Analysis of irrigation systems and water-efficient agricultural practices in the peanut-growing region: the cases of Ndiob and Niakhar (Fatick Department)

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Technical report

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Abstract

Conducted as part of the MFL (CGAIR) project, this study aims to assess agricultural practices that contribute to irrigation water savings in the municipalities of Ndiob and Niakhar. The analysis reveals that, in these areas, market gardening is heavily dependent on groundwater resources. The study thus identifies a duality in irrigation systems and agricultural practices. On the one hand, some producers use intensive systems, often resulting in enormous water losses. On the other hand, some adopt water-saving irrigation systems and practices, through localized irrigation such as drip irrigation, zaï and mulching. These allow for the rational use of irrigation water, while improving agricultural yields.

However, the dissemination and adoption of these best practices are generally hampered by a set of structural constraints such as economic barriers (cost of equipment, precarious incomes), lack of technical training and information, and unfavorable climatic conditions, which paradoxically encourage the overexploitation of water resources. As a result, the emergence of modern systems such as sprinklers, drip irrigation, and rotary sprinklers faces the same constraints. In this context, there is a clear need for a water transition based on socio-technical support, local capacity building, and support for innovation. However, these initiatives will need to be adapted to the local realities of market gardening in Ndiob and Niakhar. In addition, water pricing could be considered as a means of ensuring shared and sustainable management of water resources. A territorial approach in the form of a water use plan opens up interesting prospects.

1. Context

In agricultural systems, irrigation is an essential practice for promoting food security. It contributes to more than 40% of global food production, using less than 20% of cultivated land. This agricultural system guarantees access to water and crop quality in contexts of persistent climate vulnerability (Bouarfa et al., 2020) . In the African context, characterized by precarious socio-demographic and environmental dynamics, the sustainability and efficiency of irrigated agriculture, particularly for market gardening, must be approached from a multidimensional perspective. It must incorporate rational and integrated water resource management, sustainable practices, and inclusive governance of water resource development adapted to local contexts and realities (Jacquemot, 2023) . Irrigated agriculture is therefore an important lever for the transition to agroecological practices, making it possible to harmonize productivity requirements with environmental preservation, but also to address climate change and maintain biodiversity (Mabhaudhi et al., 2019) .

In all Sahel countries, water is seen as the key to rural development. It determines food security, ecosystem health, and economic and social stability in these regions. As such, it plays a major role in the multifunctionality of landscapes. However, this resource, shared by all, is now subject to increasing pressures linked to climate variability. The latter is altering water cycles, impacting the overexploitation of aquifers in certain irrigated areas due to demographic pressure and conflicts of use between domestic, agricultural, and industrial needs (Halimatou A. et al., 2016) . These prolonged difficulties further increase the risks of flooding and drought, causing constraints on agriculture, exacerbating tensions over water availability, and creating vulnerability among rural populations (Kadet, 2024) .

In the Groundnut Basin, the consequences of these tensions are already being felt: reduced flow rates, salinization, and competition between agricultural and domestic use. The municipalities of Ndiob and Niakhar (Fatick Department), where agriculture is the dominant economic activity, particularly market gardening, have been facing increasing water stress for several years. The two municipalities are crossed by the Sine dead valley, which provides a groundwater table that is easily accessible by wells. This situation, exacerbated by the effects of climate change, is affecting groundwater recharge and gradually limiting the availability of water resources for agriculture. In addition, certain practices adopted by farmers on their farms can increase this pressure on water resources. In this context, market gardening, due to its high water requirements, appears to be the most vulnerable production system, thus compromising the sustainability of local farms.

Faced with these social, economic, and environmental challenges, it is becoming necessary to implement more appropriate strategies. This involves promoting good agricultural and irrigation practices to ensure sustainable management of available water resources, implementing resilience strategies against climate challenges, and promoting diversification and sustainability in market gardening (Milhorance et al., 2024) . It is with this in mind that the present study, as part of the CGIAR's MutiFunctional Landscapes (MFL) project, aims to evaluate, identify, and characterize good irrigation practices in the municipalities of Ndiob and Niakhar. It also aims to assess the effects of these practices on the management and preservation of available water resources and to evaluate the impact of these practices on the sustainability of vegetable crops, taking into account the realities of the two study areas. With this in mind, our study is structured as follows: first, a literature review to better contextualize the subject; second, a proposed research methodology; and finally, the presentation of results and discussions.

2. Research analysis frameworks

In this study, irrigation practices are not viewed as simple, independent technical devices. Rather, they are considered as a set of socio-technical constructs, resulting from socio-historical and environmental trajectories, shaped by power relations, institutional frameworks, and local economic rationalities (Gadelle, 2005) . In order to analyze best practices contributing to irrigation water savings in market gardening in the municipalities of Ndiob and Niakhar, an interdisciplinary approach was adopted. This approach lies at the intersection of agroecology, natural resource economics, rural socio-anthropology, and the sociology of innovation. The methodological approach is thus based on three complementary theoretical frameworks.

Firstly, the socio-anthropological approach to rural practices, inspired by the work of Jean Pierre Olivier De Sardan, provides a relevant analytical framework for identifying and characterizing agricultural practices and irrigation systems, while highlighting the sociocultural and organizational logics that influence farmers' choices (De Sardan, 1996) .

Secondly, the socio-ecological approach has made it possible, on the one hand, to analyze the causal relationships between water consumption and agricultural yields (Bookchin, 2007) . On the other hand, it has made it possible to understand the relationships between agricultural practices, community water management, and socio-environmental, technical, and economic constraints (Ostrom, 1991) .

Thirdly, the study combined the sociological approach to the diffusion of innovations (Rogers, 1961) with that of the self-governance of common goods, theorized by Elinor Ostrom (1991). The latter considers the irrigation system as an integrated common good that *"includes the physical structure, users, organizations responsible for its management, and the rules that users and other stakeholders use to manage the system"*[1] **.** This theoretical framework allows us to analyze the mechanisms for disseminating irrigated farming techniques and the conditions that promote the effective adoption of water-saving practices on farms.

The synthesis of these different approaches has enabled an in-depth analysis of water-efficient irrigation practices, taking into account local realities, socio-economic dynamics, and ecological dimensions. It also identified innovations in irrigation implemented in the municipalities of Ndiob and Niakhar, guiding the adoption of good irrigation practices with a view to promoting sustainable water resource management and ensuring the sustainability of market gardening.

a. Methodological approaches and sampling plan

Given the chosen angle of analysis, this study is based exclusively on a qualitative and interpretative approach. With the aim of providing an in-depth understanding of the logic of actors and local contexts influencing the adoption of good water-saving irrigation practices, two data collection techniques were used: in-depth semi-structured interviews and direct field observations. Three statistical units were observed in the field of investigation: individuals, collectives, and women's promotion groups (WPGs).

Semi-structured interviews were conducted with 49 market gardeners from the two study areas. They were carried out using a flexible interview guide structured around key themes.

[1] Elinor Ostrom, *For self-managed and sustainable irrigation systems: shaping institutions*; translation and summary by Philippe Lavigne Delville, Gret, No. 67, 2009, p. 10.

Sampling was based on the official list of vegetable producers provided by the respective town halls of the two municipalities. A simple random draw was applied to this database to select the producers to be surveyed. The distribution of the sample by municipality is presented in the table below.

Ndiob areas	Niakhar areas
Bâko Dior	Sanghaie
Bâko Serere	Podome
Fintele	Sorokh
Mbenengor	Conème
Bakon Ndieme	Niakhar
Sérèle	Mboudaye
Mbaye-Tolé	Godagène
Ndiob-escale	Mbafaye
Mbélokh	Ndoss Diaraaf

The municipality of Ndiob, which is heavily involved in market gardening, is notable for its particularly high number of producers. This structural specificity explains, on the one hand, the difference in the number of producers surveyed between the two municipalities. This unbalanced sampling can also be explained by the gradual abandonment of market gardening by many farmers in the Niakhar dead valley in favor of arboriculture. This phenomenon is not simply a matter of withdrawal, but reflects a conversion strategy adopted by producers who are faced with major environmental constraints such as soil salinization and the degradation of water resources. Faced with this pressure, a large proportion of farmers in the Niakhar area are turning to shrub or fruit species, which are known to be more tolerant of salinity and drought. This explains the decline in the number of market gardeners and, consequently, the imbalance in the sampling between the two municipalities.

Direct observation was carried out on the basis of visits to the market gardens of the farmers surveyed. This immersion in the field made it possible to verify the condition of the equipment, the irrigation systems used, and the farming practices employed on the plots (drip irrigation, sprinklers, mulching, shade structures, etc.). It also provided an opportunity to document the practices reported by the respondents and to assess the agricultural landscape and the general condition of their farms.

b. Presentation of the study areas

Located in the Peanut Basin (central-western Senegal), the Fatick region is historically rooted in the ancient kingdoms of Sine and Saloum. With a population of approximately 933,000, it is characterized by a strong rural character, with more than 84% of its population living in rural areas. The region's economy is based mainly on agriculture, fishing, livestock farming, and tourism, which is developing in the Saloum Delta Biosphere Reserve. The Fatick region has surface and groundwater resources, although soil salinization is a real challenge. Among the territories in the region, the municipalities of Ndiob and Niakhar, located in the department of Fatick, are study areas that are particularly representative of the region's agricultural potential. They are heavily involved in agro-pastoral activities, with a significant proportion of the family workforce dedicated to agriculture (ANSD, 2023) .

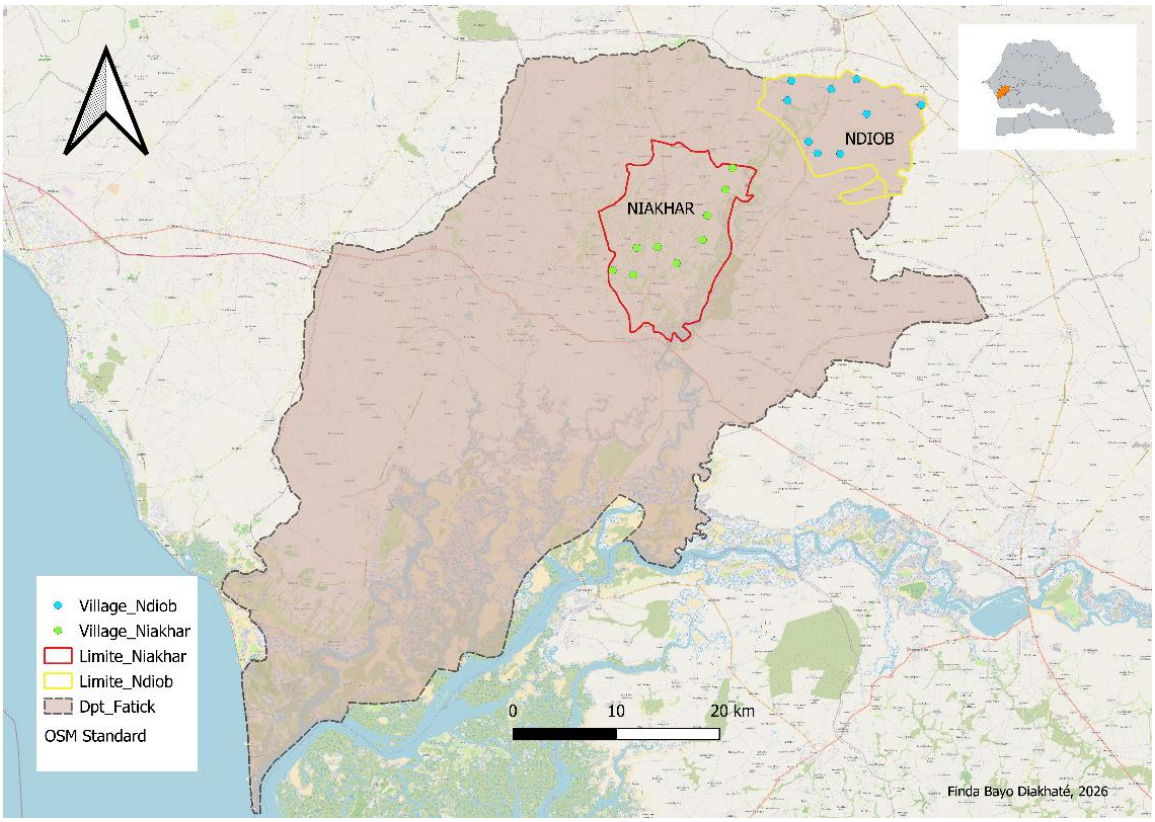
The selection of the Niakhar and Ndiob sites is based on scientific and operational criteria consistent with the approach of the MFL (Multifunctional Landscape) project, which emphasizes integrated analysis of the interactions between production systems, water resources, and territorial dynamics at the landscape scale.

Methodologically, these two sites present agroecological and hydrological conditions that are relevant for studying irrigation water-saving practices. They are characterized by the coexistence of rainfed and irrigated cropping

systems, making it possible to analyze the trade-offs made by producers in terms of water allocation, choice of irrigation systems, and management of irrigation frequencies according to the seasons and water availability. Niakhar and Ndiob also offer a variety of irrigation systems (surface irrigation, lance irrigation, laser spray irrigation, rotary irrigation, drip irrigation, small-scale irrigation practices, etc.), facilitating a comparison of water performance and associated practices. This diversity is an asset for identifying and evaluating technical and organizational levers, contributing to improved water efficiency at the plot and landscape levels.

From an operational standpoint, Niakhar and Ndiob benefit from a monitoring system and prior knowledge of agrarian systems, thanks in particular to previous work carried out with the support of ISRA and its partners. This foundation facilitates the implementation of mixed methodological tools combining producer surveys and field observations. Finally, the positioning of these sites makes it possible to produce comparable and transferable results, contributing to the construction of water economy and efficiency indicators that are compatible with the multifunctional approach of the MFL project and applicable to other similar agroecological contexts in Senegal.

Figure 1. *Map of the Fatick department showing the two intervention areas: Ndiob and Niakhar*



3. Results and discussions

We will analyze the characteristics of market gardening systems and emerging agroecological practices, followed by their impact on water use, to identify the multiple barriers to the adoption of water-efficient systems.

a. Diversified but structurally vulnerable market gardening systems

- **Characteristics of market gardening operations**

Analysis of the results shows that market gardening in the municipalities of Ndiob and Niakhar is mainly carried out by small farms. On average, the area devoted to market gardening is around 1 hectare. This configuration can be explained, on the one hand, by the environmental and socio-economic constraints that characterize Senegalese

agriculture in general and which have a decisive influence on the technical choices made by producers, particularly those in the valley.

On the other hand, irrigation methods used on farms play a key role in determining the amount of land used for market gardening. In this context, producers generally favor low-cost irrigation systems, which nevertheless have limited water performance. As illustrated by one respondent's testimony: *"I farm an area of about 1 hectare. My main crops are vegetables and cereals. I use a watering can as an irrigation system because I lack financial resources, the cost of irrigation equipment is high, and its availability is limited. I have never changed systems because I cannot afford to. I don't know exactly how much water I use, but I usually irrigate from 6 a.m. to 10 a.m. and from 5 p.m. to 7 p.m. I choose these times because I don't have enough water, so it's the only way I can irrigate my crops."*[2]

In addition, there is a high degree of diversification in vegetable crops in both municipalities. The most common species include tomatoes, cabbage, turnips, bitter eggplant (djakato), peppers, okra, chili peppers, lettuce, yams, and sorrel. This diversification is a strategy for managing risks related to climate hazards and market fluctuations. However, it complicates the technical and agronomic management of farms, as most crops require regular adjustments to irrigation systems and significant water inputs.

Image1 : salad planting

Image2 : tomato planting

Image3 : bitter eggplant planting

Source: photos taken by the authors (December 2025)

- **Irrigation dependent on groundwater and dominated by inefficient techniques**

The results show that vegetable farms are heavily dependent on groundwater resources. These resources are mainly drawn from traditional wells, natural open reservoirs (seyane), retention basins, and mini-boreholes equipped with solar-powered, gas-powered, electric, or motor-driven pumping devices.

The irrigation systems observed remain largely traditional, dominated by manual watering using hoses, perforated buckets, or watering cans. These techniques are appreciated for their flexibility and ease of use, requiring no advanced technical skills. However, manual irrigation using perforated buckets or watering cans has significant limitations in terms of water efficiency and is also perceived as a particularly arduous activity. One producer commented: *"Yes, I've already changed systems. Before, I used a watering can, but it was very hard work, requiring a lot of effort and manpower. With the lance system, it's more efficient and less tiring."*[3] .

The overexploitation of water resources can be explained in large part by the lack of measuring devices to control the volumes withdrawn, such as meters or flow meters, but also by the fact that irrigation water is free and pumping systems are easily accessible. In Ndiob, for example, observations reveal a predominance of particularly water-

[2] Text extracted from the interview on December 23, 2025, in Conème in the municipality of Niakhar
[3] Text taken from the interview on December 18, 2025, in Baccodior in the municipality of Ndiob

intensive systems. In many villages, the most widely used technique is irrigation by "lance," also known as a water cannon, fed by mini-boreholes. Although perceived by producers as more modern, faster, and less physically demanding, this technique is recognized as highly water-intensive. At the same time, a gradual adoption of more efficient irrigation techniques is being observed. These mainly involve drip irrigation and low-pressure sprinklers, generally installed with support from agricultural development projects such as those led by CARITAS, government initiatives, or NGOs. These techniques not only significantly reduce water loss through evaporation and excessive infiltration, but also optimize water availability for each crop. These systems improve both crop yields and resilience to drought. They also help reduce the labor required for traditional watering, which is a major advantage for farmers with limited human resources. In addition, rational water use promotes better management of local water resources, a crucial issue in the context of climate change and increased pressure on water reserves.

Imagery of water sources and irrigation systems observed in the two study areas

Source: photos taken by the authors (December 2025)

- **Emerging agroecological practices with measurable positive effects**

The results show a wide variety of water-saving practices in the municipalities of Ndiob and Niakhar. These include mulching, zaï, installing windbreaks, intercropping, adding organic amendments, and using shade structures. These practices play a decisive role in water resource management and soil quality improvement. They help maintain soil moisture, reduce water evaporation and soil drying, improve soil fertility, and enable rational water use at the plot level.

The adoption of these practices reflects a gradual adaptation by producers to water and environmental constraints. This trend is illustrated by the testimony of one farmer: *"I have been using mulching, windbreaks, and intercropping since I started vegetable farming. These practices contribute significantly to improving soil fertility and crop quality. For example, intercropping (tomatoes and turnips) allows two crops to be grown simultaneously with the same amount of work, thereby reducing labor intensity and increasing profitability"*[4] .

[4] Text taken from the interview on December 25, 2025, in Conème in the municipality of Niakhar

Pictured here are some water-efficient agricultural practices

Source: photos taken by the authors (December 2025)

b. Between overexploitation and optimization: contrasting irrigation systems

- **Contrasting systems between loss and efficiency**

The choice of irrigation systems is a major determinant of the amount of water used for irrigation. In the municipality of Ndiob, most vegetable farms use sprinkler irrigation, a method characterized by uncontrolled water use and excessive demand on groundwater resources. This method of irrigation causes significant water losses, which can reduce the accessibility and availability of the resource in certain areas, particularly during periods of water stress.

Lance irrigation, perceived by producers as less physically demanding, encourages uncontrolled water withdrawal. This overexploitation of shared resources also has negative effects on crops. The strong pressure exerted by the water jet tends to disrupt plant growth, weaken their root systems, and can cause significant losses in agricultural yields.

Conversely, modern irrigation systems such as lasers, drip irrigation, and sprinklers, although not widely adopted in the two study areas, offer significant potential for optimizing water consumption. These technologies, recognized for their ability to use less water, allow for localized and controlled water distribution, reduce losses through evaporation or runoff, and decrease pressure on groundwater. Their use thus contributes to strengthening the

sustainability of agricultural water resources and improving the resilience of production systems in the face of environmental constraints.

- **Water-saving practices that improve water efficiency and agronomic performance**

The adoption of water-saving practices contributes to a significant rationalization of water inputs in vegetable farms. This rationalization results in a reduction in the volumes of water applied to crops and a better match between the actual water needs of plants and the quantities of water actually used.

In other words, irrigation water is applied in a targeted manner, both spatially and temporally, which helps to limit losses. In this context of recurrent water stress, the main challenge lies not only in the quantity of water available, but also in the efficiency of its use within production systems.

Analysis of agricultural yields based on the practices adopted reveals that farms that have implemented a coherent set of water-saving practices such as mulching, zaï, crop rotation, or the use of soil amendments achieve higher yields than those relying on intensive approaches. This trend is illustrated by the testimony of one farmer: *"I have been using zaï, intercropping, manure, mulching, shade structures, and windbreaks since I started market gardening. These practices help me a lot because they allow me to reduce my expenses. For example, the manure comes from my own animals, which lowers my costs, saves me money, conserves water, and improves soil fertility. Although the work is hard and demanding, my yields have increased, and I now generate more income. Before, some parts of my plots were not producing well, but since adopting organic practices, soil fertility has improved. Mulching also helps to conserve soil moisture. Today, soil quality is better, moisture is maintained, and yields are stable."*[5] .

The agronomic performance associated with these practices on yields can be explained by several mechanisms. On the one hand, they reduce water stress thanks to more stable soil moisture and better water retention capacity. On the other hand, mulching contributes to soil temperature regulation and limits excessive temperature fluctuations, thus promoting a microclimate conducive to crop development. These techniques also help preserve soil nutrients by reducing the risk of leaching and depletion, while improving soil structure through organic inputs.

These conditions promote better plant development, more regular flowering, and good fruit set, while reducing the vulnerability of crops to leaf diseases. From this perspective, water conservation appears to be an essential lever for improving the productivity and resilience of market gardening systems, particularly in the Ndiob and Niakhar areas, which are highly exposed to the effects of climate change.

c. Multiple barriers to the adoption of water-saving systems: costs, skills, climate vulnerability, and farm diversity

- **Socio-economic constraints**

The adoption of water-efficient irrigation systems is mainly hampered by economic constraints. The high cost of the necessary equipment, combined with the irregularity of income from agricultural activities and the financial precariousness of most producers, severely limits their investment capacity.

This situation keeps producers in a vicious circle, whereby dependence on traditional practices, although recognized as ineffective in the long term, remains the only accessible option due to their low initial cost. This reality is illustrated by the testimony of one producer: *"The main difficulty is the lack of financial resources. Equipment is expensive and difficult to obtain, and we also lack labor. With all that, it's not easy to adopt cost-effective practices."*

[5] Text extracted from the interview on 21/12/2025 in Mbaye-Tolé in the municipality of Ndiob

Thus, the lack of financial resources and the difficulties in organizing producers around a common goal reduce the prospects for collective action.

- **Technical constraints**

The lack of practical training and appropriate technical support is a major obstacle to the adoption of water-saving practices. The lack of effective extension services, such as local relays and field schools, hinders the dissemination of knowledge essential to optimizing irrigation.

Many producers do not have the necessary knowledge to assess flow rates and plant water requirements or to plan irrigation frequencies and durations correctly, as evidenced by the following statement: *"No, I don't know exactly how much water I use or what the flow rate is, but I water for about 4 hours over an area of one hectare. I water mainly in the morning because it is more beneficial and the water table is better charged at that time. From 4 p.m. onwards, there is almost no pressure, so it is no longer easy to irrigate."*[6] .

This skills gap leads to a certain reluctance to adopt innovative technologies, which are perceived as risky due to uncertainty about how they work and the lack of technical and financial support to adapt these systems to local conditions. On this subject, one of the producers states: *"I am willing to adopt other economical techniques, but only if I am trained and shown how to use them. If it suits me and I see that it is beneficial, I will adopt them."*[7]

- **Environmental constraints**

Environmental constraints place paradoxical pressure on production systems. On the one hand, increased climate variability, characterized by recurrent droughts, heat waves, irregular rainfall, and a gradual decline in groundwater levels, is putting pressure on underground water resources.

On the other hand, these same factors encourage farmers to increase their irrigation frequency when water is available, for fear of production losses due to water stress. This reactive logic can lead to increased pressure on the resource, as one producer explains*: "The effects of climate change are clearly visible in market gardening. With the intense heat, we are forced to water our crops much more to protect them, otherwise they suffer too much*."

d. Building capacity and removing barriers for a sustainable water transition

- **Using training as a lever for the adoption of water-efficient irrigation systems**

The study's findings highlight the need to strengthen producers' technical and organizational capacities, which is a prerequisite for mastering and adopting water-efficient irrigation systems.

The implementation of practical training courses, backed up by field demonstrations on market gardens, would improve understanding of water management mechanisms and reduce the uncertainties associated with adopting new technologies. In this regard, school field programs and participatory approaches, which mobilize innovative producers as local relays, are relevant tools. Their widespread involvement would facilitate the dissemination of good water-saving practices in vegetable irrigation systems.

[6]Text extracted from the interview on 12/21/2025 in Mbaye-Tolé in the municipality of Ndiob
[7] Text extracted from the interview on December 19, 2025, in Baccodior in the municipality of Ndiob

- **Essential support for adopting innovation**

Coordinated institutional support is essential to promote the sustainable, large-scale adoption of water-saving systems. This support should take the form of providing water-saving irrigation equipment that is adapted to the local context and financially accessible, as well as ongoing agronomic monitoring.

In addition, the creation of appropriate financing mechanisms such as micro-loans, targeted subsidies, and guarantee funds facilitating access to credit are essential levers for supporting producers' investment in efficient technologies. These instruments would help reduce economic barriers and encourage the transition to rational and sustainable use of irrigation water.

Strengthening organizational support also appears to be strategic. Producer organizations (POs) have the capacity for collective action, enabling them to carry out water infrastructure projects, manage community access to resources, and mediate with public institutions and technical partners.

- **Water pricing: a lever for shared management**

Although irrigation water pricing remains a politically sensitive issue, it appears to be a potentially effective regulatory tool for promoting rational and collective water resource management. Several farmers see this mechanism as a means of improving local water governance, encouraging more controlled consumption. As one of them puts it: *"I think water pricing is a good idea because it will allow us to share the management of water resources and each farmer will control their water consumption."*

Introducing a cost associated with water use would limit waste, encourage more economical practices, and reinforce a sense of individual responsibility for preserving the resource. Transparent, progressive, and socially equitable pricing could thus become a key lever in promoting sustainable and shared water management.

In several market gardens visited, the installation of electric meters supplying mini-boreholes already illustrates a concrete step in the gradual implementation of this system, enabling more rigorous monitoring of water consumption and paving the way for more controlled management of withdrawals.

Electric meter installed on a vegetable farm in Bâko Dior

Source: photos taken by the authors (December 2025)

Conclusion

Ultimately, this assessment carried out in the municipalities of Ndiob and Niakhar highlights the potential performance and sustainability of market gardening, which is strongly influenced by the irrigation systems used and appropriate agricultural practices. However, the local agricultural landscape remains characterized by the predominance of traditional systems, which are often inefficient, and by increasing pressure on groundwater resources. This situation calls for an effective water transition, based on improved techniques and more rational water management.

From this perspective, water-saving practices are a strategic lever for optimizing the productivity of cropping systems and promoting sustainable groundwater management. However, their effectiveness and scalability require addressing the socio-economic determinants of farm vulnerability, including financial constraints and limitations in terms of training and management capacity among producers. Removing these barriers appears essential to strengthening adoption, innovation, and resilience in local agricultural systems.

The future of sustainable market gardening in the region will therefore depend on the convergence of socio-economic, technical, and institutional dynamics. It will be necessary to consolidate the lessons learned, strengthen support mechanisms, and promote forms of collective water resource management capable of transforming individual practices into truly resilient socio-technical systems. For decision-makers and institutions, this means integrating water-efficient irrigation into agricultural and water policies, supported by appropriate financial instruments and enhanced technical support, ensuring a sustainable and equitable transition for all producers.

Water-efficient practices contribute to the multifunctionality of landscapes because they improve productive efficiency, ecological functions, and social equity. However, their transformative potential depends on the existence of collective governance mechanisms capable, on the one hand, of aligning practices implemented at the plot level with water dynamics at the landscape level and, on the other hand, of establishing mechanisms for territorial regulation of water use.

This perspective opens up structural avenues for the future of the MFL project. The ongoing update of a local land use management agreement provides a strategic window of opportunity. Linking this to the development of a territorial plan—at the municipal level—dedicated to water management would make it possible to move beyond a strictly technical approach to irrigation and reposition water as a **territorial common good**, subject to shared rules, collective arbitration, and clear institutional accountability, linking them to broader land use regulations.

Such coordination would strengthen the coherence between agroecological transition, sustainable water resource management, and landscape governance, while providing an operational framework for incorporating water-saving practices into a long-term territorial trajectory.

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