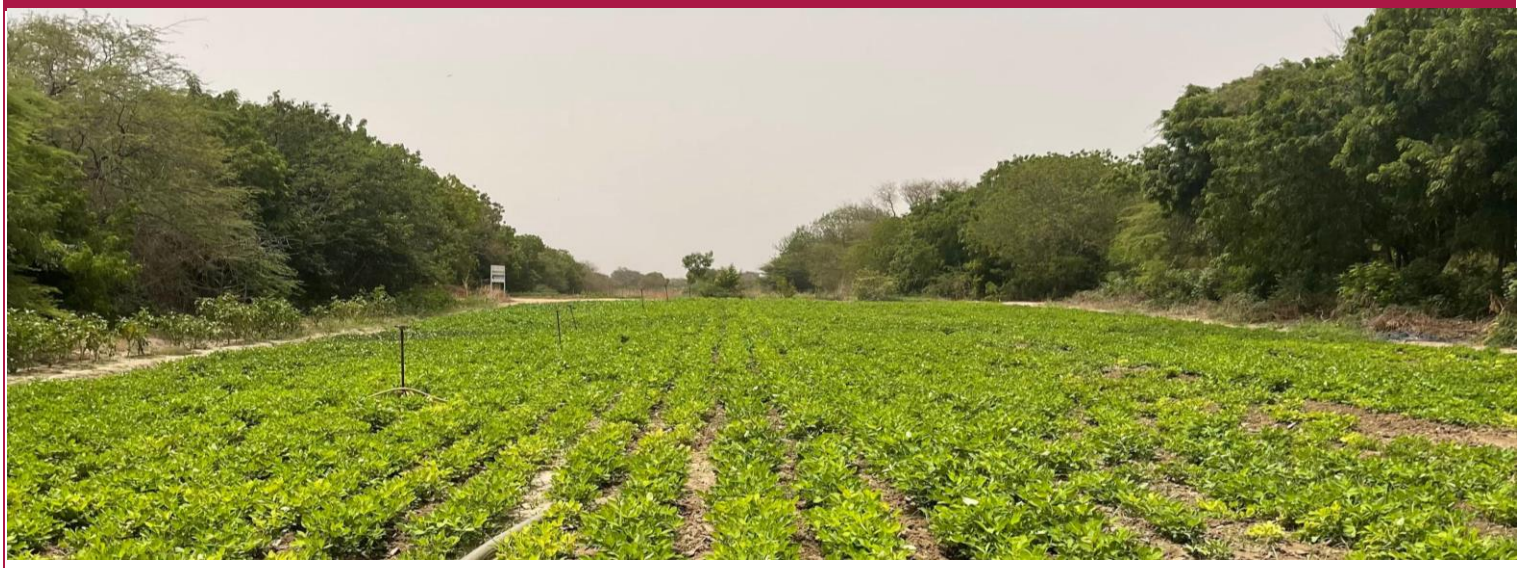

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Authors
Maarten Kommers
Ya Téning Kanté
Nurrahmi Fadilah

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Executive summary

In this second part of the Th report presents the findings of a study focused on developing a profitable agricultural operation that will sustain an independent agricultural cooperative serving the community, and contribute to food sovereignty in Senegal. This study is one of two interconnected projects commissioned by the Netherlands Enterprise Agency. Delphy conducts the current study, while Deloitte focuses on the cooperative context and organizational model. Both reports aim to provide the Senegalese government with concrete and realistic input for implementing the national strategy 'Sénégal 2050' which aims to enhance food security and food sovereignty in the country through promoting the establishment of independent, self-supporting agricultural cooperatives.

During this study, a wide range of institutional, private, and local stakeholders were interviewed, including government agencies, existing agricultural cooperatives, local authorities, farmers, and farmer groups. Through these interviews, combined with desk research and local insights, we created a comprehensive overview of Senegal's agricultural context, particularly concerning the proposed project site in the commune of Diender. The results indicate a *significant yield gap* for many horticultural products, meaning that actual yields do not meet their potential. This gap is primarily due to inadequate application of best practices, lack of collaboration, and limited access to finance. Additionally, deteriorating soil, climate, and water conditions further exacerbate these yield challenges.

Although numerous agricultural collaborative structures operate in Senegal, including along the Kayar-Diender axis, most of them are ineffective. Notably, there are no cooperatives in this region that not only provide seeds and other inputs at reduced prices but also purchase produce from farmers and sell it on their behalf. This gap is one reason the Senegalese government aims to develop a *new type of agricultural cooperative that is financially independent, agriculturally productive, and supporting smallholder farmers that are part of the local communities*. This report proposes a model that combines a cooperative structure that is supported by an agricultural operation. The emphasis of this report is on the design of such an operation.

The agricultural operation proposed in this report is commercially viable and capable of significantly increasing agricultural productivity. Consequently, the cooperative will support smallholder farmers in the commune as it *generates its own income*, *creates jobs* (over 200 direct jobs and supporting and creating 800-1.200 other jobs along the value chain), *offer small loans*, *provide training* on agricultural practices, *purchase produce* from farmers, and *procure* inputs for member farmers at competitive rates. The operation requires an initial investment of €2.65 million. The estimated after-tax income for the first year is -€315,649; the second year is projected at -€38,376; the third year is expected to generate €154,494; and by the tenth year, income is anticipated to reach €493,059.

The return on investment after five years is estimated at 15%, while the internal rate of return over ten years is projected at 6.5%. These calculations are based on funding from institutional lenders and national agricultural funding schemes, applying an interest rate of 0.5% per month.

To initiate the implementation of the agricultural operation by October 2025, recommendations include establishing a new cooperative structure if existing agri-cooperatives are unable to take on this responsibility; generating community support for the agricultural operation in Diender; involving key stakeholders in the continued development and refinement of the plan; commencing the training of essential staff and temporary labourers; and forming a consortium of key stakeholders responsible for the agricultural operational plan's development, further detailing and decision making on key matters such as location and choice of the collaborative structure of which the agricultural operation will be part.

1 Introduction

1.1 Policy framework

Food security and food sovereignty have been top priorities for the Senegalese government over the past decade. It is estimated that Senegal relies on imports to meet approximately 70% of its food needs, particularly for staple items such as rice, wheat, onions, dairy products, potatoes, and vegetables (International Trade Administration, 2024). With the projected population growth from 18 million today to 36 million by 2060, coupled with increasingly challenging climatic conditions, it is essential for the Senegalese government and other stakeholders to invest significantly in reducing the current yield gap. This investment must align with the principles of climate-smart agriculture to provide decent employment and economic opportunities for farmers.

The Senegalese government has confirmed food security and sovereignty as priority goals for the coming years, pledging to accelerate and intensify efforts to enhance local food production by supporting agricultural communities nationwide. This ambition is part of the 25-year strategy 'Sénégal 2050.' A key program aimed at increasing food security and sovereignty involves establishing 557 'Coopératives Agricole Communale' (CAC) across the country.

Through the Embassy of the Netherlands in Dakar, the Senegalese government has sought advice and support from the Dutch government to achieve the objectives outlined in the Sénégal 2050 strategy. Currently, specific support has been requested for developing a model for the Coopérative Agricole Communale, as well as a pilot project for the agricultural operation of this cooperative at a designated site in Senegal. This request aligns well with the long-term policy of the Dutch government to foster a climate-smart, sustainable, productive, and market-oriented agricultural sector in Senegal, leveraging the expertise, products, and services offered by Dutch agribusinesses. A brief reflection on how this study supports Dutch policy is provided in Annex VI.

1.2 The challenge

In the vision of the Senegalese government, agricultural cooperatives can play a crucial role in achieving food security and sovereignty. In a collaborative context, these cooperatives can foster economies of scale, increase efficiency, and enhance bargaining power, ultimately leading to improvements in both the quality and quantity of agricultural production, which in turn raises farmers' income. However, previous assessments indicate that many existing associations and cooperatives are poorly structured, lacking autonomy, professionalism, and exhibiting low productivity. Additionally, the absence of statistical and cartographic data on producers presents a significant challenge. It is believed that a well-organized cooperative could provide substantial purchasing power to support its members and possess the authority to make decisions regarding the pricing of seeds, fertilizers, and agricultural products. Such improvements would enhance productivity and resilience within farming communities.

Considering the significant impact of the socio-economic environment on smallholder farming systems in the project area, providing crop management advice alone may not lead to success. Instead, future activities in Senegal should focus on delivering crop management advice within a farming system approach, supported by well-functioning cooperatives that are financially independent and serve the local community. Understanding a farm and its surrounding area as a cohesive system requires recognizing that farmers' decisions are influenced by complex interactions between both biophysical and socio-economic components. This calls for an integrated and multidisciplinary approach to effectively address the challenges farmers are facing.

1.3 Purpose of the study

To achieve food sovereignty, it is crucial to increase current yields and water use efficiency in cultivated areas, reduce post-harvest losses, and provide farmers with training and skill development while fostering market linkages. Organizing and transforming cooperatives into more viable and autonomous entities can help bridge the organizational and knowledge gap that many farmers currently face. However, this potential can only be realized if, alongside effective organization, trust is established and a sustainable management plan for the farming areas is developed.

In this context, the Embassy of the Netherlands, through the Netherlands Enterprise Agency (RVO), has commissioned Deloitte and Delphy to conduct complementary studies focusing on different aspects of designing and developing a model Coopérative Agricole Communale (CAC). The study presented in this report, conducted by Delphy, focuses on the agricultural operations of the model CAC, while Deloitte's study addresses the organizational and governance structure of the CAC. The remainder of this report will cover the work, results, and recommendations of the Delphy study only. The objectives of this study are to:

1. Analyse the existing agricultural and market situation in the Niayes and the designated project area.

2. Propose an agricultural development plan for a specific site, outlining an operational strategy that aims to significantly reduce the current yield gap while enhancing environmental, social, and economic sustainability.

3. Provide financial substantiation by developing a business plan that demonstrates the financial viability of the agricultural operation and offers recommendations for achieving financial sustainability.

4. Advise on the role of Dutch and Senegalese private sector partners in realizing the desired agricultural outcomes.

5. Raise awareness and support for potential implementation of the model CAC in a pilot project, in close collaboration with Deloitte.

6. Propose recommendations for implementing the agricultural operational plan.

The *target group* for the proposed intervention includes *smallholder farmers* already producing in the project area who are willing to join a cooperative. This encompasses smallholder farmers, small organizations, producers, women's associations, and those already active in cooperatives. Addressing youth employment and land rights challenges is essential for enhancing agricultural productivity. The proposed agricultural development will focus on horticulture, agroforestry, and animal production.

2 Methodology and activities

2.1 Research framework

The primary research methods employed in this study include desk research, fieldwork, and interviews. These methods were chosen based on the study's objectives, the resources available at Delphy (including experts located in Senegal), and the limited timeframe for project completion.

Over the course of 10 weeks, our experts and collaborators in both the Netherlands and Senegal coordinated and conducted interviews with local stakeholders, gathered technical and financial data, and carried out the necessary fieldwork. This included desk research and establishing connections with the Dutch private sector. The overall methodological approach is illustrated in the figure below (Figure 1).

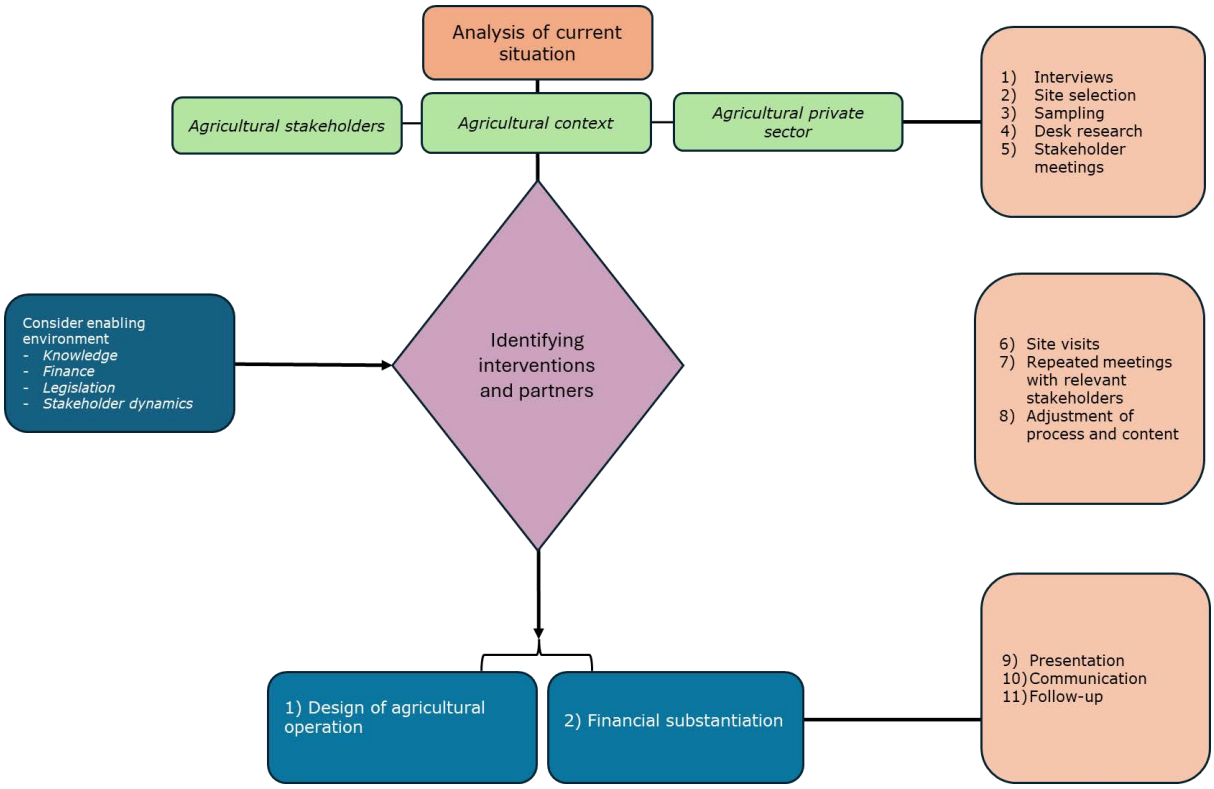


Figure 1. Methodological approach of the study

The desk research concentrated on gathering information about the current state of agriculture in Senegal, specifically in the Niayes and the project area of the commune of Diender. By reviewing previous research and scoping reports, and comparing various interventions and strategies for implementing agricultural projects and cooperatives, we developed a comprehensive understanding of the existing context.

2.2 Main activities

2.2.1 Desk research

In recent years, numerous studies on horticulture in Senegal have been conducted. The aim of this desk research was to synthesize this body of work to provide a coherent context and rationale for developing the proposed model Coopérative Agricole Communale (CAC). The research focused on gathering information about the current agricultural situation in Senegal, in the Niayes region, and specifically in the project area of the commune of Diender. By reviewing previous research and scoping reports, and comparing various interventions and strategies for implementing agricultural projects and cooperatives, we developed a comprehensive understanding of the current context. The summarized findings of this research are presented in Chapter 3.

2.2.2 Interviews

Over a period of eight weeks, a significant number of interviews were conducted with a diverse range of stakeholders (see Figure 2). This was carried out in close collaboration with Deloitte. When relevant to the specific objectives and tasks of both partners, Delphy and Deloitte conducted interviews together. The turnaround time for these interviews was longer than anticipated, as many stakeholders were unavailable on short notice. Additionally, recommendations from specific interviews led to further discussions with other parties.

Figure 2. Map of stakeholders interviewed

2.2.3 Site selection

In line with the recommendations from the Senegalese Ministry of Livestock and Agriculture (MASAE), Delphy reached out to the authorities in Diender and Kayar to identify a suitable area for designing and implementing a pilot Coopérative Agricole Communale. Interviews with the (deputy) mayors of Diender and Kayar were conducted on September 25 and 27, respectively. During the interview in Kayar, it was noted that there is a sufficiently large site (70-120 hectares) available for establishing a pilot Coopérative Agricole Communale. Following several discussions with the (deputy) mayor of Diender, two potential sites that meet the necessary specifications were identified: Diender 1, located east of the village, and Diender 2, situated west of Thieudéme (see Figure 3). These findings were reported to MASAE, along with Delphy's recommendation to select a site in Diender. This recommendation was accepted by MASAE, which initiated arrangements for the final site selection and contacted local stakeholders.

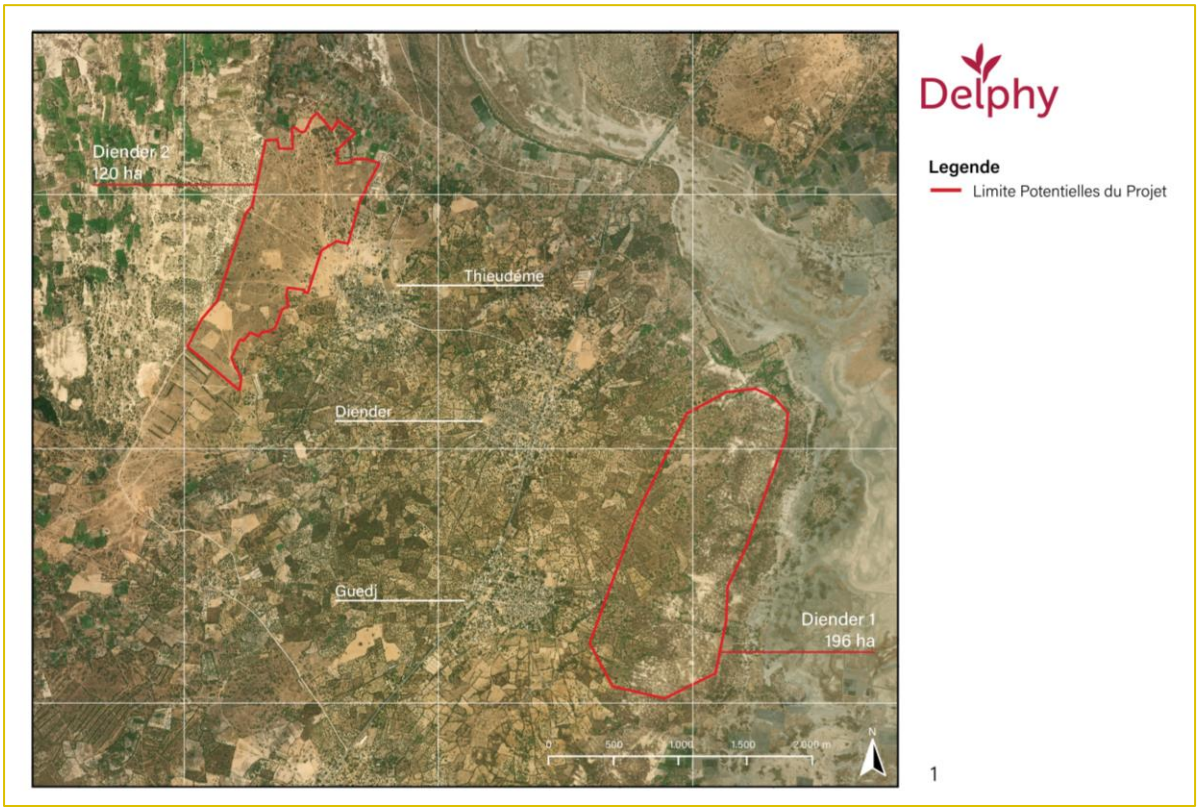


Figure 3. The two potential sites (red line) that were considered for the pilot CAC

Both sites are owned by the commune and have not been used for agricultural operations for over 50 years. After several visits to each site, the area west of Thieudéme was selected (see Figure 4) due to its relatively flat terrain (with only a 40-meter elevation difference between the lowest and highest points), making land preparation for agricultural production easier and more cost-effective. Additionally, its proximity to several smaller villages and good accessibility will facilitate potential implementation. Lastly, the protective status of the site east of Diender likely renders it unsuitable for agricultural operations.

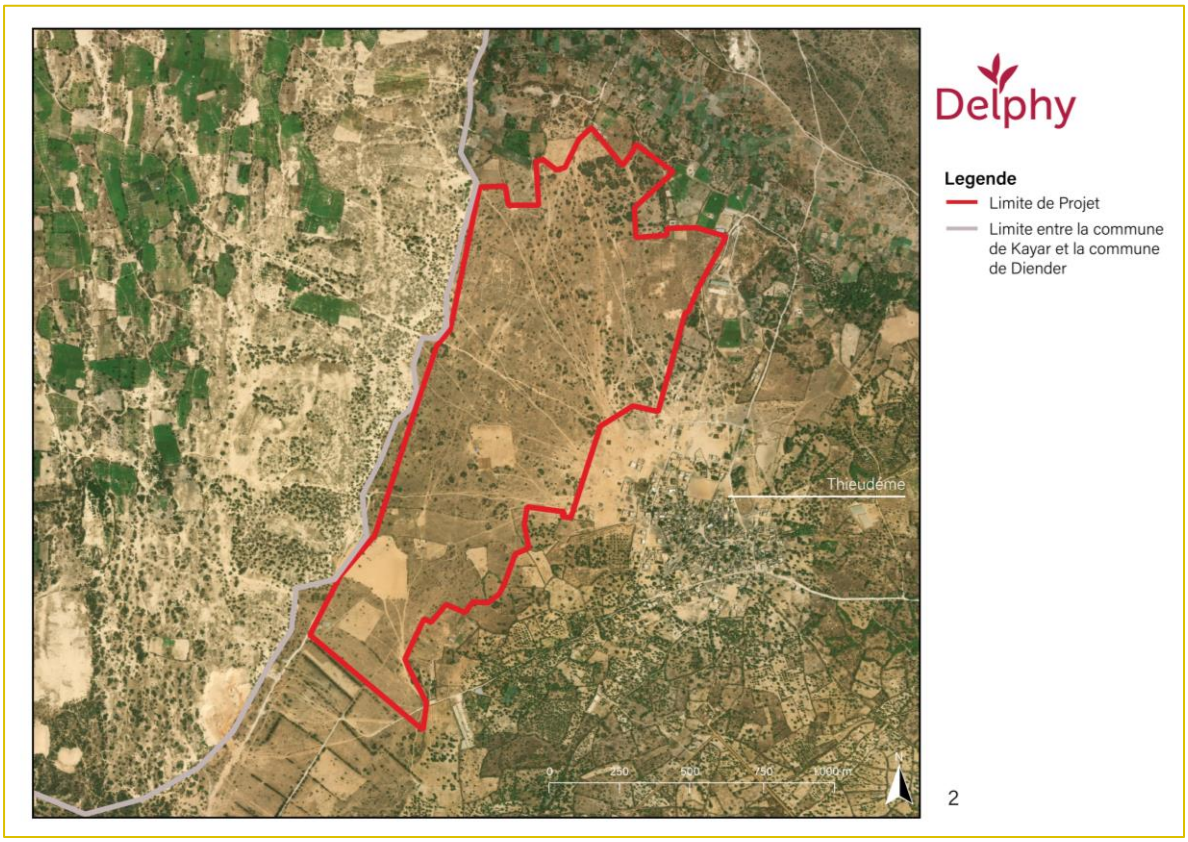


Figure 4. The selected site west of Thieudéme. The existing farming activities at the project site are temporary concessions given by the community to individual producers, and do not reflect permanent ownership.

2.2.4 Sampling of soil and water

Thiès was tasked with collecting a series of soil and water samples for analysis of various parameters, including pH, electrical conductivity (EC), cation exchange capacity (CEC), texture, carbon content, nitrogen (N), phosphorus (P), and exchangeable elements such as calcium (Ca), magnesium (Mg), sodium (Na), and potassium (K). Sampling occurred during the last week of October and the first week of November. The results of these analyses are presented in Chapter 3.

3 Results

3.1 Desk research

3.1.1 Horticultural in Senegal

Senegal is regarded as an "agricultural nation," with the majority of the population employed in the sector. This sector holds significant potential for increasing productivity and reducing food imports. Currently, 2.5 million hectares are cultivated out of a total potential of 3.8 million hectares, which includes 350,000 hectares suitable for irrigation. A prominent subsector within agriculture is horticulture, focusing on the production of a wide variety of vegetables. Smallholder farmers are the backbone of this subsector. While medium-sized farms are emerging, enhancing smallholder productivity remains crucial for alleviating poverty and ensuring food security, as they cultivate 80-90% of all agricultural land in Senegal. This necessitates that smallholders adopt technologies and practices that boost productivity and yields, moving away from practices and inputs that negatively impact productivity (Fadilah, N., 2024).

Senegal benefits from favourable climatic conditions for horticultural production in regions such as Cape Verde, the Niayes, the Senegal River Valley, and Casamance. Ninety percent of the country's horticultural production is concentrated in the Niayes region (MEYS, 2024), which stretches from Dakar along the coast to St. Louis, Senegal's second-largest city (see the pink section on the map below, Figure 5).

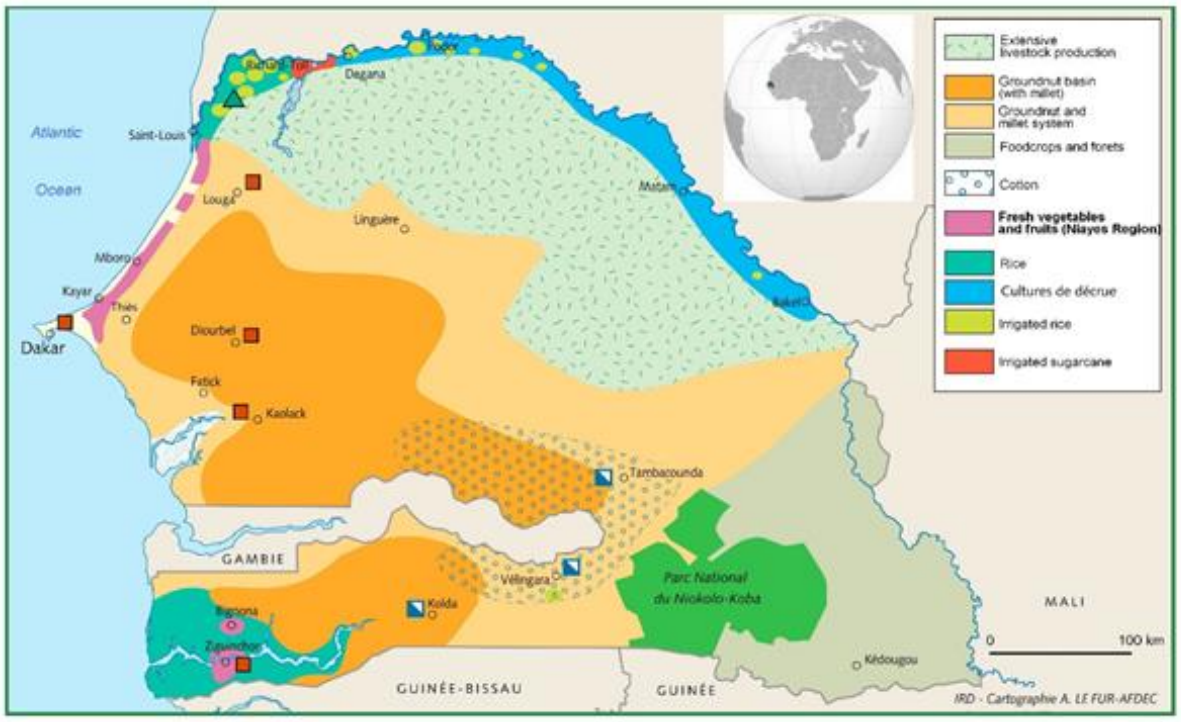


Figure 5. Map of agricultural activities in Senegal

With optimized cultivation practices, other regions could also make significant contributions to national horticultural output and food security. However, Senegal's semi-arid climate poses considerable challenges for traditional open-field horticulture, including high temperatures, drying winds, pests, diseases, heavy rainfall, and humidity. Therefore, it is essential to develop strategies that emphasize good agricultural practices, effective water management, collaboration, and the sustainable intensification of horticultural production in Senegal.

3.1.2 Horticulture in the Niayes and Diender

The Diender area is part of the Niayes region, characterized by a coastal and inland ecosystem that facilitates diverse farming practices. Below is an overview of the agricultural landscape in this area:

1. *Geography and Climate*: The Diender area experiences a semi-arid climate with a brief rainy season from June to October. Its coastal setting influences weather patterns, and the availability of underground water reserves is crucial for irrigation in this predominantly arid region.
2. *Soil*: The soils in the area are primarily sandy and well-drained, which can benefit certain crops but also requires careful water resource management. Some parts of Diender, such as Matar Gaye, have soils with a higher clay content. Soil types and textures can vary significantly at the local level.
3. *Crops*: The primary crops cultivated include market garden vegetables such as tomatoes, onions, potatoes, carrots, and peppers. The region's proximity to urban markets, particularly Dakar, creates favorable market conditions for farmers. In addition to vegetables, various fruits are produced, including melons, mangoes, and bananas, which serve both local and export markets. While less common, some farmers also grow cereal grains like millet and sorghum.
4. *Farming Practices*: Farmers typically employ a combination of traditional and modern agricultural methods. It is widely recognized that increasing both the quantity and quality of production is a key challenge and goal for most farmers.
5. *Water:* Given the climate, with average annual rainfall between 350 and 450 mm, irrigation is essential in the region. Many farmers rely on wells and small water retention systems for irrigation. Significant investments have been made in irrigation infrastructure to boost productivity, particularly for larger farmers. However, most smallholder farmers still use a variety of inefficient water use systems, such as sprinklers and open-field irrigation.

Given the multiple challenges faced by horticultural producers, a holistic and multifaceted approach is needed to address these intertwined issues. While tackling these challenges at the individual smallholder level is feasible, its impact on food security remains limited. By addressing these issues across multiple farms over a larger area, the potential impact of interventions can be significantly greater, benefiting from economies of scale.

A key success factor for creating broader impact is intentional horizontal and vertical collaboration within the horticultural value chain, particularly in the

segments focused on production, post-harvest handling, and processing. An agricultural cooperative has the potential to provide the right context for fostering collaboration, scaling efforts, and *increasing sustainable intensification* and agricultural productivity.

3.1.3 Agricultural cooperatives in Kayar – Diender

In Senegal, there have long been associations, Groupements d'Intérêt Économique (GIEs), and other producer organizations, all aimed at creating income-generating activities. However, the lack of formalization makes it very difficult for these organizations to access financing from financial institutions. In the Senegalese agricultural sector, these organizations play an important role in organizing agricultural production, distributing inputs, and marketing products.
Along the Kayar-Diender axis, there are eight active cooperative societies and associations that fulfil cooperative roles:

1. SOCOPA-ADMK (Ande Défar Mbaymi Kayar): Active in market gardening, primarily focusing on potatoes, tomatoes, eggplants, cabbage, carrots, peppers, zucchini, and cucumbers.
2. APMK (Association des Producteurs Maraîchers de Kayar): Based in the commune of Kayar, with members from this and other communes, it engages in the cultivation of various vegetables. While technically not a cooperative, it provides several services typically associated with cooperatives.
3. KABADI (Kayar-Bayakh-Diender): Engaged in horticulture, producing onions, potatoes, cabbage, carrots, tomatoes, peppers, mangoes, and lemons.
4. Momandô: Located in Diender, this organization focuses on the breeding of layers (hens).
5. SCOOP PHL: The cooperative society of horticultural producers of Lake Tanma in Diender, active in horticulture, including onions, cabbage, peppers, and potatoes.
6. SCOOP TL (Takku Liguey): Based in Diender, this cooperative specializes in the market gardening of onions, cabbage, and tomatoes.
7. SCOOP ADIFB (Agricultural Cooperative Society for the Inclusive Development of Women of Bayakh): Based in Diender Guedj, this organization focuses on horticulture, cultivating tomatoes, eggplants, and peppers.
8. SCAPTC (Cooperative Society for Production, Processing, and Marketing Support): Active in horticulture, this cooperative cultivates onions, tomatoes, cabbage, okra, bitter eggplant, sweet eggplant, peppers, mangoes, and corn.

3.1.4 Agricultural private sector

Senegal's formal private sector is relatively small and geographically concentrated in urban areas, often lacking the scale needed to create a competitive advantage beyond their respective cities or regions. It is crucial for the private sector to play a greater role in Senegal's economic development. Most private sector entities are micro, small, and medium-sized enterprises (SMEs), which account for over 90% of economic units; however, the few large formal enterprises that exist struggle

to compete in the international market. The development of a strong private sector, particularly among SMEs, faces several constraints, including: (i) high bankruptcy rates, with approximately 60% of enterprises failing within their first year; (ii) the predominance of the informal sector coupled with a lack of professionalism; (iii) difficulties in accessing public procurement; (iv) weaknesses in the production of financial information; and (v) challenges in obtaining bank financing tailored to SMEs. Additionally, there is a lack of coordination among the various structures that support SMEs and the overall business environment. In the commune of Diender, farmers primarily rely on local private SMEs that supply fertilizers, crop protection products, and a variety of farm inputs and equipment.

3.2 Interviews

3.2.1 Institutional stakeholders

During the implementation of the study, Deloitte and Delphy collaborated extensively during interviews with the institutional stakeholders listed below (see Table 1). Engaging with these stakeholders is essential for the participatory, bottom-up process needed to achieve the ambitions of the Coopératives Agricole Communale.

Table 1: Overview of institutional stakeholders interviewed

DHORT, MASAE - Direction de Horticulture	Responsible for implementing the national policy for the development of market gardening, flower, and fruit crops. DHORT evaluates and monitors programs and projects in this sector, develops measures aimed at increasing, diversifying, modernizing, and exporting production, and maintains relationships with national and international bodies involved in promoting horticulture.
ANIDA - Agence Nationale d'Insertion et de Développement Agricole	Supports producer groups in the creation of cooperatives through projects focused on developing agricultural perimeters and mechanization. It also promotes the establishment of young farmers within cooperatives.
ANCAR - Agence Nationale de Conseil Agricole et Rural	Provides support to rural producers by offering agricultural advisory services. ANCAR works to improve agricultural practices through training and technical advice to enhance productivity and improve farmers' living conditions.
BSOAP - Bureau de Soutien aux Organisations d'auto-promotion	A national office that works with MASAE structures at the decentralized level. Its main role is to facilitate the structuring and supervision of cooperatives.
DRDR - Direction Régionale du Développement Rural	Plays a key role in monitoring and evaluation, along with the Departmental Rural Development Services (SDDR), providing essential data for the Central Directorates and MASAE, particularly in areas such as input distribution, crop monitoring, and agricultural performance.
CEP	Coordinates, prepares, and monitors projects and programs, with responsibilities including data collection and planning for various government initiatives.

DAPSA - Direction de l'Analyse, de la Prévision et des Statistiques Agricoles	A public body responsible for providing data and information on agricultural production in Senegal, developing proposals for agricultural development policies, planning strategies, monitoring implementation, evaluating results, and securing funding for agricultural projects and programs.
PACAO - Projet d'Appui à la Compétitivité en Afrique de l'Ouest	A collaborative project initiated by the Government of Senegal, the International Trade Centre (ITC), and supported by the European Union, aimed at establishing cooperative societies.
PIESAN – Projet d'intensifaction eco-soutenable de l'agriculture dans les Niayes	Focuses on improving food security by enhancing the capacities of agricultural cooperatives, particularly regarding production, climate risk management, and market access, contributing to sustainable and profitable agriculture in the Niayes eco-geographical zone.
PROVALE CV	Aims to modernize and develop agricultural infrastructure, enhance value chains, and promote youth entrepreneurship in agriculture
RESOPP	A union of rural cooperatives established in 2002 and approved in 2007 by the Ministry of Agriculture. With a headquarters and training centre in Thiès, it comprises 37 cooperative units with 50,000 members, including 9 parent cooperatives and one mutual savings and credit union (COOPEC-RESOPP), spanning 8 regions of Senega
AGRITERRA	An agri-agency for cooperative development founded by the Dutch Cooperative Sector. For over 25 years, Agriterra has provided services to farmer organizations worldwide, focusing on governance, financial management, and business development.

3.2.2 Stakeholders at project site

A sample of local stakeholders interviewed at the project site is presented below (Table 2).

Table 2: Sample over local stakeholders interviewed

KABADI - Kayar-Bayakh-Diender Cooperative Societies	Before the arrival of the PACAO project, members of KABADI were part of the Federation of Agropastoralists of Diender (FAPD) and received support from CRADESC (Center for Research and Action on Economic, Social, and Cultural Rights). With PACAO, they established a pilot committee to raise awareness among producers, Economic Interest Groups (EIGs), and associations. The members have formed cooperative societies to increase their bargaining power and reduce losses. However, ensuring guaranteed sales for member producers before production remains challenging due to a lack of partners and financial resources. Certain commitments made by the board members to their peers have yet to be fulfilled. Their vision includes making inputs more accessible during the campaign period, training producers in good agricultural practices, developing a market for organic crop producers, and securing the ability to purchase and sell their members' production through partnerships.
SCAPTS - Cooperative Society for the Support of	SCAPTS brings together producer organizations and EIGs from four municipalities: Pout, Keur Moussa, parts of Diender, and parts of Mont Rolland. Its members are engaged in production, processing, and

Production, Processing and Marketing	conservation, with many women in leadership positions also belonging to women's groups. Similar to KABADI, SCAPTS was established through the PACAO project. The members of their board have received training and a procedural manual that equips them with skills in interpersonal relations, conflict management, cash management, and accounting. Challenges faced by SCAPTS include a lack of storage and conservation equipment, market stabilization issues, insufficient state support, particularly during international fairs, the need to create export branches for onions, reducing post-harvest losses, and adopting new technologies.
Producers (18)	The study involved several villages in the Diender commune, including Thor, Thieudéme, and Keur Matar. These areas are primarily focused on vegetable production, although some producers also engage in sheep and cattle farming. The findings from interviews with these producers are presented in paragraph 3.3.
Civil authorities	The study involved several villages in the Diender commune, including Thor, Thieudéme, and Keur Matar. These areas are primarily focused on vegetable production, although some producers also engage in sheep and cattle farming. The findings from interviews with these producers are presented in paragraph 3.3.
Others	This includes the community development officer.

3.2.3 Challenges and needs of existing cooperative organisations

The interviews conducted with institutional organizations and local cooperative associations identified several challenges that most organizations encounter to varying degrees. These challenges are summarized in Table 3, as well as needs that arise from that challenge.

Table 3: challenges and needs of cooperative organisations

Topic	Challenge	Need
Structure of cooperative societies	Weak internal organization and lack of governance.	A professional, business-oriented approach to cooperative development, with a clear separation of roles between business activities and governance.
Access to finance	Difficulties in obtaining credit and an over-reliance on subsidies and external aid.	The need to generate independent income to achieve financial autonomy.
Role of cooperative in the community	Most cooperatives do not engage in collective buying and marketing of farmers' products, nor do they negotiate better prices with financial institutions. Additionally, many cooperatives lack training and capacity-building activities for promoting entrepreneurship and employment in rural communities.	A financially sustainable cooperative that goes beyond just distributing inputs. Integrated support for the community that is economically viable and partly financed by farmers themselves.

Infrastructure and logistics	Insufficient or poorly maintained infrastructure and limited access to water.	Investment in storage facilities and sustainable water management practices, including increased utilization of rainfall through water catchment areas.
Technical knowledge and training	Lack of training in best practices, business management, modern technologies, and limited access to market information.	Development and implementation of training programs run by cooperatives for both staff and hired labour, with adequate support
Environment and climate change	Issues related to land degradation (e.g., erosion, salinization) and vulnerability to climatic hazards (e.g., drought, flooding).	An integrated agricultural operation that considers ecological needs, promotes healthy food production, and restores soil and biodiversity without compromising agricultural output.
Autonomy	Existing cooperatives lack the autonomy and independence necessary for effective functioning, hindered by complex legislation and financial dependence.	More autonomous agricultural cooperatives through robust commercial activities that maintain their cooperative nature.

3.2.4 Stakeholders from The Netherlands

The interviews revealed a strong and consistent interest among Dutch private sector companies in providing inputs, technologies, and services specifically tailored to Senegal's agricultural sector. Thirteen companies were interviewed (see Annex III), each offering expertise in areas such as seeds, water management, soil health, storage solutions, and market analysis services. These companies emphasized the importance of training and technical support to help cooperatives fully integrate technology into their operations. Many highlighted that establishing partnerships with local representatives and cooperatives is essential for successful implementation. As detailed in Chapters 6.3 and 6.4, Dutch companies recognize clear potential for their solutions to contribute to agricultural growth in Senegal.

3.3 Project site and farming context in Diender

3.3.1 Geography and location project site

The project site selected for the purpose of this pilot is located in the commune of Diender, next to the village of Thieudéme and approximately 1 hour drive from Thiès (40 km) and 1,5 hours from downtown Dakar (65 km), Figure 6. A total area of 110 ha has been selected for the purpose of designing a new agricultural operation as part of a cooperative structure.

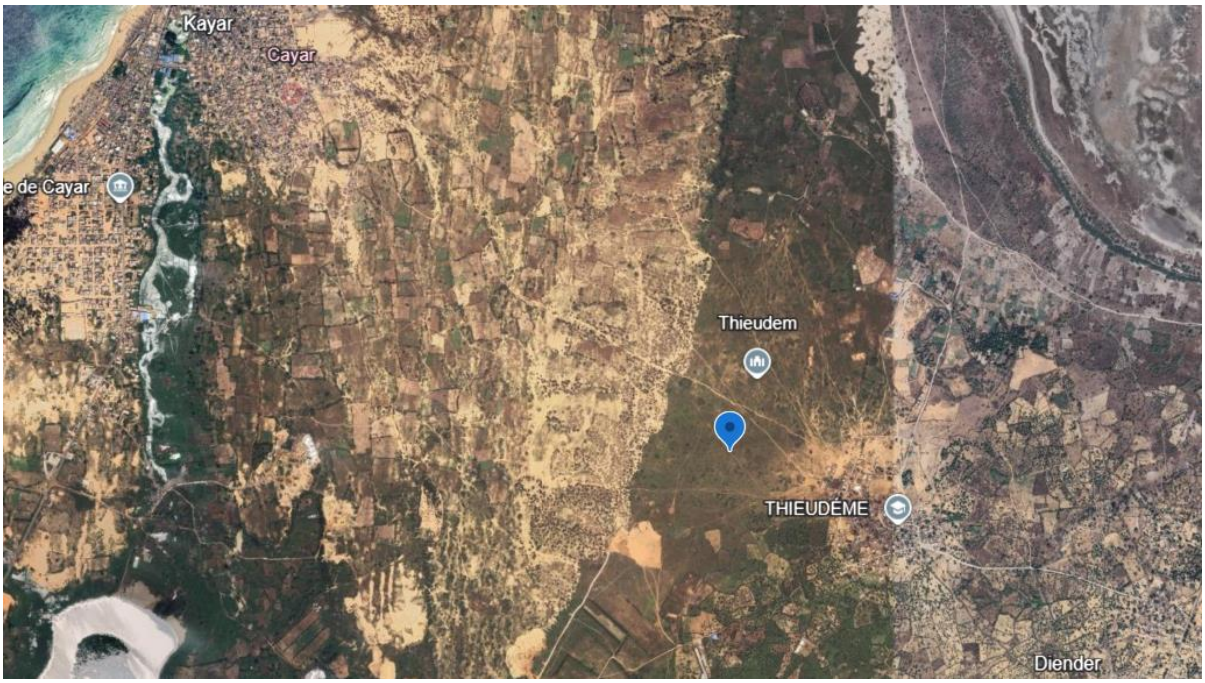


Figure 6: Project location selected in the commune of Diender, next to the village of Thieudéme

Currently, the site remains largely fallow (see Figure 7), although some agricultural production occurs in certain areas. All land ownership belongs to the community, and the agricultural activities taking place in these spots are governed by short-term agreements between the community and individual producers.

Figure 7. Landscape of the project site.in its current state

To create a realistic model and agricultural operational plan, this specific site was selected. However, this does not indicate that it will be the site for the pilot implementation.

The final decision on where to implement the pilot agricultural operation rests with the Senegalese government (MASAE) and local authorities. This was confirmed by numerous stakeholders interviewed, many of whom suggested changing the 'C' in 'Communale' (municipality) to 'Communauté' (community) to avoid constraints related to geographical delimitations and potential disputes. Additionally, there are existing cooperatives that serve farmers across municipal borders.

3.3.2 Farming in Diender commune

Agricultural practices

Good agricultural practices, such as crop rotation, minimal soil tillage, and smart application of inputs, are essential for sustainable crop production. However, most smallholder farmers do not implement these fundamental practices. As a result, soils in Diender and the broader Niayes region are suffering from degradation, reduced soil life and biodiversity, nutrient depletion, and consequently diminished soil fertility. This degradation leads to weaker plants that are more susceptible to diseases and pests, contributing to a substantial *yield gap*. Many farmers' immediate response is to apply more inputs, such as chemical fertilizers and crop protection methods. While this may yield short-term benefits, the long-term effects can be detrimental to the soil's future production capacity. Additionally, many farmers lack access to training and education on best agricultural practices, pest management, and sustainable farming techniques. This knowledge gap can hinder productivity and limit their ability to adapt to changing environmental conditions.

Yield gap

Using onions as an example, there is a significant yield gap in the Diender area, with actual yields averaging 10 tons per hectare, while the estimated potential yield ranges from 40 to 50 tons per hectare. Efforts to close this yield gap should focus on key factors. Various interconnected biophysical, crop management, and socio-economic factors contribute to the yield gap, including poor soil conditions, water scarcity, salinization, and the pressures of weeds, pests, and diseases. Options for sustainable intensification include implementing crop rotation, improving nursery management, utilizing drip irrigation, and enhancing storage facilities. However, it is important to recognize that there is no one-size-fits-all solution for farmers. Instead, a range of options should be provided, allowing farmers to select the best-fit practices for their specific circumstances.

Farmers in the region primarily rely on chemical fertilizers, with urea, DAP (diammonium phosphate), and NPK being the most commonly used products, typically applied in granular form. These fertilizers come in bags of either 25 or 50 kg and are spread manually across the fields. Generally, a specific fertilization plan that considers soil nutrient availability and crop requirements is often lacking.

Most farmers are not aware of the exact application rates for specific nutrients; instead, they tend to know how many bags they apply to their fields each year. For instance, it is estimated that an average smallholder farmer in Diender applies about 7 bags (50 kg each) of urea per hectare, providing approximately 160 kg of mineral nitrogen per hectare due to urea's nitrogen content of 46%. In addition to mineral fertilizers, some farmers apply organic manure, typically chicken manure, though in very small quantities due to the limited availability of organic manure in the area. This manure is usually incorporated into the soil before sowing a new crop.

For crop protection, farmers primarily depend on chemical crop protection products, including herbicides, fungicides, and insecticides. These are widely available and typically sold in small quantities, which farmers purchase individually. Often, a mix of chemicals is applied repeatedly, sometimes every week during the growing season. To manage weeds, farmers also rely on manual weeding and may hire labourers for this task. The inadequate application of fertilizers and crop protection products often results in over-application, which can negatively impact both the soil and the crops. This practice stems partly from the principle of "better safe than sorry," as well as recommendations from input sellers who have a vested interest in promoting higher sales. Such poor agricultural practices exacerbate soil degradation, increase salinization from chemical compounds, and lead to high losses from leaching and inaccurate distribution, often resulting in poorer crop quality. For example, in the case of onions, excessive nitrogen application can reduce dry matter content, ultimately diminishing the storability of the harvest. Beyond the negative impacts on soil health, water quality, and crop yield, over-application of inputs also adds to the financial burden on farmers, as input costs rank second only to labour in overall production expenses

Soil and soil management

The dominant soil type on the proposed site is tropical ferruginous, with some coastal dunes located towards the east. The ferruginous soils are sandy but also deficient in essential nutrients such as iron, nitrogen and phosphorous. They are deep, well drained but poor in structure, organic matter and nutrients and consist mostly of sand. Key results of the soil samples are presented below (Table 4).

Table 4: key results of soil samples conducted

PH:	5,50 – 5,68	Slightly acidic soils, suitable for acid-loving vegetables (carrots, potatoes). Onions will need addition of calcium.
CE	17,44 à 44,7 µS/cm	Low salinity, ideal for vegetable production
OM%	0,049 à 0,325	Very low, and therefore reduced water and nutrient retention capacity. This argues for mulching, leaving crop residues on the soil, add compost and other forms of organic matter during the first year of the implementation.
P	2,433 à 18,566 ppm	Phosphorus deficiency in certain areas
Sand %	94.5% to 97.75%	Very sandy soils, with good drainage but poor water and nutrient retention.

Most agricultural work is conducted manually or with the assistance of animal-drawn ploughs. The common practice involves removing crop residues and weeds, followed by tilling the top layer to prepare a seedbed. Burning crop residues is a prevalent practice, which contributes to the low levels of soil organic matter in many areas of Diender. Consequently, the resilience of the soil is reduced (characterized by poor soil life), leading to high nutrient leaching due to the decreased nutrient retention capacity, as well as low water retention capability.

Climate, vegetation and water

The climate in in Diender is characterised as 'coastal Sahelian'. It is part of the tropical climate, characterised by alternating periods of drought lasting from 8 to 9 months and rain from June/July to September/October. The coastal facades of the area are on the maritime trade winds and the cold current affects the Grande and Petite Côte. This helps to cool average temperatures while reducing humidity.

This site is currently characterised by a degraded wooded to shrubby savannah dominated by species of the combretaceous family of the Combretaceae family such as *Combretum glutinosum* (ratte) and *Combretum micranthum* (kinkeliba). The herbaceous cover is characterised by annual grasses that generally dry out around the rainy season. the rainy season. Eucalyptus trees line most of the site.

Smallholder farmers in Diender encounter numerous challenges when producing vegetables. Water competition is particularly intense during the dry season, as most farmers rely on groundwater. Although there are several large aquifers in the area, the increasing demand for vegetable production, coupled with inefficient irrigation techniques, puts substantial pressure on the availability of clean water for irrigation. This situation is further complicated by rising salinity levels resulting from declining groundwater tables each year. Moreover, changing rainfall patterns—characterized by reduced precipitation and increased unpredictability—along with rising temperatures, adversely affect the length of the growing season and crop yields.

The current agricultural context and practices are severely limiting the land use yield potential while increasing the costs of smallholder farmers in Diender. This underlines the need for the implementation of good agricultural practices, increased collaboration and investing in skills and infrastructure to enhance environmentally and economically sustainable agricultural production.

Post-harvest loss and practices

As previously mentioned, the yield gap refers to the difference between the potential yield and the actual yield achieved by farmers (the gross yield). In optimal farming systems, a significant portion of this gross yield would reach consumers, assuming that storage, processing, and distribution are effectively managed. However, in the case of smallholder onion production in Diender, considerable post-harvest losses occur, primarily due to the lack of storage facilities.

Interviews revealed that local crop varieties tend to perish faster than imported varieties. One reason for this is that short-day onions generally have a shorter storage life compared to long-day varieties. However, it was also noted that farmers' management practices adversely affect the storability of the produce. It is estimated that approximately 30% of total production is lost before reaching the market. In the context of onions, this 30% accounts for a substantial portion of national onion imports. Proper storage of local onions could significantly reduce the need for imports, thereby enhancing food sovereignty in Senegal.

While farmers in this area have a geographical advantage over those in many other regions of the country, many are unable to capitalize on this potential. Their market position is generally weak, with limited opportunities or knowledge to secure good and stable prices for their crops. Farmers often aim to harvest their vegetables as early as possible, preferably before production peaks, in order to take advantage of relatively high prices. However, this practice can result in harvesting crops before they have reached physiological maturity.
Harvesting is primarily done manually, with most of the work carried out by women. After harvesting, the majority of farmers sell their produce directly at the edge of their fields to local traders, known as bana-bana's. These traders purchase goods from smallholder farmers and sell them in markets in nearby villages or towns.

Additionally, farmers typically do not participate in collaborative initiatives that could strengthen their market position and income. As a result, profit margins are very narrow, limiting their spending power and loan capacity needed to invest in new technologies, inputs, and practices that could enhance the quality and quantity of their produce.

Labour

Many areas in Diender, like numerous other parts of Senegal, are experiencing a labour outflow to larger urban centres as income for farmers stagnates. Many young people are moving to cities in search of better financial opportunities, while others are seeking illegal emigration to places like Europe. Consequently, labour is becoming increasingly scarce and expensive, particularly during the planting and harvesting seasons. Additionally, due to limited spending power, most farmers are unable to invest in mechanization to mitigate this challenge.

Urgent needs of farmers

In summary, farmers in Diender face several urgent challenges and have expressed the following needs:

- *Restoration of soil fertility:* There is a critical need to improve soil health and fertility.
- *Access to finance:* Farmers seek access to financing with more favourable terms than those offered by banks to help develop their farms.
- *Alignment of crop calendar with equipment and labour availability:* They require improved timing and planning to match the desired crop calendar with the availability of equipment and labour.
- *Collaboration among farmers:* There is a need for collaboration among individual smallholder farmers to collectively acquire or rent equipment, thereby reducing costs and enhancing land efficiency.
- *Proper storage solutions*: With increasing post-harvest losses reaching a dramatic peak last year, effective storage solutions are essential.
- *Cost-effective irrigation:* Farmers need to reduce irrigation costs while ensuring a reliable water supply.
- *Coordinated buying and selling:* Efforts to coordinate the buying and selling of inputs and produce are crucial to recapturing profit margins that are currently lost to middlemen, known as “coxeurs” or "bana-bana."
- *Increased productivity of available land:* Many farmers currently work only 20% of their land due to a lack of resources; thus, increasing productivity on available land is vital.

4 Operational agricultural planning for project site

4.1 Assumptions

The proposed agricultural operation is based on the assumption that local authorities, community leaders, and the Senegalese government fully support the project. Their support is crucial for facilitating implementation by addressing potential barriers related to ownership issues, governance, the selection of a cooperative model, and obtaining permissions for necessary infrastructure development, such as wells and roads.

Additionally, we assume there will be sufficient availability of labour from neighbouring villages within the Diender commune to staff the agricultural operation. Finally, it is assumed that the land required for the agricultural operation will be provided by the commune.

4.2 Building blocks of agricultural operation

Designing a new agricultural operation on a significant area presents an opportunity to incorporate essential building blocks for long-term sustainability. This includes considerations related to agriculture, ecology, biodiversity, community engagement, and finance. To achieve this, we propose five pillars (building blocks) that are supported by a solid soil management strategy, which serves as the foundation (see Figure 8).

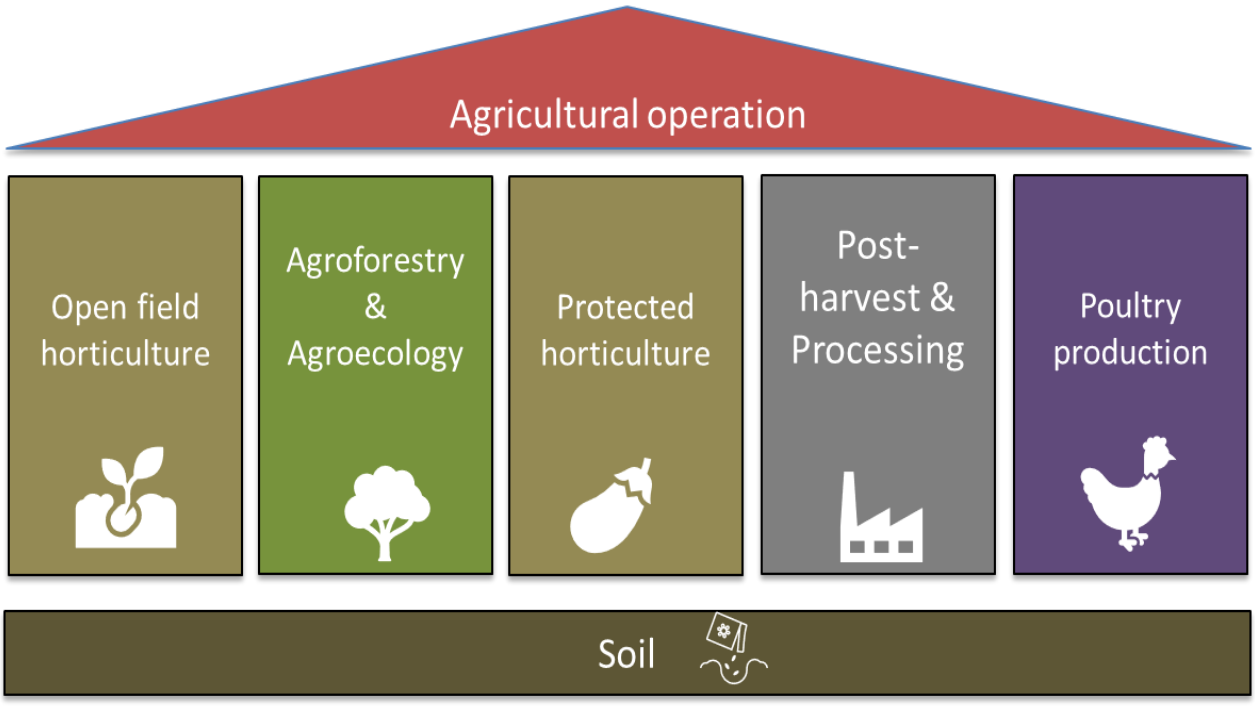


Figure 8. Building blocks for sustainable agricultural operation.

Foundation - soil

A sound and sustainable agricultural operation prioritizes soil health and effective soil management as its foremost objective. Healthy soil structure and robust soil life enhance water retention capacity, reduce the loss of valuable minerals, improve resilience against pests and diseases, and ensure long-term agricultural productivity. A crucial element in soil restoration and management is soil organic matter. Consequently, all agricultural practices in this operation will focus on increasing soil organic matter. This approach includes implementing minimum tillage, growing low-maintenance cover crops, and utilizing mulching techniques with residues from cash crops and cover crops. Additionally, agricultural practices should promote the circularity of nutrients within the farm boundaries to maximize sustainability.

Building block 1 – Open field vegetable production (85 ha reserved)

This building block will occupy the majority of the agricultural operation's acreage, capitalizing on the growing demand for locally produced vegetables. The economies of scale inherent in the proposed operation enable large-scale production, reducing the cost per square meter while simultaneously allowing for the necessary rotation of crops.

Crop plan and rotation

A sustainable rotation schedule, such as a 1:5 rotation, is essential for improving soil structure and health, reducing pests and disease pressure, and preventing nutrient depletion. The crops will be rotated in two cycles per year, with the second cycle dedicated to either a cover crop or wheat. In each year's second cycle (the wet season), legumes or other cover crops will be introduced. This practice boosts soil organic matter, promotes nitrogen fixation, competes with weed growth, and minimizes erosion, especially following nutrient-demanding crops like potatoes.

The proposed crop plan outlined in Table 5 provides an overview of the recommended 1:5 crop rotation for potatoes, onions, carrots, wheat, cabbage, green beans, and okra, utilizing two cycles per year. Given that potatoes are heavy feeders that remove a significant amount of nutrients upon harvest, they will be followed by cover crops in the second cycle of the first year to help restore nitrogen levels and organic matter in the soil.

In the subsequent year, green beans (a legume) will be planted before potatoes to further replenish nitrogen levels. The plan ensures that no crop is planted consecutively on the same field, with particular attention paid to pest-sensitive crops, such as those in the Solanaceae family (e.g., potatoes). For instance, onions are planted after potatoes in the third year, as they can help suppress nematodes that are often attracted to potatoes. This sequence effectively breaks the pest and disease cycle. The rotation also alternates between wheat and cover crops in the second cycle to reduce weed pressure and maintain soil cover throughout the year.

Table 5. Crop rotation program across 85ha for open field cultivation

Plot	Year 1		Year 2		Year 3		Year 4		Year 5	
ha	1st cycle	2nd cycle	1st cycle	2nd cycle	1st cycle	2nd cycle	1st cycle	2nd cycle	1st cycle	2nd cycle
5,0	Onion	Cover crops	Green beans	Wheat	Potato	Cover crops	Carrot	Wheat	Onion	Cover crops
5,0	Onion	Cover crops	Green beans	Wheat	Potato	Cover crops	Carrot	Wheat	Onion	Cover crops
5,0	Onion	Cover crops	Green beans	Wheat	Potato	Cover crops	Carrot	Wheat	Onion	Cover crops
5,0	Onion	Cover crops	Cabbage	Wheat	Carrot	Cover crops	Green beans	Wheat	Potato	Cover crops
5,0	Onion	Cover crops	Cabbage	Wheat	Carrot	Cover crops	Green beans	Wheat	Potato	Cover crops
5,0	Potato	Cover crops	Onion	Wheat	Carrot	Cover crops	Green beans	Wheat	Potato	Cover crops
5,0	Potato	Cover crops	Onion	Wheat	Okra	Cover crops	Cabbage	Wheat	Green beans	Cover crops
5,0	Potato	Cover crops	Carrot	Wheat	Okra	Cover crops	Cabbage	Wheat	Green beans	Cover crops
5,0	Potato	Cover crops	Carrot	Wheat	Okra	Cover crops	Onion	Wheat	Green beans	Cover crops
5,0	Green beans	Wheat	Carrot	Cover crops	Cabbage	Wheat	Onion	Cover crops	Okra	Wheat
5,0	Green beans	Wheat	Potato	Cover crops	Cabbage	Wheat	Onion	Cover crops	Okra	Wheat
5,0	Green beans	Wheat	Potato	Cover crops	Onion	Wheat	Okra	Cover crops	Okra	Wheat
5,0	Cabbage	Wheat	Potato	Cover crops	Onion	Wheat	Okra	Cover crops	Carrot	Wheat
5,0	Cabbage	Wheat	Potato	Cover crops	Onion	Wheat	Okra	Cover crops	Carrot	Wheat
5,0	Carrot	Wheat	Onion	Cover crops	Green beans	Wheat	Potato	Cover crops	Carrot	Wheat
5,0	Carrot	Wheat	Onion	Cover crops	Green beans	Wheat	Potato	Cover crops	Cabbage	Wheat
5,0	Carrot	Wheat	Onion	Cover crops	Green beans	Wheat	Potato	Cover crops	Cabbage	Wheat
85	ha in total									

During the first two years, the area allocated for potatoes and onions will be larger than in subsequent years, taking advantage of the extensive production area available before the full rotation schedule is implemented. The open field production area is planned to be divided into 17 blocks, each measuring 5 hectares. These blocks will be configured as 625 x 80 meters, which aligns with the desired maximum length of a single dripline. However, as indicated in the maps, not all blocks are the same size due to the uneven delimitation of the project site.

Irrigation management

Switching to drip irrigation is essential for reducing water use and managing salinity. By applying water directly to the soil instead of the leaves, drip irrigation helps prevent leaf damage. The primary goal of a drip irrigation system is to maintain a constantly moist root zone, known as the "wet bulb." This wet bulb helps lower salt concentrations in the immediate vicinity of the roots. Although there are currently no restrictions on groundwater extraction for irrigation, it is anticipated that future climate change and population growth will place increased pressure on groundwater resources. Therefore, adopting more water-efficient techniques like drip irrigation will help prepare farmers for these impending challenges. The drip irrigation system will consist of two wells feeding into a central water basin, which will supply main water pipes connected to secondary (fixed) pipes. These secondary pipes will distribute water to the driplines at the parcel level. Irrigation can be activated at the block level (5 hectares).

The good agricultural practices to be implemented will consist of principles, regulations, and technical recommendations for agricultural production. These practices are built on four pillars: (i) economic viability, (ii) environmental sustainability, (iii) social acceptability, and (iv) food safety and quality. Specifically, these practices will be detailed during the implementation phase to inform training and skill development activities for farm workers. The goal is to minimize environmental impact while maximizing yields, reducing costs, and optimizing economic operations.

Machinery, equipment and inputs

Infrastructure	
Open warehouse	**Storing machinery and equipment, as well as stock protected from wind and rain.**
Crop production	
Tractor 4-wheel	90-100 kw, track width 1.50 / 3.00 meter
Roller plough (3 scissors)	For sowing plough the field to underwork crop residues
Ridge cultivator (3.00 m)	Ridge cultivator for sowing
Full-field chopping kit and bed caps for cultivator	To make ridge cultivator also suitable for beds
Field sprayer 1200 litre carried 24 m	Simple field sprayer
*Centrifugal spreader 12-24 m carried 3000 litre**s***	simple fertiliser spreader
Hoeing machine ridges 3 m	to hoe between ridges or beds
Planting machine (potatoes)	simple planting machine 3 m
Seed drill 6 rows	1.5 m seeder for vegetables
Handler	For moving pallets etc in rough terrain
Irrigation	
Two water wells	60-100 meter deep to allow for long term water availability, feeding water basin
Water basin	1.200 m3 (20*20*3 meter)
Fertigation equipment	Mixing fertilizers
Pumps	Feeding main water lines from water basin, number depending on final number of main lines.
Main water distribution pipes	Fixed, running north-south
Secondary water distribution pipes	Fixed, running east west
Driplines	Moveable between crops and for replacement, running north-south
Solar power unit	250 solar panels powering the whole irrigation system as well as other farming operations

Building block 2 – agroforestry and agroecology (15 ha reserved)

The goal of the agricultural operation is to promote agroecological practices that help adapt to climate change, sequester carbon dioxide, and support long-term soil fertility, environmentally sustainable production, and biodiversity. These practices will be integrated into everyday agricultural activities, as well as implemented through agroforestry on a significant portion of the project site.

Alongside a variety of tree species that can withstand water stress, such as *Tamarindus indica* (tamarind), *Faidherbia albida*, *Sclerocarya birrea* (marula), and others (see Figure 9), agroforestry will also include fruit trees like mangoes and papayas, which thrive in the climate of Diender. These practices will contribute to wood production, soil restoration, and erosion protection.

Figure 9. Tree species to be planted as part of agroforestry strategy, Tamarinde, Ana tree and Marula from left to right.

During implementation, an approach that integrates agroecological principles into agricultural practices will be adopted, taking into account the interrelationships between plants, animals, humans, and the environment. This approach will encompass the following aspects:

1. *Biodiversity:* Promoting a diverse range of crops and tree/brush species to enhance ecosystem resilience and productivity.
2. *Soil and agricultural practices:* This includes cover cropping, mulching, permaculture, fruit cultivation, wood production, and minimizing tillage whenever possible.
3. *Natural pest control:* By increasing biodiversity, the population of beneficial organisms and natural predators will also rise, reducing dependency on chemical crop protection products. Where feasible, natural crop-enhancing products, including bio-stimulants, will be introduced.
4. *Water management:* Drip irrigation will be the standard irrigation method, reducing water loss and enhancing water productivity. Additionally, the project site features several natural low points suitable for harvesting and conserving rainwater during the wet season.
5. *Local knowledge*: During training and capacity-building activities for new farm workers from neighbouring villages, local and proven farming practices will be identified and integrated into modern agricultural techniques whenever possible

Machinery, equipment and inputs

Infrastructure	
Nursery	Growing trees and other plants before planting on designated spaces
Warehouse	Small warehouse, temporary storage unit, stock, tools and equipment
Production	
Watering unit	Small watering tank (tractor or cart mounted) to water young trees
Tools	Equipment for maintenance, pruning, cutting

Building block 3 – Protected horticulture (5 ha reserved)

While still in its early stages, protected horticulture offers significant potential to increase production per square meter of important crops—such as pepper, cucumber, and aubergine—by over 50%, while also reducing the use of costly inputs like fertilizers and crop protection products, as well as water consumption (by up to 90%). However, developing protected horticulture requires solutions tailored to local climatic conditions and additional skills for growers and workers. We recommend initially investing in two types of greenhouses suitable for the West African context: four multispan greenhouses of approximately 500 m² each and five greenhouses constructed from locally sourced materials, each with a floor capacity of 400 m² (see Figure 10). Together, these nine greenhouses will cover an initial total floor area of 4,000 m² and will be constructed on a 5-hectare site adjacent to the project's central area, close to the proposed water basins and main farm buildings. Greenhouse operations can expand over time, and the total area designated for greenhouse cultivation will also be used to plant trees, which will help create a more favourable microclimate.

The greenhouse cultivation activities will focus on cucumber, bell pepper, and aubergine, as these crops thrive in Senegal's hot climate when grown under cover, unlike tomatoes, for example. The greenhouse operation will be characterized by low to mid-tech levels, utilizing fertigation, drip irrigation, and, where possible, substrate-based systems.

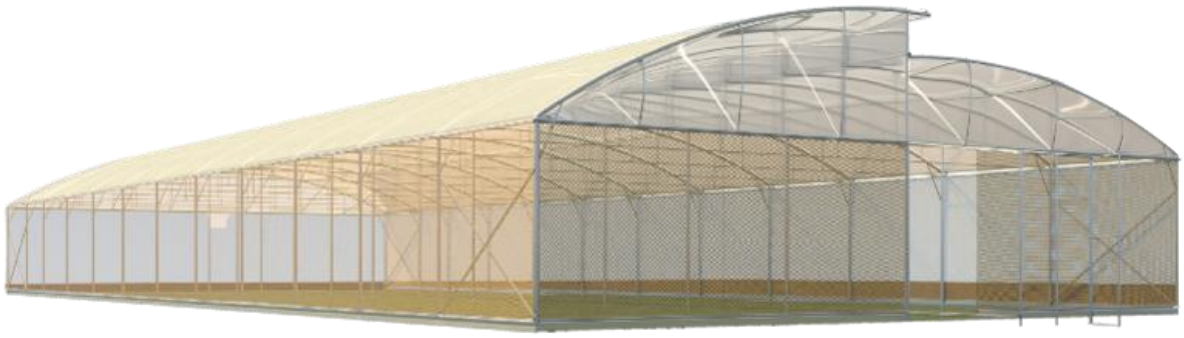


Figure 10. Impression of a typical multispan greenhouse (top) and 'bamboo greenhouse' as designed by Féro BV

Machinery, equipment and inputs

Infrastructure	
4 multispan greenhouses	Available on local market, each of 500m2 of production area
5 bamboo greenhouses	Available on local market, each of 400m2
Small closed warehouse	Store machinery, equipment and stock + indoor cooling unit (30m2) for temporary storage of produce
1 Nursery	Designed to create suitable environment for uniform germination
Crop production	*Per greenhouse*
Hydroponic equipment	1 set per greenhouse including tanks, piping and growing trays
Sensors	EC, pH, Temperature, and Humidity measurement
Substrate	8-10 m3 preferably sourced locally
Winding wire	100 meters for plant support within greenhouse
(Soluble) fertilizers	Customizable nutrient solutions to cater different crop requirements
Crop protection products	yellow and blue roller traps per greenhouse to manage pests effectively
Crop protection application equipment	Including sprayers and dispensers for pest control products
Irrigation	
Pump	Irrigation pump connected to the tank and controlled by a central system

Water pipes	Approximately 100-150 meter to cover the primary and secondary piping (distribution lines for driplines) depends on the spacing and design
Driplines	100-150 meter for targeted root-level irrigation
Fertigation unit	1 fertigation unit with two tanks (A and B) for nutrient mixing and distribution

Building block 4 – post-harvest and processing (3 ha reserved)

Investment in post-harvest infrastructure, such as storage and processing solutions, is essential for a profitable agricultural operation. Proper storage enables better control over the timing of market entry, allowing farmers to benefit from increased demand and higher prices after peak harvest periods. Processing adds value to products that exit the agricultural operation. For poultry production, on-site slaughtering and processing (freezing) are crucial for effectively serving the market at the right time.
We propose constructing a cooled storage facility for potatoes with a capacity of 500 tons (see Figure 11) and a naturally ventilated storage facility for onions with a capacity of 750 tons. Additionally, a sorting and packaging line for potatoes, capable of handling 1-3 tons per hour, will be included. The expected storage duration for potatoes ranges from 2 to 20 weeks, while for onions, it will be between 2 and 12 weeks. The sorting and grading line for potatoes will allow for appropriate packaging and better service to the urban market with smaller packaging sizes (5 kg mesh bags instead of 40 kg bulk bags).

Apart from the technical requirements for a good storage, the key success factor for storage of any crop is the quality of the produce that enters the storage. A poor quality onion or potato will not be storable for more than a week, while also infecting the rest of the stored produce. Good crop management and harvesting management are therefore key.

Machinery, equipment and inputs

Infrastructure	
Storage onions	Simple storage, natural ventilation only
Potato storage	Cooled storage
Slaughter unit broilers	
Freezing unit broilers	To allow for storing slaughtered broilers and shipping to market at the right time
Cold storage greenhouse vegetables	Short term storage before transport to market.

Building block 5 – Poultry production (0,5 ha reserved)

While the agricultural operation primarily focuses on vegetable production, the project also takes into account the growing domestic demand for animal protein in Senegal. This demand for poultry consumption has been rising due to factors such as increasing incomes, urbanization, population growth, and a decline in the availability of marine fish, which has traditionally been the primary source of protein for the Senegalese population. Incorporating poultry production into the agricultural operation diversifies agricultural output and enhances the circularity of nutrients, thereby reducing the need for synthetic fertilizers. Currently, poultry consumption in Senegal is steadily growing, with chicken being a popular protein source, averaging between 10-15 kg per person per year. This increased availability of both local and imported poultry products has fuelled growth in the sector. Projected demand for poultry consumption is expected to continue rising in the coming years, driven by urbanization, economic development, and government initiatives aimed at boosting local production. Establishing a broiler operation with a capacity of 10,000 birds (as illustrated in Figure 12) has the potential to yield a substantial profit every production cycle of 45 days.

Economic analyses indicate that medium-scale broiler farms are performing well, largely due to the use of high-quality feed, chicks, and effective husbandry practices. However, in addition to investing in the initial broiler production unit, we recommend simultaneous investment in onsite slaughtering and freezing facilities. This approach will enable better market service while preventing the growing period from extending beyond the 45-day cycle, which would significantly reduce feed conversion efficiency

Figure 12. Impression of broiler production operation. Photo Olam Agri Holdings Pte Ltd

Machinery, equipment and inputs

Infrastructure	
Broiler production unit	10.000 birds, approximately 1.000m2
Management building	Small building for administration, management, stocking
Manure storage and handling unit	Collecting and storing of manure, first level processing (grinding), to make it suitable for application via manure spreader

Production	
Feeders	70-100
Drinkers	Nipple drinkers (1.000)
Water storage	1m2 tank minimum with constant supply
Ventilation fans	4 exhaust fabs
Bedding and littering	10-15 tons per cycle of 45 days
Sensors	Humidity and temperature, warning systems
Health management equipment	Disinfectants, vaccinations

4.3 Phases of implementation

The agricultural operation will be implemented over a period of four years, divided into different phases.

Phase 1 - Preparation & Procurement

During this phase, the land will be prepared to make it suitable for construction, including levelling the area for open field cultivation as necessary. This phase will also involve the construction of main farm and administrative buildings, as well as the installation of water, irrigation, and solar power infrastructure. Finally, a detailed analysis will be conducted to determine the required inputs, materials, and equipment, followed by the development of a procurement plan.

Phase 2 - Agroforestry

In this phase, a thorough assessment and planning process will take place to finalize decisions regarding crop species based on climate and community needs (e.g., alley cropping, silvopasture, or forest farming). Staff will be trained to prepare for agroforestry activities, including planting and maintaining the designated areas. Implementation will proceed according to the design, with ongoing maintenance supervised by a dedicated team.

Phase 3 - Open Field Cultivation

Open field cultivation will serve as the backbone of the agricultural operation. This phase will begin with proper training for permanent staff (5) and temporary workers (planting and harvesting). Initially, 30 hectares will be cultivated, with additional hectares brought into production in subsequent years, following recommendations for crop rotation and best agricultural practices.

At the same time, construction of storage units will occur to accommodate the first harvested produce.

Phase 4 - Greenhouse Cultivation

Greenhouse operations will commence in the second full year, involving the establishment of various greenhouses. This will occur simultaneously with intensive training for both permanent (3) and temporary staff. Greenhouse cultivation, particularly hydroponics, necessitates a different mindset and skill set compared to open field cultivation.

Phase 5 - Poultry Production

The agricultural operation will be completed with the establishment of the poultry production facility. Training and staff preparation will be crucial for successful production. At the same time, construction of the production unit will take place, followed by the initiation of the first production cycle. Before the end of the first cycle, the processing units must be constructed and ready for operation. The indicative phasing is summarized in the Gantt chart presented in Annex I.

4.4 Mapping of agricultural operation

Figure 13 and 14 present the fully operational agricultural map after four years of implementation. Additional maps are presented in Annex II.

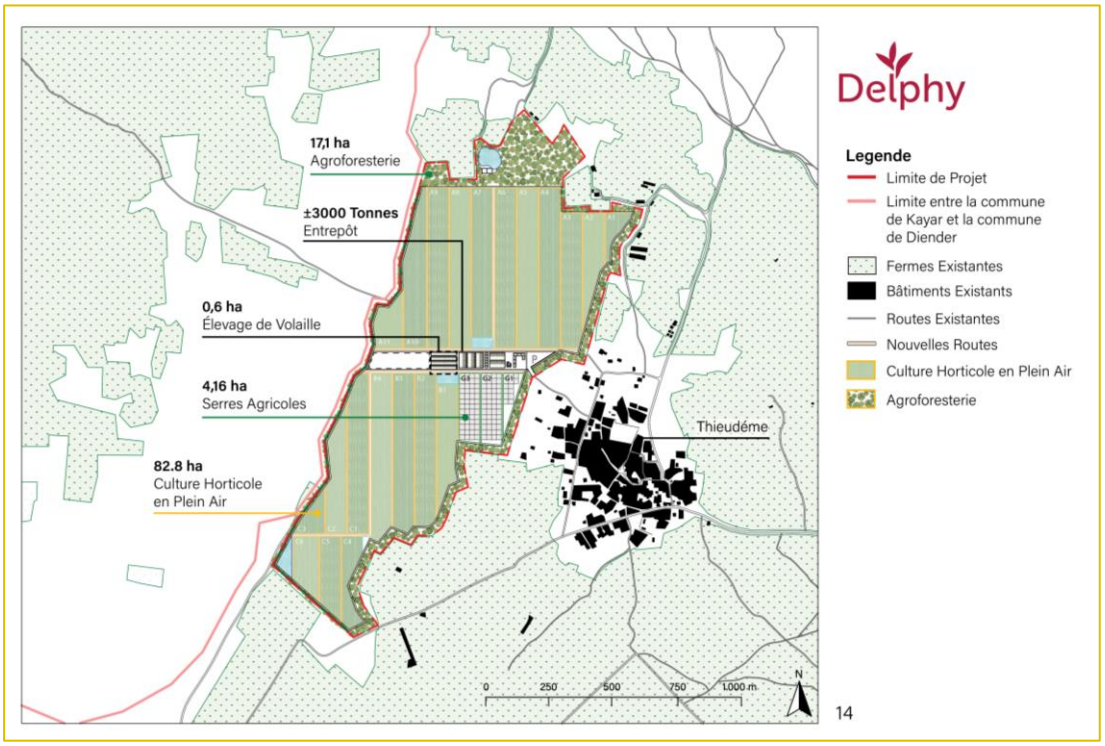


Figure 13. Agricultural operation in completed stage

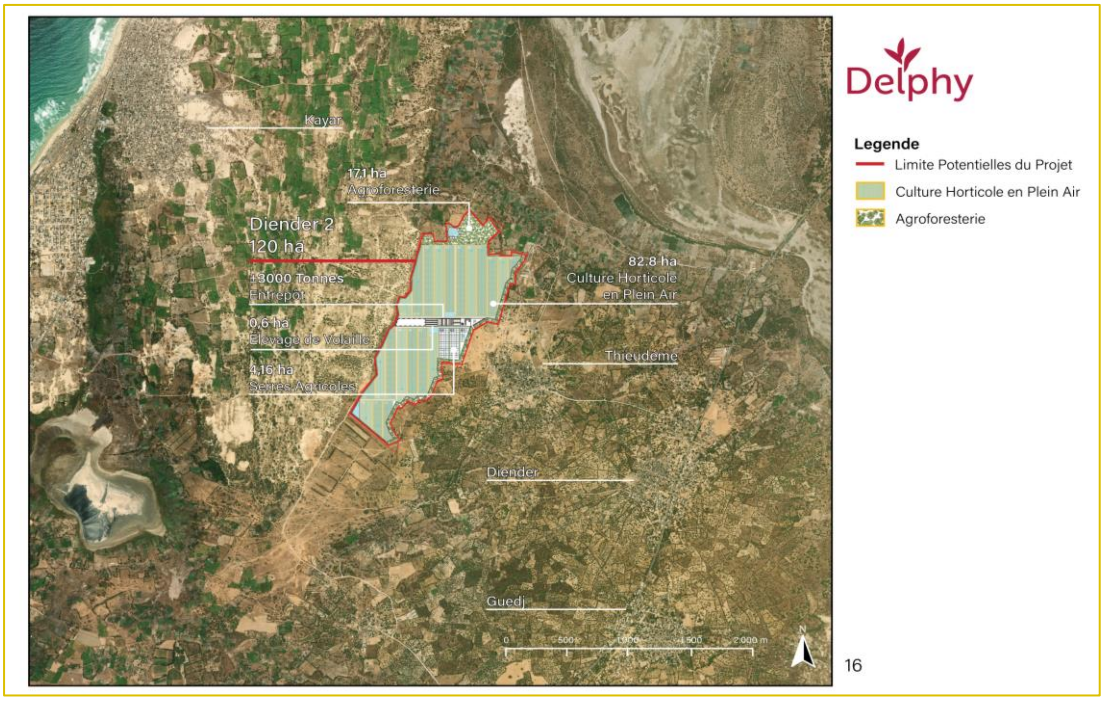


Figure 14. Full operation projected on satellite image

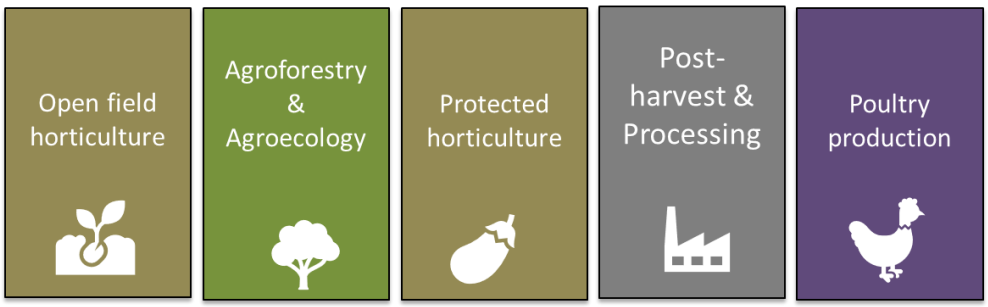
4.5 Role of agricultural cooperative towards Diender community

The agricultural cooperative will fulfil several important roles, including: 1) generating employment, 2) generating income from its agricultural operations, which can eventually be used to 3) provide microcredits to farmers in the commune, 4) offer training and capacity building for cooperative staff and farmers, 5) purchase produce from farmers at competitive prices, and 6) serve as a central procurement center for the inputs that farmers require.

1 - Generating employment

The agricultural cooperative and the proposed agricultural operation will create 32 permanent jobs and 175 temporary jobs annually, with both types of positions sourced from the community of Diender. Figure 15 (next page) illustrates the categories of labour required for each pillar of the agricultural operation. In addition to the paid workers, the cooperative is governed by a board consisting of a president, secretary and treasurer who are elected by the members of the cooperative.

Adding to the direct employment generated, the agricultural operation will stimulate job creation throughout the value chain in which it operates. Given the diversity of products and services offered, it is estimated that an additional 800 to 1,200 jobs will be supported or created in collaboration with input suppliers, small to midsize processing companies, buyers, vendors, and, importantly, smallholder farmers in the Diender commune.



Unskilled temporary	50 (x3)	10	10		4
Unskilled permanent	8	4	3	2	2
Foreman	1		1	1	
Technician	2	1	1	1	1
Administrative staff	3				
General manager	1				

Total permanent	**32**
Total temporary	**175**

Figure 15. Overview of staff needed for each of the agricultural operation

2 – Generate income

The agricultural operation will cultivate a large area of productive land, generating revenue for the cooperative. The various pillars of the operation will provide diverse income sources, thereby reducing risks associated with crop failures or unfavorable market conditions. The financial outlook for the cooperative is further elaborated in Chapter 5.

3 – Provide micro credits to members

Over time, after allocating funds for the agricultural operation, remaining revenues will be added to a microcredit fund. This fund will provide small loans to cooperative members at interest rates significantly lower than those available in the market. By doing so, the cooperative will support smallholder farmers who currently lack access to external financing, enabling them to invest in their farms and utilize more of their land.

4 – Training and capacity building

Training and capacity building are essential for initiating a successful agricultural operation. The quality of plant and animal production largely depends on the staff managing operations. Training activities will be organized around the various pillars, focusing on areas such as open field cultivation, greenhouse cultivation, and more. Emphasis will be placed on experiential learning and practical training in the field and greenhouse environments.

Experience from training programs in other countries highlights that continuous training is crucial. Agricultural systems evolve, and new practices and principles are developed over time rather than through one-time training sessions.

Additionally, workers will require supervision and ongoing training as they implement their learning. To support this, a training facility will be established at the agricultural operation. Here, permanent staff and cooperative management will receive regular, ongoing training, while temporary staff and seasonal labourers will undergo tailored, practical training relevant to their roles. Training for management and administrative staff will also cover areas such as agricultural financial management, staff management, organizational (cooperative) development, entrepreneurship, and marketing.

The cooperative will actively engage in training its members—smallholder farmers in the Diender commune—providing guidance to help them improve their farming businesses. This support will enable smallholder farmers to enhance the quality and quantity of their horticultural production, ultimately increasing their revenues and making them eligible to sell produce to the cooperative too. The cooperative's training activities are summarized in Figure 16.

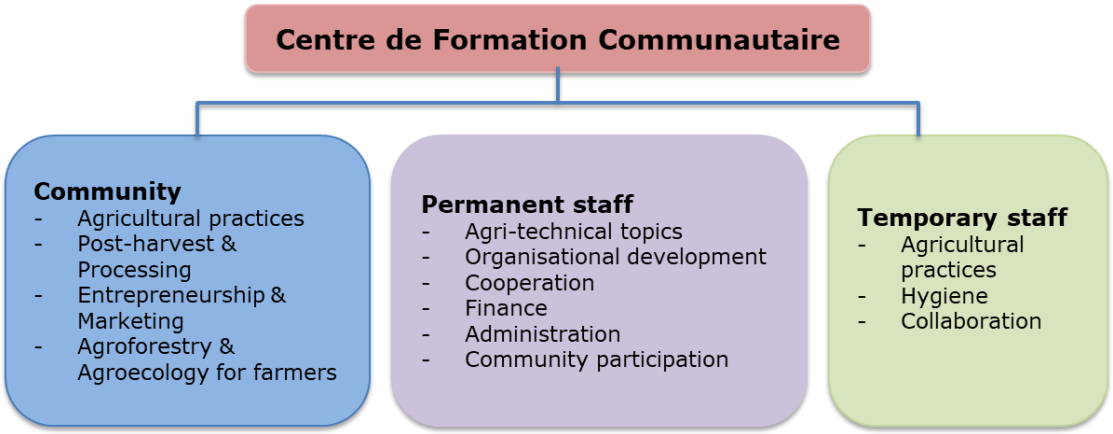


Figure 16. The training activities of the cooperative for staff and members

5 – Buy produce from members

The cooperative will purchase produce from its member farmers in addition to the crops produced on the cooperative farm. However, the quality and consistency of the produce are critical conditions for purchasing from smallholder farmers, underscoring the importance of the training outlined in point 4. Without high-quality produce, farmers will remain in a weak market position. With good quality products, however, the cooperative can buy crops from farmers at competitive prices, slightly higher than those offered by buyers at the farm gate, providing a stable outlet for their goods.

6 – Procuring inputs and supplies

The final role of the cooperative is to procure inputs and farm supplies for its own operations and for its members at competitive prices. Currently, smallholder farmers are heavily reliant on input sellers for advice on types and amounts of inputs.

These suppliers often capitalize on the farmers' lack of knowledge regarding the appropriate types, dosages, and application frequency of fertilizers and crop protection products. By acting as a large agricultural operation, the cooperative can purchase inputs at lower prices and offer the same benefits to its members. Additionally, the cooperative will provide independent advice regarding input usage, which will help reduce farming costs while simultaneously protecting the environment and promoting soil health and biodiversity.

4.6 Organisational structure

The agricultural operation is managed by a general manager who reports to the cooperative's executive body. It is strongly recommended that the agricultural operation functions as an independent entity, with its own organizational and financial structure, professional and knowledgeable staff, and clearly defined responsibilities to ensure effective management of the agricultural lands. After accounting for taxes and investments, the revenues generated will be channelled to the cooperative, which can utilize these funds to provide the services outlined earlier in this report. Figure 17 presents a simplified overview of the cooperative's organizational structure, illustrating how the agricultural operation functions as a separate entity within this framework. The combination of a cooperative structure that owns a separate, commercially run agricultural operation is a novel approach for Senegal and thus requires careful organizational, legal, and financial arrangements.

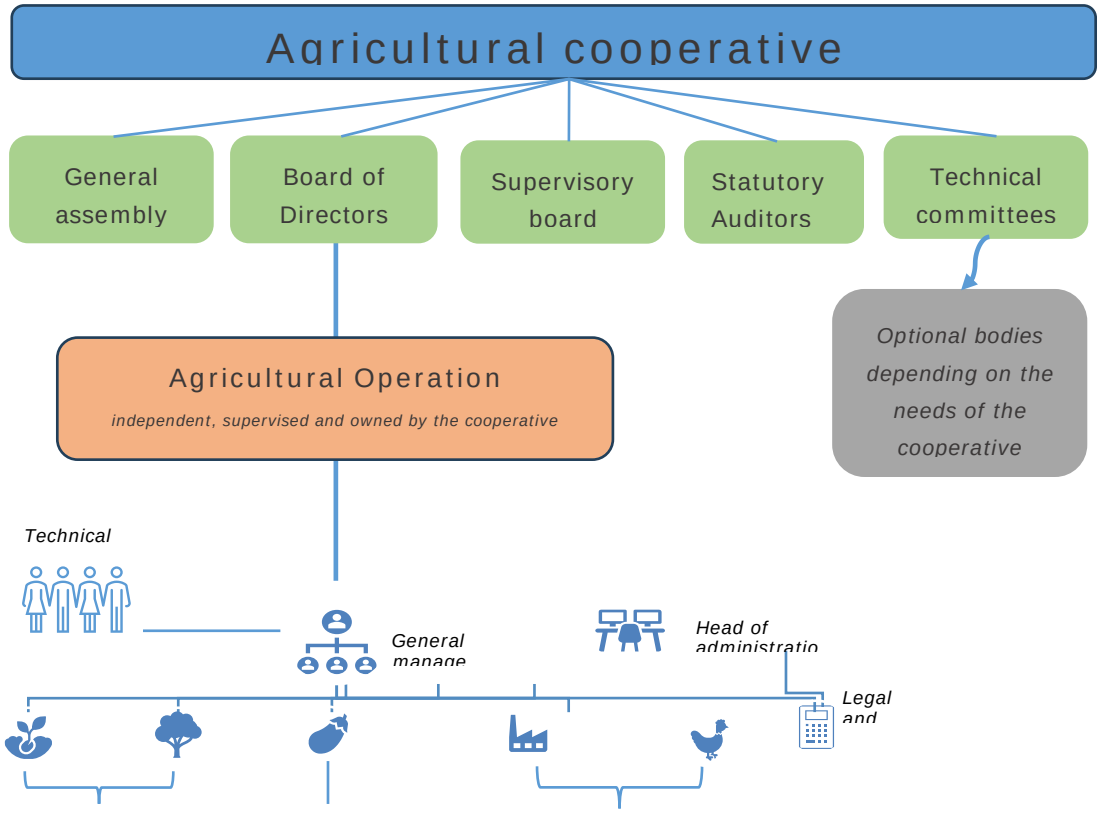


Figure 17. Overview of staff needed for each of the agricultural operation

5 Financial calculations for the agricultural operation

5.1 Assumptions

While calculating the financial framework for the agricultural operation, a number of assumptions and choices were made, including the following:

- *Land provision*: Land needed for the agricultural operation will be provided by the community, thereby excluding costs associated with land acquisition.
- *Inflation rate*: The inflation rate is set at 2%, reflecting current conditions in Senegal. However, inflation tends to be unpredictable and volatile.
- *Salary and cost increases*: Yearly salary increases are projected at 5%, with yearly sales price increases at 4%. Social charges are estimated at 6%, and the profit tax is set at 30%.
- *Cultivation area*: Open field cultivation will begin with 30 hectares in the first year, with full acreage expected to be under cultivation starting in year three.
- *Agroforestry revenues*: Revenues from agroforestry are not anticipated until year five for wood products. However, vegetable revenues can be expected from year one.
- *Infrastructure costs*: Costs for levelling and other infrastructure preparations are included. However, these costs may be covered by government agencies that provide services and equipment.
- *Storage impact on price*: Storing onions and potatoes is expected to enhance the selling price of the produce by approximately 33%.
- *Validation of data:* Numbers regarding production, wages, and costs will need further validation during the implementation preparation phase. The data used for calculations have been sourced from various entities, with realistic averages applied when discrepancies are encountered.
- *Poultry production:* A lump-sum amount (based on specific data) has been included in the profit and loss statement for poultry production, as the typical "yields per hectare" metric cannot be applied to this production unit.
- *Conservative estimates:* Calculations are based on conservative production estimates, while cost estimates are on the higher side. Both sets of estimates will need validation once a decision is made to proceed with implementing the pilot.
- *Income estimates:* Income projections are based on common market prices, with best and worst prices outlined in alternative scenarios.
- *Interest rate on loans:* An interest rate of 0.5% per month on loans has been calculated, though this may change depending on the funding scheme and agreements established

5.2 Summary of business plan

Business Overview
The agricultural operation is owned and managed under a cooperative organization and will assume the legal status pertaining to cooperatives in Senegal.

Vision
The cooperative's vision is to contribute to food security and sovereignty through large-scale vegetable and animal production while also fostering the technical and economic development of rural smallholder communities in Diender.

Main Business Objectives
The primary objective is to increase the quality and quantity of important vegetables by at least 150% within the first five years of operation, compared to the average yields in the Diender area. Target yields per hectare are as follows:

- Onions: 50 tons
- Potatoes: 30 tons
- Cabbage: 20 tons
- Carrots: 23 tons
- Okra: 13 tons
- Green beans: 12 tons

Additionally, the cooperative aims to become the leading agricultural operation and training centre in the Diender commune.

Products and Services
The agricultural operation will focus on producing high-quality vegetables from both open fields and greenhouses. It will also engage in fruit and wood production from agroforestry activities and poultry meat from broiler production. Furthermore, the cooperative will provide several services, including:

- Generating employment
- Offering small loans to members
- Providing training and skill development
- Purchasing produce from members
- Acting as a distributor of inputs at competitive prices for its members

Market
The target market for the agricultural products produced by the operation consists of consumers in the urban areas of Dakar and Thiès. The services mentioned above will specifically target smallholder farmers in the Diender commune.

Financial Projections
The total investment required is €2.5 million, to be paid back over a period of six years. An annual profit (after tax) of -€313,129 is expected in the first year, with break-even anticipated in year three. By year ten, an annual profit (after tax) of €493,059 is projected, resulting in an internal rate of return (IRR) of 6.5%. Return on investment (ROI) over the first five years is expected to be 15%.

The development of production, cumulative cash flow, variable and fixed costs, and the profit-loss account are presented in Figures 18, 19, 20, and 21, respectively.

Production

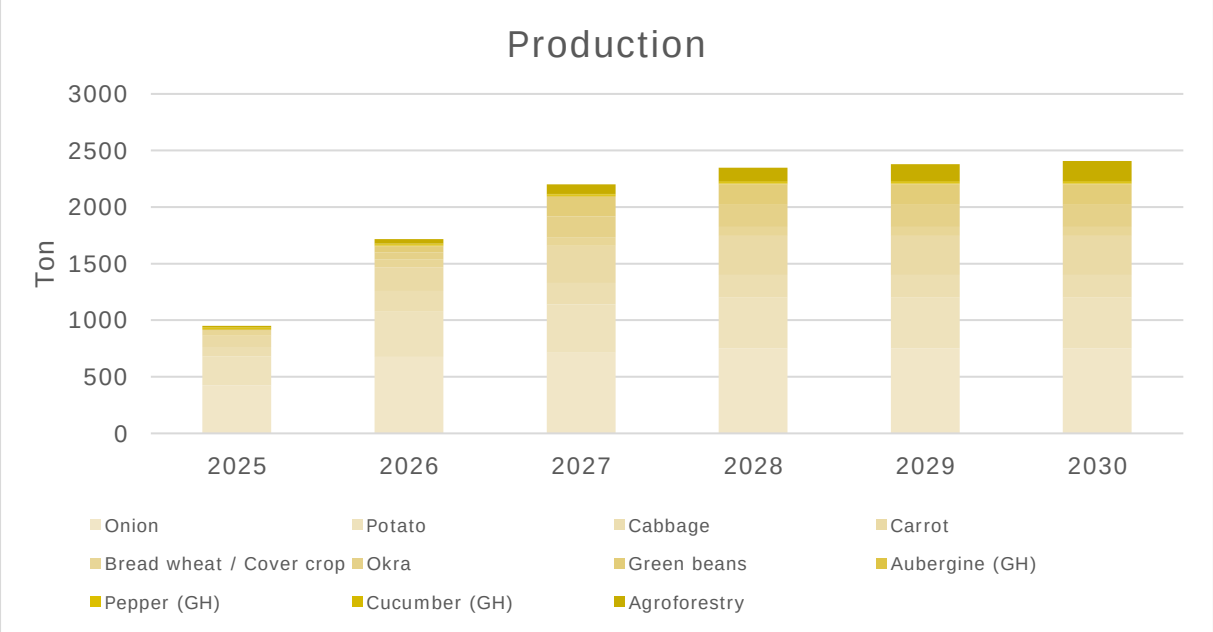
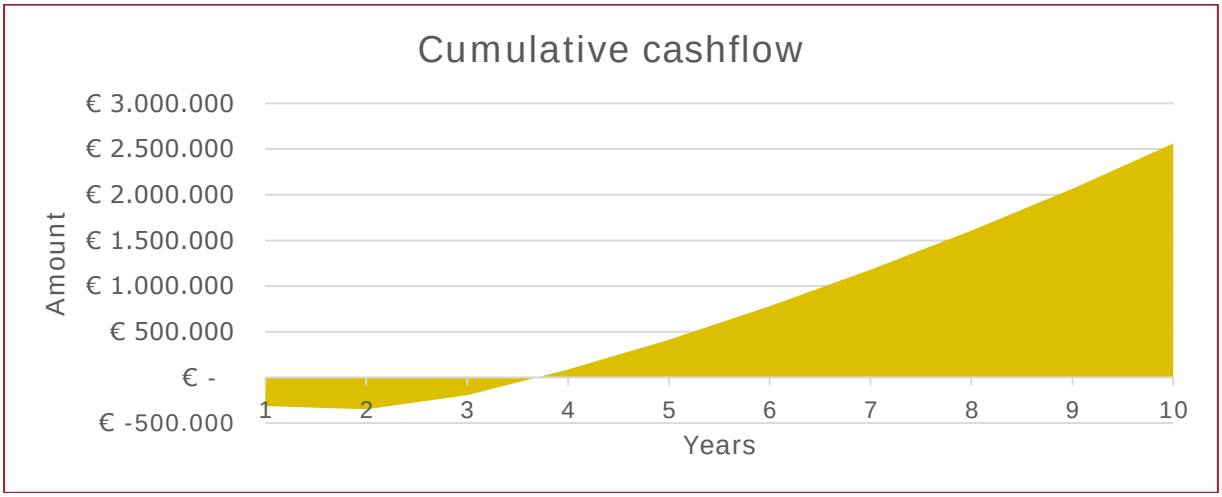


Figure 18. Projected development of crop production over time

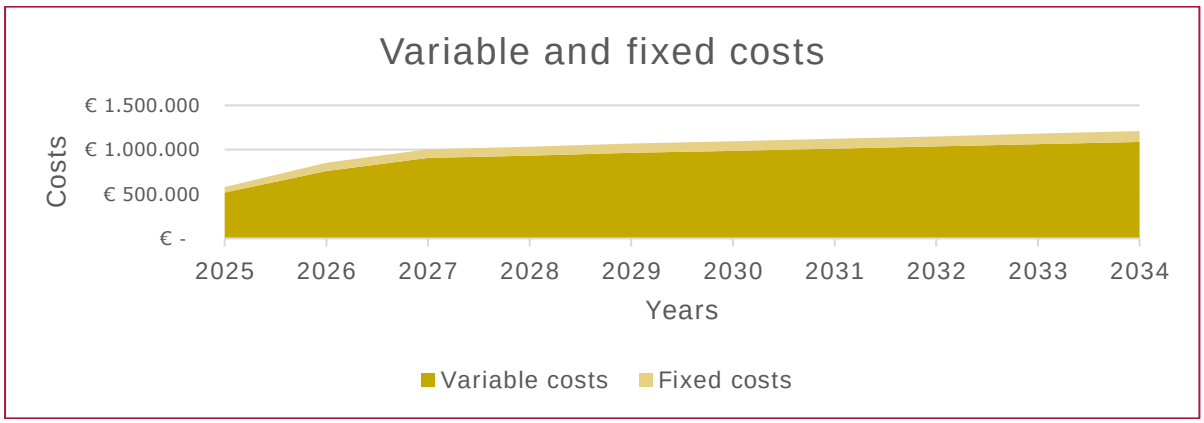
Cumulative cashflow



2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
€ -313.129	€ -349.330	€ -193.733	€ 87.306	€ 410.836	€ 780.781	€ 1.179.063	€ 1.606.847	€ 2.067.605	€ 2.560.664

Figure 19. Projected development of cashflow over time

Variable and fixed costs



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Variable costs	€ 515.983	€ 759.912	€ 908.435	€ 932.810	€ 964.178	€ 987.464	€ 1.011.416	€ 1.036.058	€ 1.061.413	€ 1.087.507
Fixed costs	€ 64.710	€ 94.824	€ 97.863	€ 101.019	€ 104.298	€ 107.706	€ 111.248	€ 114.931	€ 118.760	€ 122.742

Figure 20. Projected development of variable and fixed costs

Profit and loss

Income										
Income before tax	€ -313.129	€ -36.201	€ 222.281	€ 401.485	€ 462.186	€ 528.492	€ 568.974	€ 611.121	€ 658.226	€ 704.370
Income tax	€ -	€ -	€ 66.684	€ 120.445	€ 138.656	€ 158.548	€ 170.692	€ 183.336	€ 197.468	€ 211.311
Income after tax	€ -313.129	€ -36.201	€ 155.596	€ 281.039	€ 323.530	€ 369.945	€ 398.282	€ 427.784	€ 460.758	€ 493.059

Figure 21. Projected development of profit and loss over time

5.3 Funding

The agricultural operation requires an upfront capital investment of €2.65 million. To secure financing for the operation, external funds must be attracted, as no existing or newly formed cooperative will have sufficient equity capital to finance the investments independently. Potential sources of funding include international institutional donors and loan providers, local and regional agricultural investment banks, national government agricultural investment schemes, and private sector partners. The calculations summarized above indicate a return on investment over ten years, with a loan payback period of 60 months. The choice of financing partners cannot be finalized at this stage of the project. To make informed decisions, the results of the studies conducted by Delphy and Deloitte will need to be shared and discussed with key national, regional, and local governments. More information on this is provided in Chapter 7.

6 Role of Senegalese and Dutch private sector

6.1 Private sector from Senegal

The private sector in Senegal is increasingly engaging in agricultural activities through investments in production, supply chain management, and agro-processing. This involvement includes local entrepreneurs and foreign investors who aim to modernize farming techniques and enhance efficiency. Additionally, there is a growing agricultural processing industry focused on adding value to raw agricultural products. This includes the processing of fruits and vegetables, dairy production, and packaging of local foods, all of which contribute to job creation and enhance the export potential of Senegal's agricultural products.

Organizations such as the Senegalese Agency for Agricultural and Rural Development (ASPRA) support the agricultural private sector through initiatives that promote sustainability, provide training, and improve access to technology. A significant emphasis is being placed on sustainable agricultural practices and innovation, including climate-smart agriculture, to improve resilience against climate change and enhance food security.

A sample of potential partners for the implementation of the agricultural operation is presented in Table 6 below. This overview is visualized in Annex IV.

Table 6. Potential local partners and its role in agricultural operation

Private sector partners in Senegal – sample overview	
Greenhouse - Nursery materials and equipment for open field and protected horticulture	Hortica | Khelcom Agribusiness | Bati Serre | Top Mountain | Local branch of Holland Greentech / Variety of local suppliers and vendors | EcoGreen Senegal | SENAF | Société de Production et de Distribution de Semences (SPDS)
Storage, warehouse	Keblink | ICE Senegal | Société de Gestion des Stocks Agricoles (SGSA) | SITAC (Société d'Ingénierie et de Travaux Agricoles) | Société d'Ingénierie et de Construction (SIC)
Irrigation	Be Green | Terragrisen | B3E Senegal | local branch Holland Greentech | AgriTech Senegal | SENAGRI| Netafim Senegal | SoluSun
Fertilizers, chemicals	RMG Concept | Société de Distribution de Produits Agricoles (SODIPRAG) | AgroZone | Rayen Agro | Société d'Agriculture et d'Élevage (SAGE) | Société Africaine de Protection des Plantes (SAPP):
Solar power	B3E Senegal | Nadji Bi Group | Sotilma / Ibriz | CIES (Centre d'Initiatives pour l'Environnement et le Sol)
Soil and water analysis	Suqali Mbay Mi | GAS Global Agro Services
Crop advice and planning	Suqali Mbay Mi | SENADIS | Dakar Agro Services | Crisil | Agro Consulting

Forage	B3E Senegal | Société de Sondage et de Forage (SOFOR) | Eau Forage Services | Agroforage
Heavy machinery	Terragrisen | Senegal Machinery & Equipment (SME) | Société de Distribution de Matériel Agricole (DIMA) | Troc Afrique
Processing	Société Nationale de Commercialisation des Produits Agricoles (SONACOS) | Société Nationale de Commercialisation des Produits Agricoles (SONACOS) | Compagnie des Céréales du Sénégal (CCS) | SODAGRI
Seed	Terragrisen | Top Mountain | RMG concept | Société de Distribution de Produits Agricoles (SODIPRAG) | AgroZone | Rayen Agro | EcoSeed | Keur Cankourang
Livestock	Africa Smart Citizens (livestock protection) | Société d'Agriculture et d'Élevage (SAGE)
Poultry	Soproda, NTD France, Poultec | Société d'Agriculture et d'Élevage (SAGE) | Société des Équipements Agricoles (SEA) | SENEPOL
Agriculture project management	Africa Worldwide Business Holding / Baykat & Business | AgroConsulting | Crisil | Société d'Ingénierie et de Gestion de Projets Agricoles (SIGPA):

6.2 Potential contribution of Senegalese private sector to CAC

The Senegalese private sector plays a crucial role in supporting and sustaining the agricultural cooperatives to be established. Most entities within the Senegalese private sector operate as distributors for large companies, both locally and internationally. There exists a well-established network of distributors of technologies and inputs that are accessible to farmers.

The Senegalese private sector is well-equipped to provide the standardized inputs necessary for crop production, including fertilizers, crop protection products, backpack sprayers, drip lines, irrigation pipes, small pumps, organic manure, and a variety of seeds. They also supply heavy equipment and facilitate infrastructural works, such as well drilling.

To support and promote the local agricultural private sector, it is recommended that the agricultural operation procure as many standardized inputs as possible from the local Senegalese market. This approach not only bolsters the local economy but also minimizes transportation and import costs, along with their associated CO2 emissions.

6.3 Private sector from The Netherlands

The Netherlands is known as an agricultural powerhouse, creating opportunities for investments in research and development of innovative solutions across various sub-sectors. The agricultural private sector in the Netherlands is particularly recognized for its high-tech solutions aimed at increasing the quality and profitability of agricultural production, which are exported globally. Key export products, technologies, and services include greenhouse construction and equipment, storage facilities, poultry processing equipment, seeds, water-saving technologies, and biological crop protection products.

6.4 Potential contribution of Dutch private sector to CAC

Complementary to the services and product offerings of Senegalese private sector partners, Dutch companies have much to contribute in terms of innovative and efficient infrastructure (such as storage and post-harvest solutions), inputs (seeds, organic fertilizers), technology (farm equipment, machinery, greenhouses, sensors), and services (training, crop advice, certification, etc.). The products, services, and technologies provided will be tailored to address the specific needs for innovative solutions in Senegal that the Senegalese private sector may not sufficiently meet in terms of capacity, quality, and innovation. During the implementation of the study, Dutch companies were interviewed about which products and services they could offer for the pilot agricultural cooperative project. A summary of these offerings is presented below, and an overview can be found in Annex V. The following summarizes each private sector company's role and expertise (Table 7).

Table 7. Potential Dutch partners and their role in the agricultural operation

Private sector partners in Senegal – sample overview	
Protected cultivation	Implementing greenhouse solutions adapted to local circumstances is essential. For greenhouse construction, we recommend multispan greenhouses, alongside components like insect-proof netting, shade nets, and plastic covers. *BOAL BV* | *VDH BV* | *Holland Greentech* | *Féro BV* | *Rovero*
Irrigation infrastructure and water expertise:	Improving water use efficiency and productivity is crucial for sustaining and expanding agricultural production in Senegal. Dutch companies have state of art knowledge and expertise to increase water productivity. *Hydrosat* | *Netafim* | *Holland Greentech* | *Royal Eijkelkamp* | *Acacia Water*
Soil quality and salinity:	Soil management is the foundation of the agricultural operation. Dutch companies that provide services and technologies that promote soil health and soil management.

	Royal Eijkelkamp | *Terranauta* | *The Salt Doctors* | *Eurifins* | *Tauw* | *CLM Advies*
Pest management:	To achieve sustainable crop protection, an integrated approach to innovative, sustainable pest management (IPM) is essential. *Koppert* | *Ecovéa* | *Syngenta Crop Protection*
Seed providers:	Seed selection is a critical area where Dutch expertise can enhance the agricultural practices of Senegalese cooperatives. Not only by selling seeds from The Netherlands or elsewhere, but also through investing in domestic seed production facilities in Senegal. *Rijk Zwaan* | *ENZA Zaden* | *Bejo Seeds* | *East West Seeds* | *HZPC* | *Agrico* | *Q-Potato*
Post-harvest storage	Addressing post-harvest losses in Senegal is a significant challeng but key to achieve food security and food sovereignty. Storage is a key solution, and so are processing solutions. *Hanse Agrostore* | *Go&Grow Solutions* | *Tolsma-Grisnich* | *Sormac* | *GEGE Machinebouw*
Training, crop advice and farm management	Technologies and infrastructure are essential for developing profitable agricultural production. However, to fully capitalize on the potential of these advancements, practical and tailored implementation support, as well as on-site independent advice and training, is necessary. *Delphy BV* | *InnovaFruit* | *Groen Agro Control* | *Nater Consulting* | *Meys Emerging Market Research* | *RHS* | *Agriterra*

7 Road towards implementation

7.1 Introduction

In this chapter we provide an action plan for the preparatory phase leading up to the implementation of the outcomes of this study. We do so by identifying key roles and partners who fulfil these roles (paragraph 7.2), a timeline for implementation (7.3) and additional recommendations to consider when moving to the implementation stage (7.4).

Based on the interactions with multiple stakeholders we propose an approach in which first the cooperative structure is established, second the agricultural operation is implemented, and third the cooperative engages in her services towards the community and smallholder farmers in the commune of Diender and beyond. Farmers will be more inclined to engage in paid membership of a cooperative if they observe a well-run and productive agricultural operation that secures (financial) independence. Farmers indicate that the added value of current cooperative structures is very limited, except from serving as a distribution hub for (subsidized) inputs. The new model we propose ensures that there is a business mindset and approach from the start enabling the cooperative to promote an entrepreneurial mindset to (future) members.

7.2 Key roles and partners

Many different stakeholders have been identified and approached, based on which Deloitte and Delphy recommend the approach as presented in the respective reports. In this section we zoom in on the different stakeholders and partners that in our view are key to the successful preparation of the implementation of the pilot. We distinguish four main role types: 1) implementers, 2) facilitators, 3) funders, 4) partners. The main local, national and international stakeholders can all be categorized according to these four role types.

7.2.1 Implementers during preparation

The following parties are identified as main actors in the preparatory phase as well as the implementation phase.

Government of Senegal – MASAE: Throughout the study, it became evident that there are conflicting interests and ideas regarding whether to start with a current cooperative organization or to develop a new cooperative. From the perspective of efficiency and timeline, starting a new cooperative is recommended. This position aligns with the stance of the Senegalese government, which has advocated for this approach due to the underperformance and dependency of many existing cooperative structures.

Alternatively, starting within the context of an existing agricultural cooperative also has benefits, provided that it receives extensive guidance and capacity building to govern the agricultural operation as described in this report. The (new) cooperative that will manage the implementation of the agricultural operation will have to develop along the lines of what is presented in the Deloitte report. In case of the scenario in which a new cooperative is started, the following steps will need to be taken under the direction of the Ministry of Agriculture:

Step	Activity
1	Establish a preparatory project group (MASAE, commune of Diender, experts, farmers) tasked with developing a (legal) design of a cooperative as described in the Deloitte report and decide on staffing of the key positions in the cooperative and agricultural operation, considering outcomes, technical approach and recommendations in this current report.
2	Connect with existing cooperative structures active in the Diender commune to ensure due process, raise awareness and secure support from key local stakeholders and identify areas of collaboration.
3	Secure support for organisational, physical and financial infrastructure of the cooperative, including securing the funds needed for both the preparatory and implementation phase.
4	Establish / confirm legal structure and entity of (new) cooperative organisation that will be charged with implementing and overseeing the agricultural operation.
5	Handover of executive responsibilities to new board and management of the cooperative, mandating them to implement the CAC pilot project
6	Train cooperative staff and executives on general management topics as well as how to supervise the autonomous agricultural operation.
7	Monitor and facilitate the implementation of cooperative activities, including the agricultural operation.

In case the starting point is an existing cooperative the following steps are needed, also guided by the Ministry of Agriculture:

Step	Activity
1	Establish a preparatory project group (MASAE, commune of Diender, local farmers, experts, key representatives of existing organisations) tasked with identifying potential existing agricultural cooperatives that could be charged with implementing the CAC pilot and plan the required field work to raise awareness and support.

2	Identify criteria for requirements an existing cooperative structure should (be able to) meet, taking into account the recommendations in both reports of Delphy and Deloitte.
3	Develop and secure support for organisational, physical and financial infrastructure of the cooperative, including securing the funds needed for both the preparatory and implementation phase.
4	In close coordination with local authorise of Diender and farmer's organisations, set up stakeholder engagement process in which existing cooperative structures are represented.
5	Choose which existing cooperative structure that will oversee the implementation of the agricultural operation.
6	Mandating the cooperative to implement the CAC pilot
7	Develop an action plan to strengthen the existing organization (training and capacity building) to such a degree that it is able to better manage the existing activities, as well as overseeing the new agricultural operation.
8	Monitor and facilitate implementation phase and support cooperative

Community of Diender: A vital implementing partner is the commune of Diender, represented by the legal authorities. The will need to be part of the decision making an planning process from the beginning as they will be a key party during the implementation phase. The project site will need to be secured and obstacles in land ownership be removed to ensure a sound and reliable legal context, which is critical to generate a favourable business and investment climate. Also in the area of engagement of local smallholder farmers, the role of the commune of Diender is critical.

External advisor(s): External advisors with experience and knowledge of implementing a successful agricultural operation are key to a successful implementation. While the government is instrumental in this stage of development of the pilot to initiate, validate and boost the road towards implementation of the pilot CAC, we recommend that guiding the implementation of the agricultural activities will be taken up by an external, independent professional entity or advisor(s) experienced with establishing and managing an agricultural operation. This will require an additional investment from the side of the Ministry of Agriculture.

7.2.3 Facilitators during preparation and implementation

Ministry of Agriculture of Senegal: Assume the role of key facilitator throughout the process of preparation, implementation and replication. Key activities include:

A	Organising stakeholder meetings, identifying (bureaucratic) obstacles and removing these
B	Making available existing resources, services and equipment (machinery, knowledge etc) that will support the implementation of the pilot, reducing costs along the way
C	Matchmaking between (international) donors and the CAC initiative to secure co-funding for the implementation of the pilot and potential replication in other zones
D	Provide legal and governmental back-up to local stakeholders, including authorities in Diender.

Government of The Netherlands: The CAC initiative is instrumental to the policies of The Netherlands as described in Annex 6. The government of The Netherlands is well positioned to facilitate the implementation of the CAC pilot project, including the establishment of the agricultural operation. We see the following roles for the government of The Netherlands:

A	Serve as liaison and parring partner for the Senegalese government, and especially the Senegal ministry of Agriculture as they develop their strategy on food security and food sovereignty Sénégal 2025, of which the CAC initiative is one instrument.
B	Matchmaking between national and international (institutional) donors, thus supporting securing co-funding the implementation phase
C	Actively support the implementation phase through current foreign policy objectives and (financial) instruments
D	Facilitating matchmaking between Dutch private sector partners and the Senegalese government

7.2.4 Funders of preparatory and implementation phase

This report presents potential donors with a concrete pathway and approach to establish a commercially viable agricultural operation that can sustain an agricultural cooperative and through this contribute to increased food production, climate resilience and providing key services to farmers. The agricultural operation requires an upfront capital investment of €2.65 million.

To secure financing for the operation, external funds must be attracted, as no existing or newly formed cooperative will have sufficient equity capital to finance the investments independently. The calculations summarized above indicate a return on investment over ten years, with a loan payback period of 60 months. The choice of financing partners cannot be finalized at this stage of the project (study). To make informed decisions, the results of the studies conducted by Delphy and Deloitte will need to be shared and discussed with key national, regional, and local governments. These stakeholders will play a crucial role in determining the choice of location and deciding whether to initiate the pilot agricultural operation with an existing cooperative or a new model cooperative. Nevertheless we can name a number of potential funding sources that need to be actively approached and presented with the results of the study. Sources of funding include:

International institutional donors – especially for this stage of the project (pilot). *Examples: Governmental funds form aid, development and trade funds*
Financial organisation and institutions that provide loans with the aim to support start-ups, social enterprises and businesses for development, such as the one proposed in this report. Example *Rabo Foundation, African Development, European Bank for Reconstruction and Development (EBRD) etc*
Agricultural Banks with strong local networks and knowledge. These banks can benefit from funding / investing in the pilot project as a key role / service of the cooperative is to support the business of smallholder farmers in the community through training, increasing productivity and therefore spending power of smallholder farmers. *Examples: La Banque Agricole, Compagnie Financière Africane, etc*
National government funds from Senegal. It is imperative that the Senegalese government seeks opportunities to source co-funding for the implementation of the pilot CAC from current and future budgets for rural development and increased food security.
Private sector partners. Like mentioned earlier in this paragraph, the private sector at this stage will be reluctant to make upfront investments. However, when a stable business climate is created, private sector partners will be more likely to consider investing.

7.2.2 Project partners during implementation

Private sector - suppliers

The private sector from both Senegal and The Netherlands has shown keen interest in playing an active role as partner in the implementation stage. As mentioned in Chapter six, so far they see their role mainly as suppliers of inputs, machinery, technology and services. For most companies, investing actively in the agricultural operation is not an option in this stage. However, when the right legal and organisation context is established, the initiators of the CAC will be in a better information position to present the business case to private sector partners, inviting them to participate in the agricultural operation through capital investment and / or provision of key infrastructure for example with agreements on a share in the profit of the agribusiness activities.

7.3 Timeline towards implementation

Given the extend of the preparations needed, the start of implementation is aimed for the end of 2025. Considering the action steps outlined in the previous paragraph, the roadmap leading is summarized in Figure 22 below.

		2024	2025										
		Q3	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Study phase														
1	Field work													
2	Stakeholder engagement													
3	Reports													
Preparation phase														
1	Presentation of studies and results to the Senegalese government													
2	Key stakeholder meetings - key decision making, support and awareness raising													
3	Secure funding for the preparatory phase													
4	Set up a preparatory project group including representatives from MASAE, Diender commune, farmers and possibly external consultants													
5	Define the final structure of the organisation and the cooperative, and set up a legal structure, staffing													
6	Securing funding for implementation (financial, physical, organisational)													
7	Preparing final planning, staffing procurement													
8	Training cooperative and farm staff													

Figure 22. Timeline of preparatory phase

The preparatory activities will require additional funding (activity 3), and this is not included in the funding requirements presented in Chapter 5, as these are concerned with the investments needed for the agricultural operation only.

Figure 23 presents a visual timeline of the preparatory activities leading up to the start of the implement

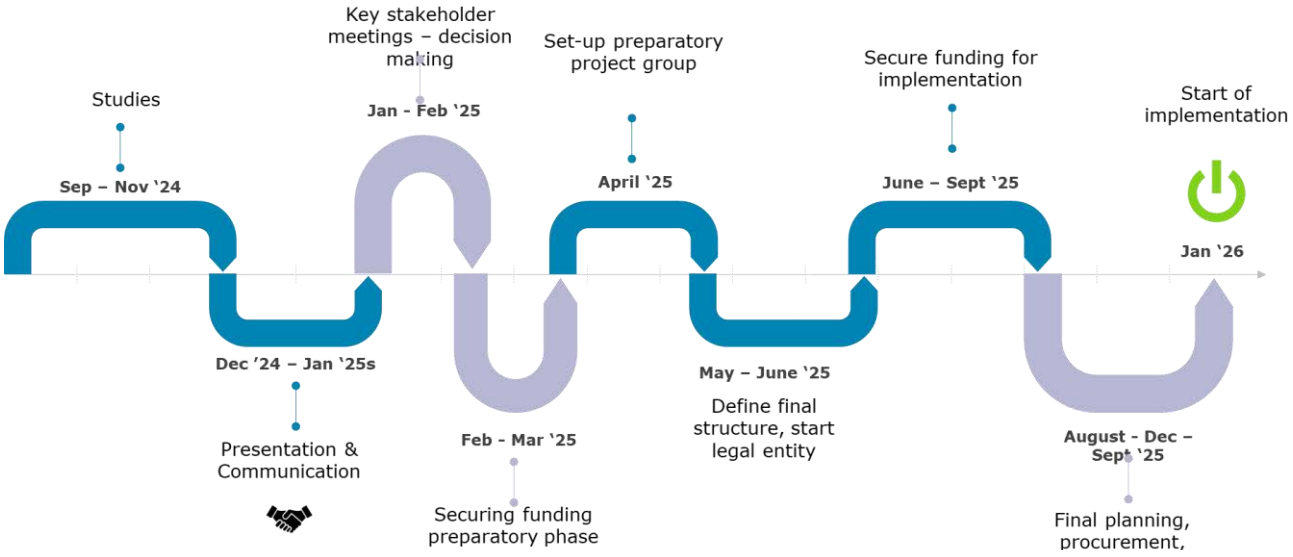


Figure 23. Roadmap for implementation of the agricultural operation

7.4 Recommendations

This study presents the results of data collection, interviews and field work. However, during the execution of the study it became clear that a critical part of the time had to be spend on stakeholder management, awareness raising and raising support of a potential implementation. Based on technical activities as well as the numerous engagements with many stakeholders the following recommendations are made.

1) Cooperative development

While this report focuses on the agricultural operation, it is equally important to discuss and finalize the appropriate cooperative organizational model that will govern the agricultural operation. Like mentioned earlier, this could involve either establishing a new cooperative or supporting an existing cooperative structure through training to fulfil the required roles outlined in this report. Regardless of the chosen option, national and local authorities should make the final decision, and a proper legal framework must be established, along with all necessary due diligence steps to ensure compliance with national regulations.

2) Embedding agricultural cooperative operation in community

The success of the proposed agricultural operation heavily relies on its support and added value to the communities and authorities of Diender. The added value has been described in paragraph 4.5 (roles of the cooperative). For the cooperative to effectively fulfil its roles, farmers and other community members must be actively involved in implementing the agricultural operation. This requires a participatory process in which the results of the study and plans for the agricultural operation are presented and discussed with community members. Engaging farmers in the detailed planning of the operation and activities from the beginning will help foster a sense of ownership. These discussions will also provide an opportunity to make adjustments to the plans and activities if necessary.

3) Staffing and training

It is recommended to recruit both temporary and permanent staff from the commune of Diender, with the exception of the general manager, who should be hired from outside the commune to ensure impartiality. This distance will provide the necessary perspective for professional management of the operation, which will involve regular and sometimes difficult decision-making. Technical staff (both temporary and permanent) will undergo extensive training prior to implementation and will continue to receive training throughout the operation on the topics and issues previously mentioned.

4) Technical advisory committee

To provide guidance and support for the general manager and their team of foremen and workers, it is advisable to establish a technical advisory committee comprising individuals with strong backgrounds in commercial agriculture, local farmers, and representatives from agricultural research institutions such as ENSA or ISRA.

This committee will offer advice on technical and commercial aspects of the farm operation, as well as matters related to agricultural staff. Additionally, the committee will serve as a bridge between the agricultural cooperative operation and similar initiatives planned in other regions of the country.

5) Project consortium

This report presents a concrete plan for the agricultural operation; however, it is imperative that further detailing and elaboration of the technical and financial plan occurs before implementation. The national government, in conjunction with local authorities, should decide on the precise location and boundaries of the pilot project site, taking into consideration sensitivities regarding land ownership and cooperative ownership. As independent service providers, Delphy and Deloitte are available to support this project group based on insights and expertise from their respective reports, as well as to assist in the sensitive process of stakeholder management that began during the study.

6) Involvement of government agencies

The Senegalese government and its various institutions will play a crucial role during the implementation of the agricultural operation. While the operation and cooperative will be established using a participatory, bottom-up approach, the government must take a strong role in creating a favourable enabling environment, including developing a regulatory framework suitable for establishing the cooperative and the subsequent agricultural operation.

Government agencies can also provide essential services and technical assistance, offering their expertise and equipment for tasks such as well drilling and land levelling. Currently, these costs are factored into the financial calculations; if the government provides these services, the business case for the operation will become more attractive.

7) Revalidation of numbers

The prices, costs, and income projected in the financial calculations should be revalidated during the preparation for implementation to ensure maximum financial reliability and to account for any changes, such as inflation.

8) Communication

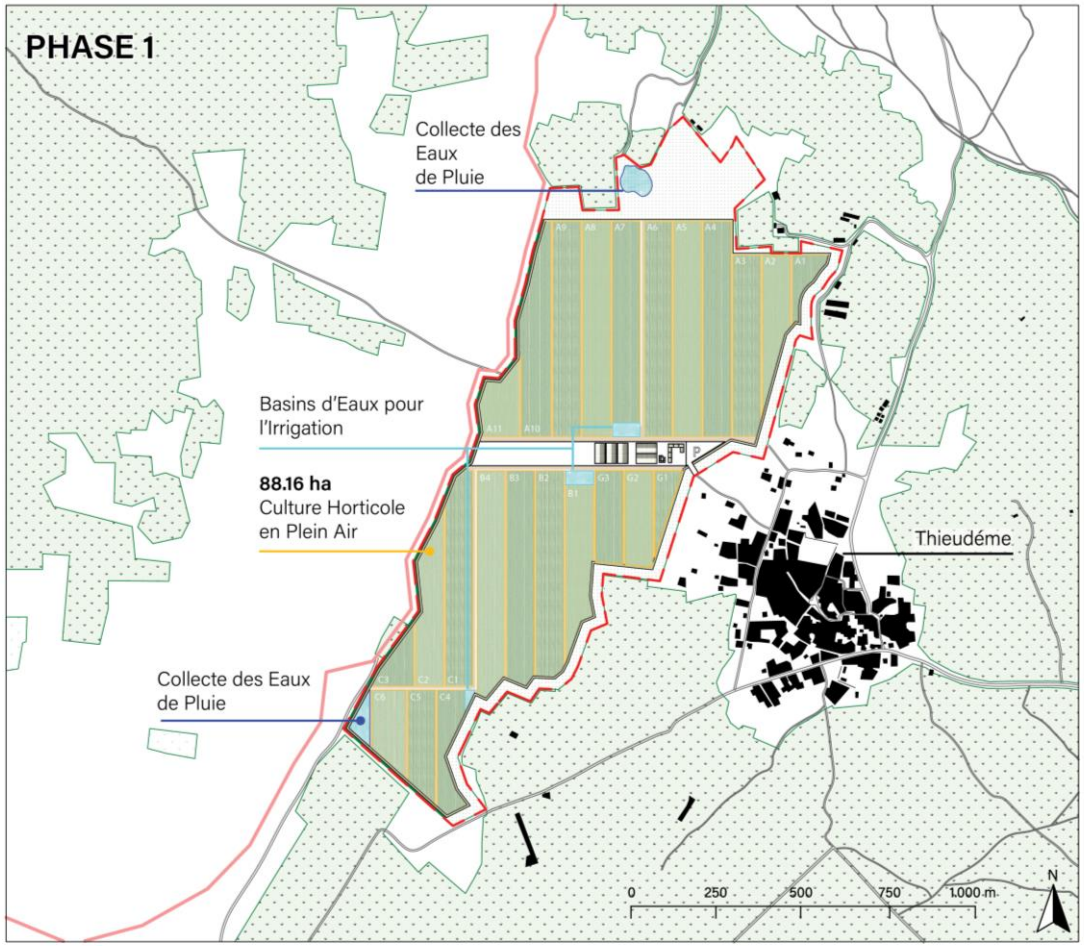
It is highly recommended to exercise caution in communicating the outcomes of this study as well as the study conducted by Deloitte. Throughout the execution of the study and numerous engagements with stakeholders, significant time was spent explaining the background and nature of the government's CAC initiative.

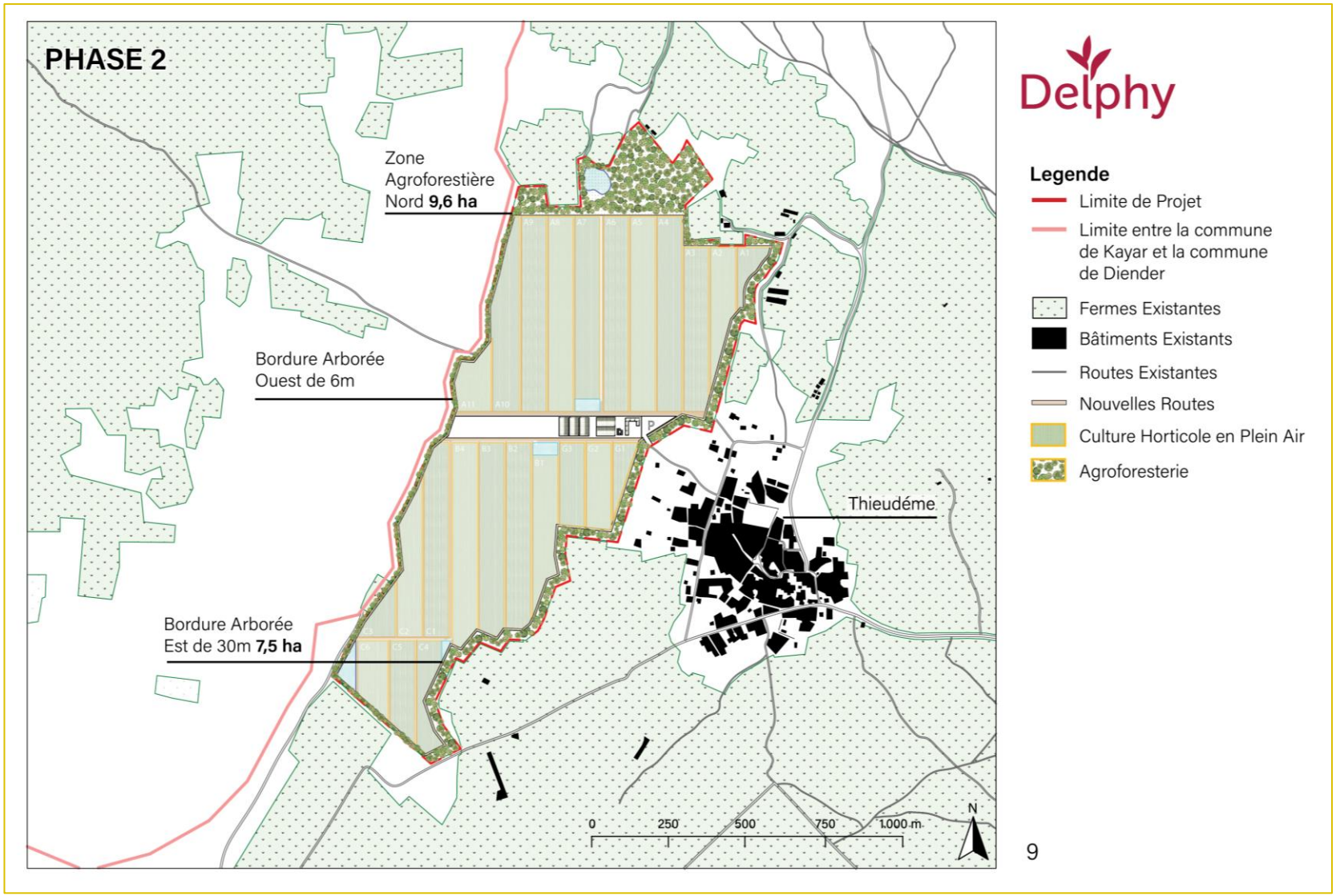
As a result, awareness and support for the initiative have increased; however, this progress must be safeguarded and further developed. To achieve this, communication should refrain from making public statements regarding locations, maps, numerical data, and the selection of partners (including the naming of a new or existing cooperative) without first involving and informing key national and local stakeholders and authorities (such as MASAE and the Commune of Diender). Failing to adequately inform key stakeholders can lead to misunderstandings or obstructions, potentially jeopardizing the proposal for the agricultural operation. The outcomes of this report should be communicated to the appropriate individuals in the correct sequence, accompanied by disclaimers regarding specifics such as the exact location and boundaries of the proposed agricultural operation.

Annex I - Provisional phasing of implementation

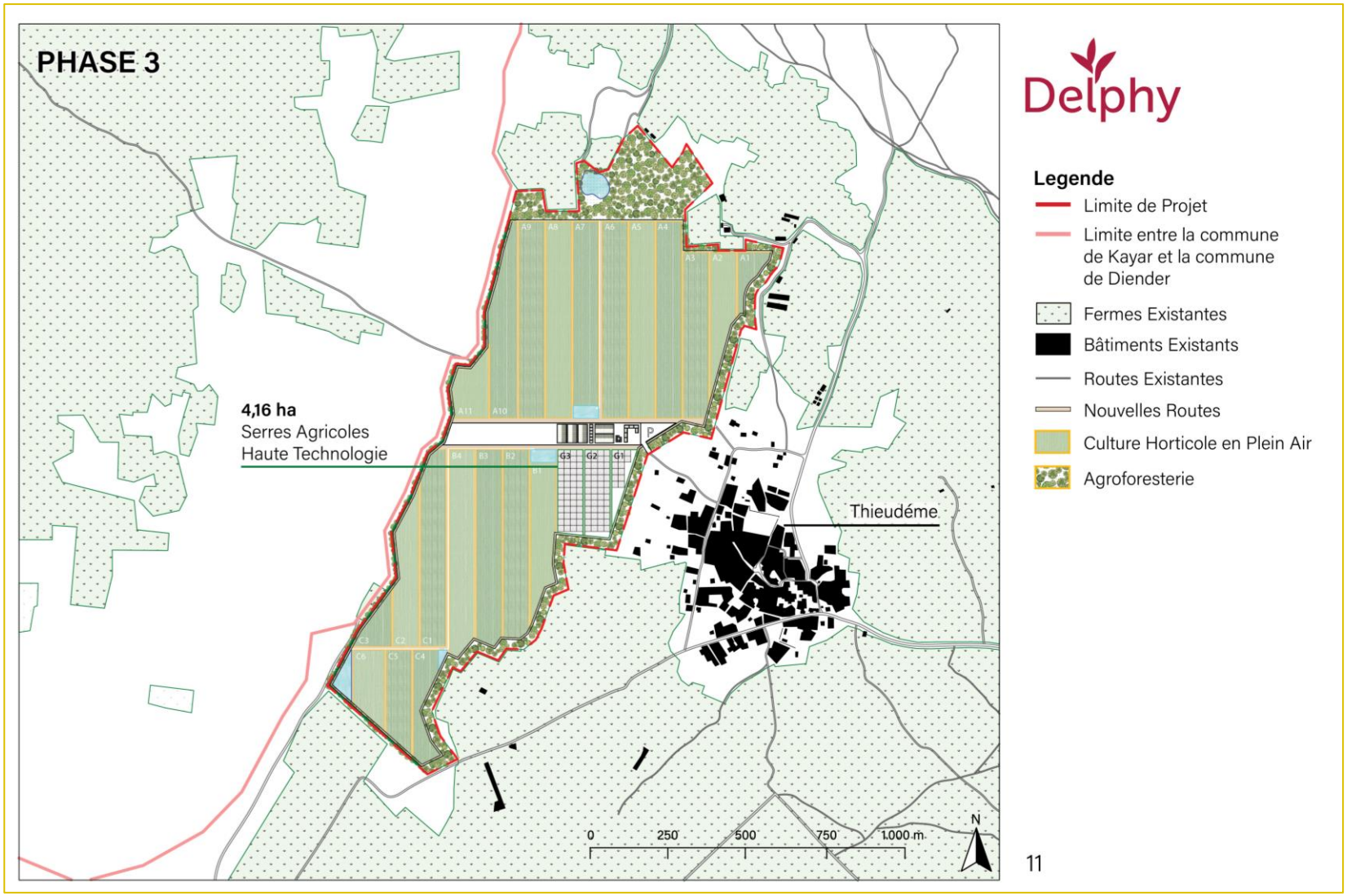
		2026				2027				2028				2029				2030
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Phase 1 - Preparation & Procurement																		
1.A	Procurement of equipment, labour, inputs																	
1.B	Land preparation and levelling																	
1.C	Construction of main administration building																	
1.D	Construction of main warehouse																	
1.E	Installing solar power as per requirements																	
1.F	Drilling of wells, construction of water basin, laying of primary and secondary water pipes																	
1.G	Mapping and establishing cultivation blocks, plot trails																	
Phase 2 - Agroforestry																		
2.A	Training and skill development																	
2.B	Planting trees and shrubs for fruits and wood																	
Phase 3 – open field cultivation																		
3.A	Training and skill development of permanent staff																	
	Construction of storage units																	
3.B	Preparing and sowing / planting of 30 ha																	
3.C	Preparing and sowing / planting of 30 ha																	
3.D	Preparing and sowing / planting of 25 ha																	
3.E	Full operational open field cultivation (85 ha)																	
Phase 4 - Greenhouse cultivation																		
4.A	Training and skill development of staff																	
4.B	Construction 4 multispan greenhouses																	
4.C	Construction of 5 bamboo greenhouses																	
4.D	Training and skill development of staff																	
4.E	Starting up cultivation in greenhouses																	
Phase 5 - Poultry production																		
5.A	Training and skill development of staff																	
5.B	Construction of poultry production unit																	
5.C	Construction of poultry processing units																	
5.D	Setting up of poultry production																	

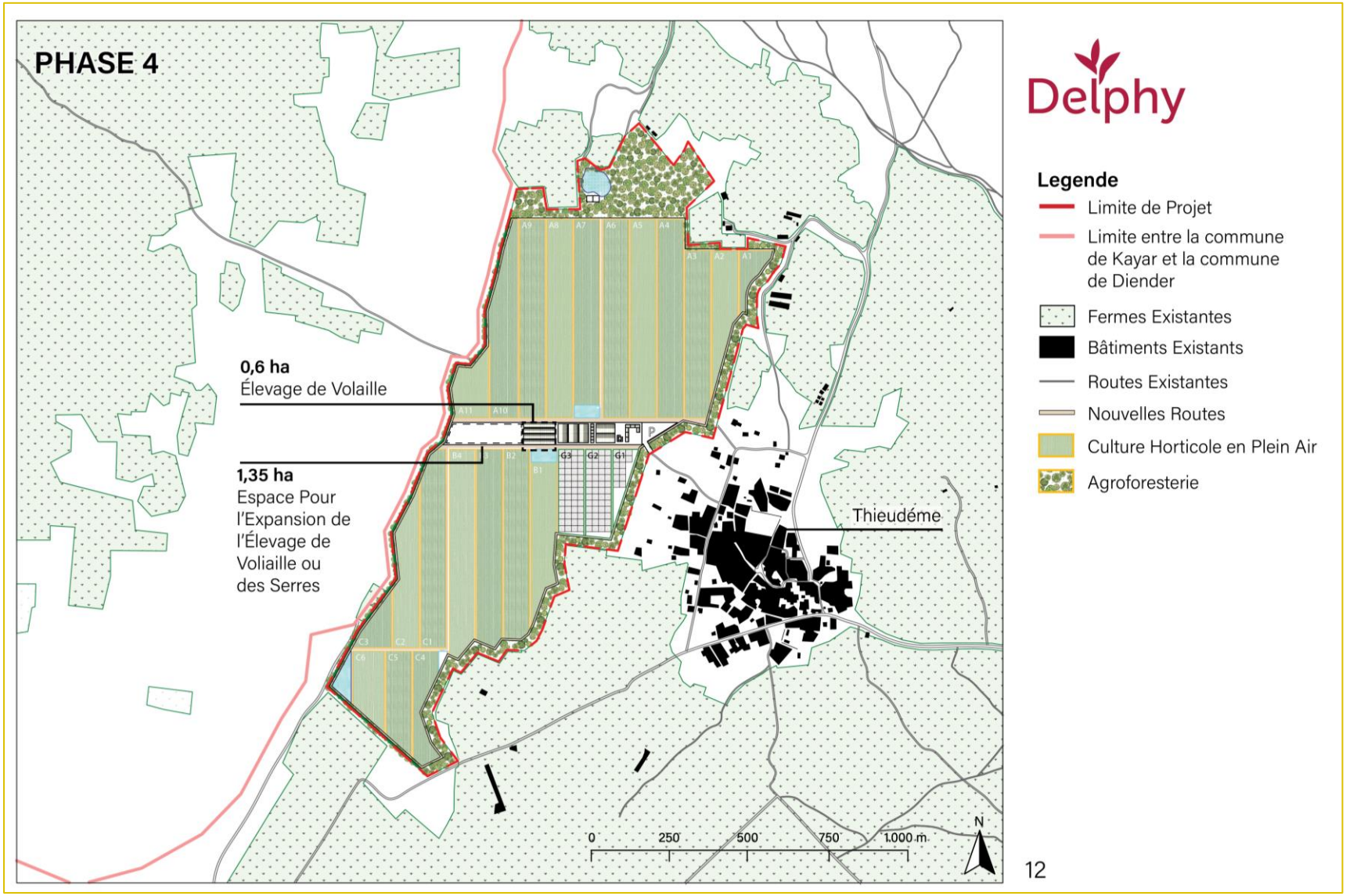
Annex II - Maps of the different phases of implementation



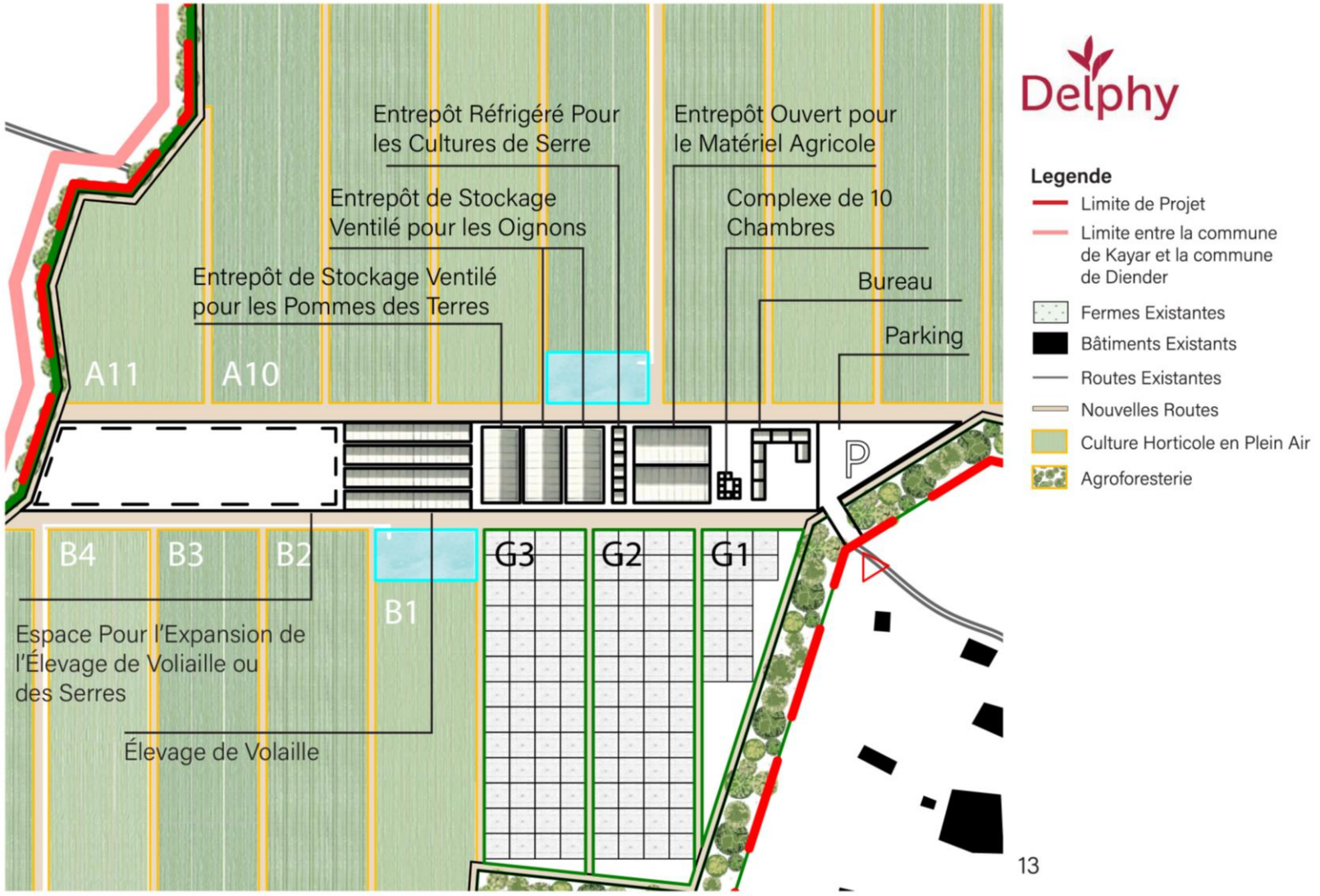

PHASE 2
Zone
Agroforestière
Nord 9,6 ha
Bordure Arborée
Ouest de 6m
Bordure Arborée
Est de 30m 7,5 ha
Thieudéme
0
250
500
750
1.000 m
N
Delphy
Legende
Limite de Projet
Limite entre la commune de Kayar et la commune de Diender
Fermes Existantes
Bâtiments Existants
Routes Existantes
Nouvelles Routes
Culture Horticole en Plein Air
Agroforesterie

9


PHASE 3
4,16 ha
Serres Agricoles
Haute Technologie
Thieudéme
0
250
500
750
1.000 m
N
Delphy
Legende
Limite de Projet
Limite entre la commune de Kayar et la commune de Diender
Fermes Existantes
Bâtiments Existants
Routes Existantes
Nouvelles Routes
Culture Horticole en Plein Air
Agroforesterie
11


PHASE 4
0,6 ha
Élevage de Volaille
1,35 ha
Espace Pour
l'Expansion de
l'Élevage de
Voliaille ou
des Serres
Thieudéme
0
250
500
750
1.000 m
N
Delphy
Legende
Limite de Projet
Limite entre la commune de Kayar et la commune de Diender
Fermes Existantes
Bâtiments Existants
Routes Existantes
Nouvelles Routes
Culture Horticole en Plein Air
Agroforesterie

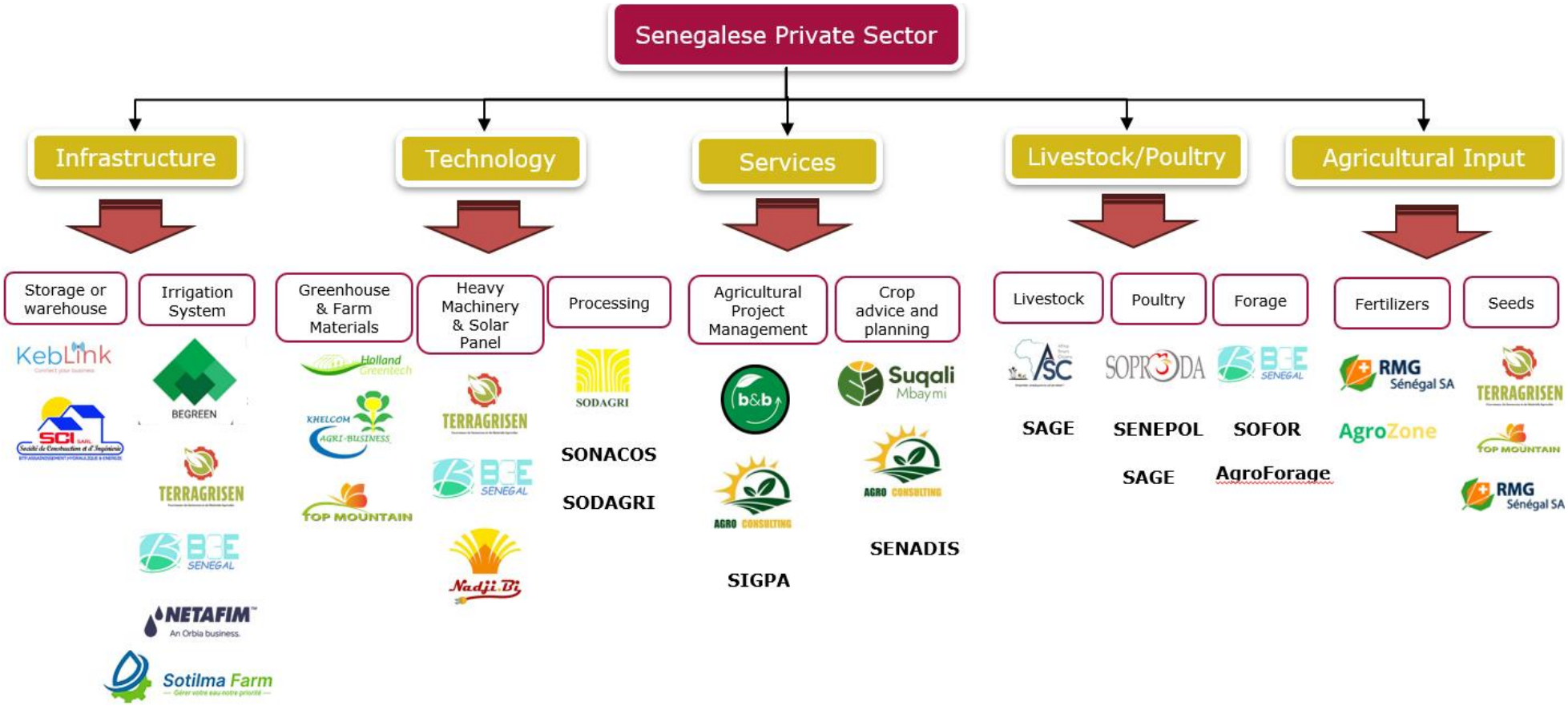
12


Entrepôt Réfrigéré Pour les Cultures de Serre
Entrepôt Ouvert pour le Matériel Agricole
Entrepôt de Stockage Ventilé pour les Oignons
Complexe de 10 Chambres
Entrepôt de Stockage Ventilé pour les Pommes des Terres
Bureau
Parking
A11
A10
P
B4
B3
B2
B1
G3
G2
G1
Espace Pour l'Expansion de l'Élevage de Voliaille ou des Serres
Élevage de Volaille
13
Delphy
Legende
Limite de Projet
Limite entre la commune de Kayar et la commune de Diender
Fermes Existantes
Bâtiments Existants
Routes Existantes
Nouvelles Routes
Culture Horticole en Plein Air
Agroforesterie

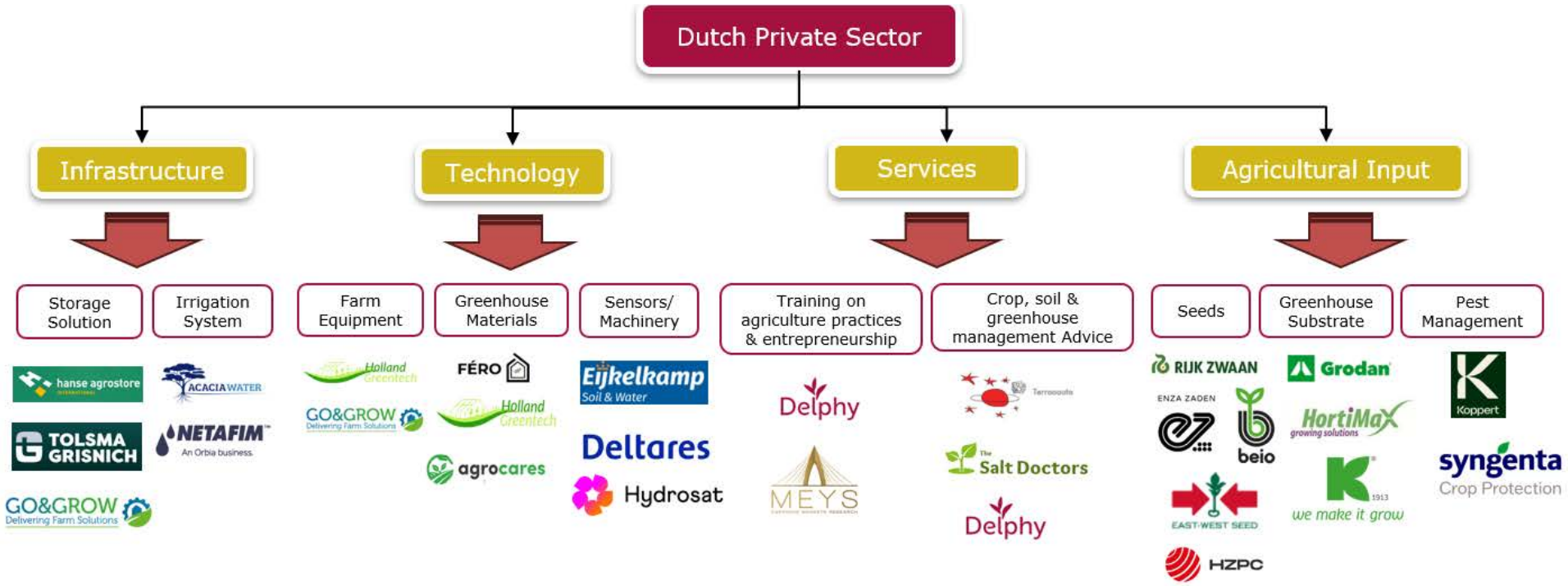
Annex III - List of Dutch private sectors interviewed

Company	Description
Hans Agrostore	Provides storage facilities for produce, with options for cooling. Their service helps farmers manage market dynamics by allowing them to store produce longer.
Acacia Water	Specializes in water resource management, including sustainable agriculture, water efficiency, and contamination remediation.
Rijk Zwaan	Provides seed delivery with training and knowledge transfer services. Their focus is on sustainable farming and market access through partnerships. They collaborate with local distributors and organizations
Enza Zaden	Offers seed breeding for vegetables particularly adapted to specific climates and training for good farming practices. They also provide technical support and collaborate with local distributors.
The Salt Doctor	Designs solutions for soil and water management, particularly in areas affected by salinity. They offer services for open-field hydroponics, salinity assessment, and consulting on sustainable farming practices.
Koppert	Crop protection and plant health, focusing on biological control and integrated pest management (IPM)
Tolsma Grisnich	provides storage solutions for agriculture, primarily focusing on potatoes and onions. Their products include ventilation and cooling systems, temperature and humidity probes, and handling systems
Eijkelkamp	specializes in providing advanced soil and groundwater monitoring equipment, which includes electrical devices for soil analysis and sampling tools.
Terranauta	focusses mainly on soil improvement, landscape design and reforestation.
Grodan	specializes in sustainable, inert, and sterile rockwool substrate, designed for soilless cultivation in greenhouse horticulture.
Féro BV	Specializes in modular, bamboo-based greenhouses. Its approach combines with reforestation around the greenhouse and utilized recyclable materials.
Holland Greentech	Supplies greenhouse kits and components like insect-proof netting, shade nets, and plastic covers. Also supplies farm equipment such as driplines, fittings and other irrigation components
MEYS	Doing market research in several African countries, including Senegal by doing interviews and questionnaire to identify value chain in the agricultural market.

Annex IV - Potential Senegalese private sector partners during implementation



Annex V – Potential Dutch private sector partners during implementation



Annex VI - Monitoring & Evaluation CATK

This study presented in this report has been commissioned by The Netherlands Enterprise Agency, and part of a larger program 'Combitrack HortiCote'. In order to evaluate the impact and progress of this program a number of indicators and learning questions have been defined. A reflection on some of those indicators and learning questions is presented below.

Indicators

Indicator 3b: Number of companies with a supported plan to invest, trade or provide services

In this report a 26 companies have been identified that could play a role in the implementation of the pilot Coopérative Agricole Communale. Many of these companies are − in varying degrees − already active in Senegal. They view the strategy of the government of Senegal to increase food production and therefore food security and food sovereignty, as an opportunity to grow their sales of services, products and technologies alongside suitable Senegalese private sector partners. For these reason, 13 companies have indicated their strong interest to play a role in the establishment of the agricultural operation, as it will showcase their products and services in the growing Senegal agricultural sector.

Once the Senegal national and local authorities decide on the exact location and cooperative structure of which the agricultural operation is an integral part, Dutch companies will be able to provide a specific plan and offer to provide services, products and technologies. It is realistic to expect that 10-15 Dutch companies will play an active role in implementing the agricultural operation.

Indicator 3e: number of direct beneficiaries supported to have raised incomes

The report indicates that the agricultural operation will provide new employment to 32 permanent and (yearly) 175 temporary people form the commune of Diender. Once the agricultural operation is fully implemented it will provide a stable financial basis for the cooperative, who in turn will be able to provide small loans, training, buy-up produce, and sell inputs at competitive prices to local smallholder farmers in the commune of Diender. It is estimated that these are four strategies will contribute to raising incomes of 500 smallholder farmers from six to 7 years in the implementation of the agricultural operation. In addition the agricultural operation will grow employment across the horticultural value chain. The effect on employment will multiply significantly once the model of a profitable agricultural operation as part of a cooperative structure is replicated in other parts of the country.

Learning questions

To what extent and how does the project lead to more presence of Dutch business in Senegal?

See text under Indicator 3b.

To what extent and how does the project boost climate smart horticulture in the Niayes region?

The project is contributing directly to de development of a more productive, sustainable and climate resilient horticulture in the Niayes region. The report presents an integral approach that considers a number of key measures that only when implemented simultaneously will sort a positive effect on feeding and greening Senegal. These include: agroforestry, water saving technologies, reduction of harvest losses, improved agricultural practices (e.g. reduced usage of chemical fertilizers and crop protection products), reduced tillage to improve soil life, promote circularity of nutrients and harvest rain water. Implementation of individual measures can sort some effect, but when implemented together, the combination of measures will have a catalysing effect and the result will be more than the sum of its part.

Once in full operation, the project site will be greener, more productive, hold more water, and will have a larger variety of plants and insects as compared to the adjacent lands. The combination of a 1) productive and profitable agricultural operation and 2) a greener, healthier and more attractive space will serve as an inspiring example to neighbouring small-holder farmers to adopt measures on their own farm and attract public and private investors keen to replicate the model in other parts of the Niayes and Senegal, boosting a horticultural production that is resilient to climate change induced challenges.

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Netherlands Enterprise Agency
Prinses Beatrixlaan 2
PO Box 93144 | 2509 AC The Hague
T +31 (0) 88 042 42 42
Contact
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