Massire
Eau et innovation rurale
dans les territoires sud du Maghreb

MASSIRE PROJECT: STRENGTHENING NETWORKS FOR AGRICULTURAL AND RURAL INNOVATION IN OASES AND ARID ZONES OF THE MAGHREB

Approach, activities and results

CONTENTS

List of acronyms

- **CIRAD:** Agricultural Research Centre for International Development (France)
- **CREAD:** Research Institute in Applied Economics for Development (Algeria)
- **CU Tipaza:** University Centre of Tipaza (Algeria)
- **ENAM:** National School of Agriculture of Meknes (Morocco)
- **IAV Hassan II:** Agronomic and Veterinary Institute Hassan II (Morocco)
- **INAT:** National Agronomic Institute of Tunisia
- **INRAE:** National Research Institute for Agriculture, Food and the Environment (France)
- **INRGREF:** National Institute for Research in Rural Engineering, Water and Forestry (Tunisia)
- **INSFP:** National Institute for Vocational Training in Algeria
- **MSP:** Multi-stakeholder process

Photo 1. Biodiversity in an oasis of Kebili region

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EXECUTIVE SUMMARY

The Massire Project (2019–2024) was a research-for-development project implemented by a consortium of research and education institutions from Morocco, Algeria, Tunisia and France. It was funded by IFAD, with a financial contribution of project academic partners. The project aimed to strengthen agricultural and rural innovation systems in the oases and arid zones of Morocco, Algeria, and Tunisia. Addressing challenges such as resource vulnerability, biodiversity loss, and social inequalities, the project facilitated sustainable development pathways through innovative, participatory, and inclusive approaches.

Objectives and Approach

The project focused on:

1. Analysing Innovations:
Identifying and testing innovations to enhance territorial resilience.

2. Capacity-Building:
Empowering local actors, including youth and women, to engage in agricultural innovation systems.

3. Knowledge Dissemination:
Sharing research and findings with diverse stakeholders.

Core to the approach were Multistakeholder Processes (MSPs), fostering collaboration among farmers, entrepreneurs, researchers, and policymakers. Activities included participatory studies, workshops, capacity-building programs, and pilot projects.

Key Achievements

Innovation Testing:

Implementation and assessment of innovations like aquifer recharge, organic date farming, and treated wastewater reuse, enhancing water and soil management.

Capacity Development:

Over 100 workshops and training sessions benefited more than 1,100 local actors, including 301 women and 152 young people. Participants gained skills in sustainable farming practices, strategic planning and digital marketing.

Networking:

18 multistakeholder processes created new partnerships across sectors and countries, fostering knowledge exchange and collective action.

Knowledge products:

Development of guides, videos, and policy briefs in Arabic, French, and English to promote sustainable practices.

Impact and Sustainability

The project improved local livelihoods by:

Enhancing agricultural productivity and biodiversity through innovative techniques like composting and organic certification.

Facilitating discussions on water management and environmental sustainability, influencing local and national policies.

Supporting entrepreneurship among women and youth, increasing income and self-confidence.

The participatory methodology of Massire project can be scalable and replicable. It underscores the value of inclusive innovation for resilient agricultural development in fragile environments.

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OBJECTIVES, ORGANISATION AND APPROACH

Photo 2. Discussion during a collective in-field training period in Msemrir region

2.1 Project goal and main phases

The oases and arid zones of the Maghreb are undergoing significant changes that impact both society and the environment. These include increased mobility and heightened vulnerability of natural resources. The agricultural sector is particularly affected, as modern farming practices emerge alongside traditional methods. While these changes offer opportunities for economic and social progress, they also pose risks to sustainable development, such as unsustainable soil and water use, biodiversity loss, and growing social inequalities.

Innovations—often involving technical, economic, and organizational aspects—are being tested in these oases and arid zones or in similar contexts. Many of these innovations are locally conceived and tested but often remain under the radar. Under specific conditions, they can support more sustainable development paths and enhance community resilience in the face of global changes.

To leverage these innovations as drivers of sustainable development, key questions arise:

- What existing innovations, either local or from comparable areas, can be identified? What are their impacts, and how can they be implemented effectively?
- How can we strengthen collaboration among stakeholders to envision and apply these innovations?

The Massire Project (2019–2024) was designed **to enhance the capacity of stakeholders in the Maghreb's oases and arid zones to develop and implement innovations that promote sustainable development in these regions.**

Photo 3. Saffron plot in Ghardaïa

The Massire project had more specifically three objectives (Figure 1).

Objective 1:

Analyse, test, and discuss selected innovations in the project areas through a participatory, territorial, and multi-stakeholder approach, from participatory diagnosis to the development of scenarios.

Objective 2:

Enhance the capacity of local actors and young graduates to actively engage in agricultural and rural innovation systems.

Objective 3:

Disseminate knowledge co-created with partner actors about current agricultural and rural dynamics, as well as existing and potential innovations that could strengthen the resilience of communities in arid and oasis zones, to diverse audiences.

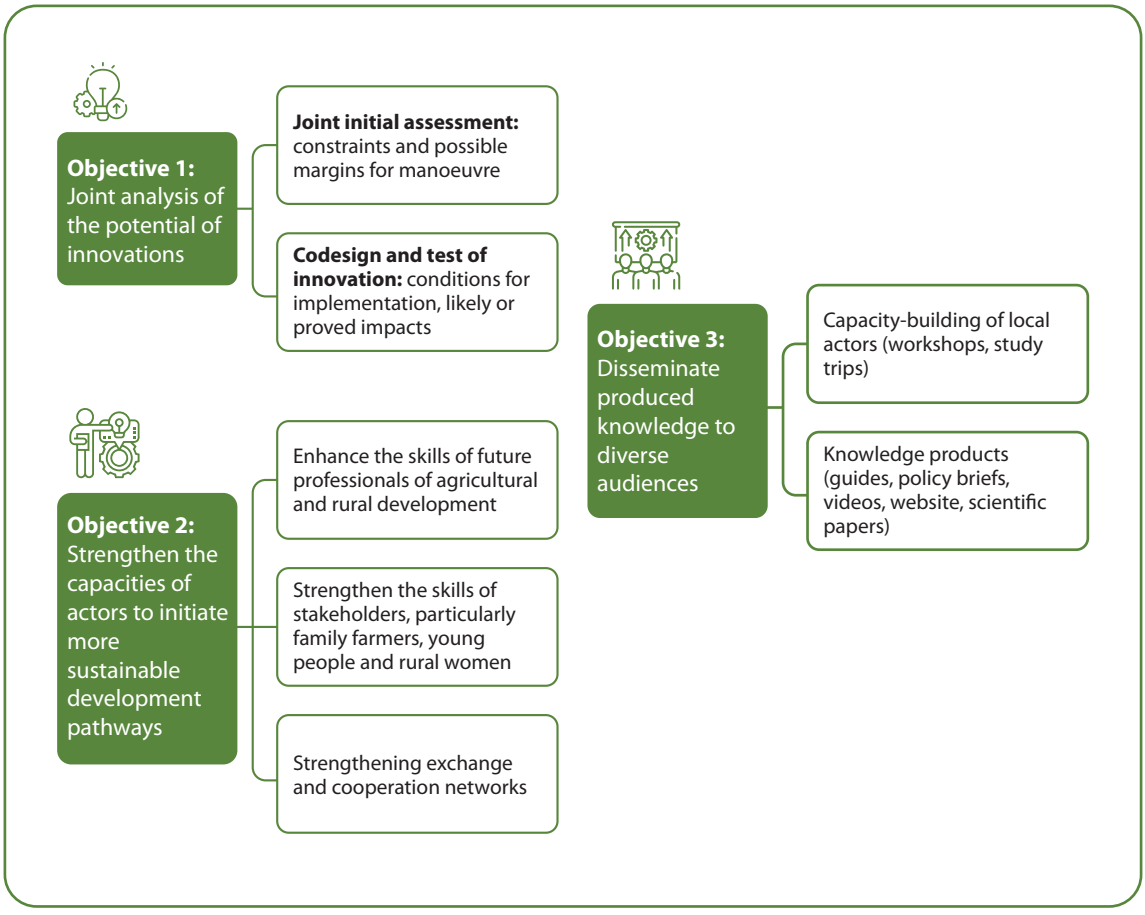

Figure 1. Main objectives of Massire project

To achieve these objectives, the project:

- **identified innovations** with the potential to improve territorial resilience;
- **characterized** and tested these innovations to validate their effectiveness and collaboratively determine the conditions for their adoption and dissemination;
- **strengthened** the capacities of stakeholders, particularly young women and men, fostering their sustainable integration into agricultural and rural innovation systems.

The Massire Project placed multi-stakeholder processes at its core, ensuring objectives and actions were discussed and validated with local stakeholders. These efforts spanned a variety of activities, including: 1) conducting in-depth studies; 2) facilitating collective reflection and knowledge sharing; 3) implementing coordinated actions, particularly for testing innovations; 4) building capacities and creating networks; and 5) undertaking communication and knowledge capitalization efforts.

Figure 2 presents the key phases and activities of Massire project.

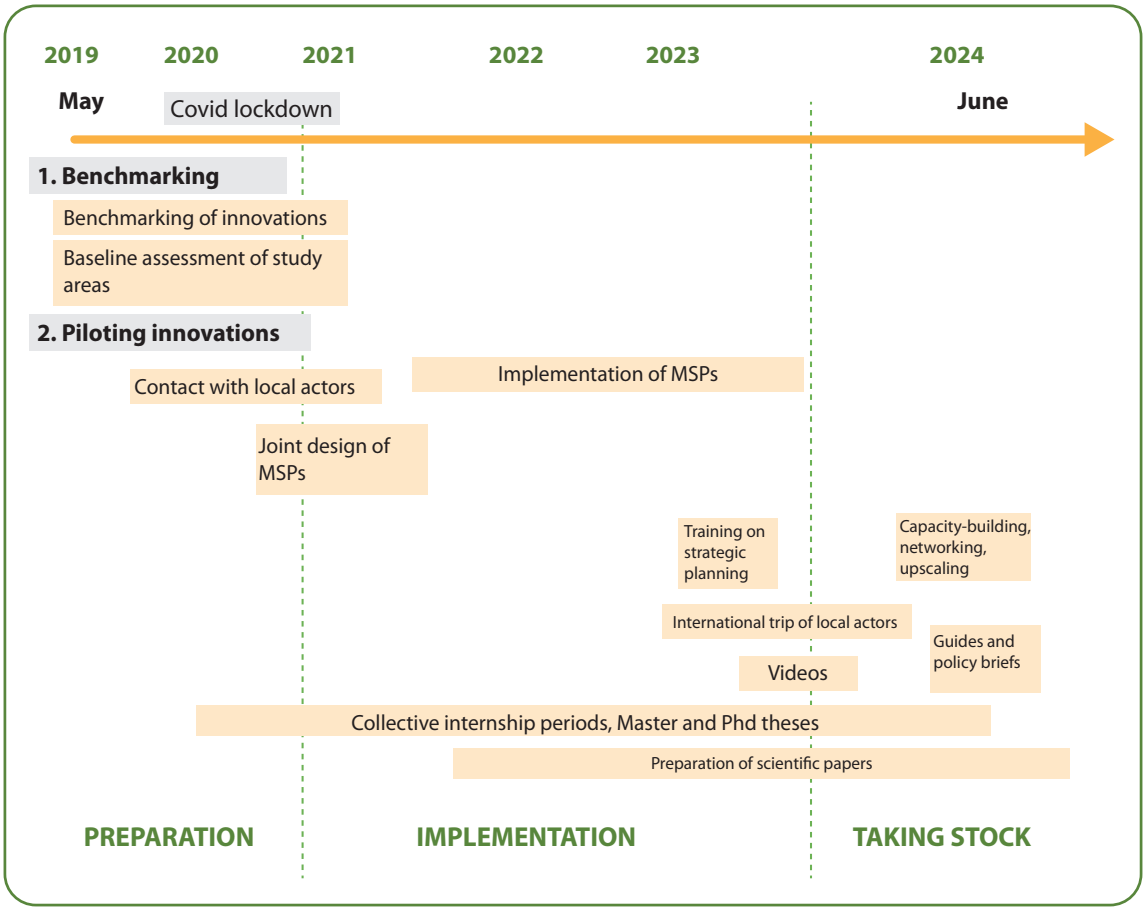

Figure 2. Main phases and activities of Massire project

2.2. Work areas

The Massire Project operated in the Drâa-Tafilalet region of Morocco, the Ghardaïa region of Algeria, and the Medenine and Kebili regions of Tunisia (Figure 3). Its interventions targeted two main environments:

- **Arid zones historically centred around traditional oases:** These oases feature long-standing systems for the collection, storage, and distribution of irrigation water. Since the 1990s, agricultural expansions have developed around these oases, driven by private boreholes. These extensions are managed by both local family farmers and external investors, focusing on market-oriented crops such as the Deglet Noor and Majhoul date varieties.
- **Mountain areas in Morocco's Msemrir–Tilmi districts:** Historically, livelihoods in these regions relied on pastoralism and small-scale irrigated farming. Over recent decades, agricultural expansions using groundwater have grown, primarily for apple production.

Figure 3. Work areas of Massire project

These regions share several characteristics and face common challenges. First, a rapid growth of agricultural activities and of the economy coexists with significant vulnerabilities. In traditional oases, limited profitability often risks marginalizing their economic role.

Agricultural extensions have seen rapid economic growth driven by intensive crop production, but these practices involve high input and water usage. This capital-intensive agriculture often excludes local populations and tends toward monoculture, leading to risks such as economic instability and susceptibility to diseases.

Second, intensive groundwater usage in agricultural extensions contributes to declining groundwater levels. Both traditional oases and agricultural extensions face challenges like a reduction in the synergy between agriculture and livestock and a decline in biodiversity. Third, these regions also face a series of social and governance challenges. Socioeconomic integration of youth and women remains difficult. Young people face obstacles in launching economic projects. Women's entrepreneurship has emerged over the last two decades, but these initiatives remain fragile and involve a limited number of participants.

Institutionalized spaces for collaboration are rare, whether for analysing local dynamics and developing sustainable and resilient development strategies or for designing and testing innovations in agriculture and natural resource management.

By addressing these interconnected challenges, the Massire project aimed to foster sustainable development pathways and build resilience in these regions.

2.3. Partners

The project was implemented based on collaboration between various organisations (Figure 4):

- 9 research and education institutions;
- Actors of the work areas, i.e. farmers, young and/or women entrepreneurs, farmers' associations and cooperatives, NGOs, public administrations, private companies.
- Facilitators who supported coordination and dialogue between all participants. These involved: a) four start-ups had been created by young professionals (2 in Tunisia, 1 in Algeria and 1 in Morocco); b) Lisode, which is a cooperative based in France and specialised in the facilitation of multi-stakeholder processes and more generally in participatory approaches.

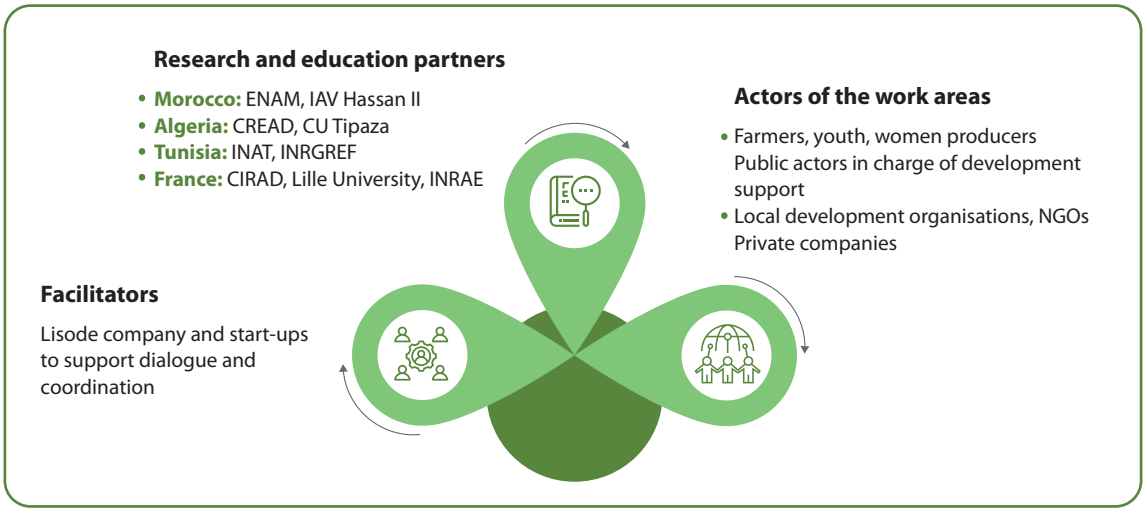

Figure 4. Partners involved in the implementation of Massire

2.4. Multistakeholder processes

A multistakeholder process (MSP) is a group of actors committed to the long term and who use tools and practices to jointly learn, produce knowledge and change their practices for the sustainable development of rural development of rural areas in the Maghreb (Hassenforder et al., 2024). The Massire project implemented 18 MSPs (Table 1, 2 and 3).

2.4.1. Multistakeholder processes in Morocco

Table 1 presents the 6 MSPs implemented in Morocco.

Table 1. Multistakeholder processes in Morocco

Aquifer recharge	This MSP focused on infrastructure and organisation enabling artificial recharge of aquifers in arid areas.
Irrigation management	This MSP focused on improving irrigation management in palm groves.
Reuse of treated wastewater	This MSP tested a low-cost system for treating wastewater from water consumption units not connected to the sewerage network, and for using treated water for irrigation.
Mountain oases	This MSP organised a multi-stakeholder dialogue on sustainable development options for mountain areas.
Observatory	This MSP developed an innovative approach to collaboration between stakeholders to organize sustainable information exchange and coordination on specific issues.
Organic dates	This MSP supported a group of stakeholders in developing agricultural practices for the production of organic dates, and in obtaining organic certification.

Example of the MSP on mountain oases

In the 2010s, a local development association in Tinghir initiated the creation of a 100-hectare agricultural extension, transforming former rangelands into a small oasis.

By 2020, 24 hectares were irrigated, benefiting 600 members, each cultivating a 0.04-hectare plot with gradually planted Majhoul date palms. Water management was organized collectively, but the association faced challenges due to water shortages and the complexity of the irrigation system.

At the start of the Massire Project, the team engaged with the association to identify their water management needs and undertake collaborative actions.

In 2021, three MSc studies were conducted to analyze the irrigation system in detail, covering water requirements, network design, and system operation and maintenance.

These studies helped the association identify opportunities for improving water management. Additionally, various studies examined the performance of irrigation systems, particularly drip irrigation, and new solar-powered irrigation technologies in the region.

In 2021, the results of these studies and internships were discussed during a meeting involving the association's management committee, students, and the Massire team.

In 2022 and 2023, collaboration continued, including a training program on irrigation management for association members and support for developing an automated irrigation pilot system.

Photo 4. Irrigation system in the area of the MSP on irrigation management in Morocco

Example of the MSP on mountain oases

The MSP on "mountain oases" operated in the M'Semrir-Telmi area. In the early years of the project, the focus was on analyzing the dynamics of key agricultural value chains, particularly the apple value chain. Studies also explored the changes occurring in pastoral activities within the region.

As the project progressed, MSP participants decided to expand the scope of their analysis to cover the entire M'Semrir-Tilmi area and initiate discussions on creating a local development plan.

The MSP activities initially relied on the work of students, with 25 MSc theses and 5 collective internships conducted in the region.

Additionally, a series of workshops were held with farmers and development actors, primarily to discuss the students' findings

A conversation began around the potential for establishing a certification for the entire area, aimed at promoting local identity and heritage—both natural and cultural—while ensuring environmental sustainability.

Photo 5. Mountain oasis in M'semrir region

2.4.2. Multistakeholder processes in Algeria

Table 2 presents the 5 MSPs implemented in Algeria.

Table 2. Multistakeholder processes in Algeria

Reuse of treated wastewater	This MSP tested a low-maintenance wastewater treatment system that allows wastewater to be treated and then used to irrigate a park.
Collective borehole management	This MSP analysed the challenges and options for improving the management of water user associations.
Water circularity	This MSP took stock of traditional know-how on artificial groundwater recharge, and analysed how this know-how is evolving and can be maintained in the future.
Saffron value chain	This MSP supported a reflection and joint initiatives to strengthen saffron production and value chain.
Income-generating activities for women	This MSP organised capacity-building for women producers to make online sales.

Example of the MSP on saffron value chain

Saffron cultivation was introduced in 2016 in the Ghardaïa region. The success of pioneering initiatives sparked significant interest among farmers, leading to the rapid expansion of saffron farming in the region.

This crop offers several advantages that make it a key resource in the sustainable and inclusive development of oasis territories.

It is particularly accessible to smallholder farmers, requires minimal inputs, is well-suited to the climate, and has the potential to generate substantial income for producers.

However, the emerging saffron sector faces several technical, organizational, and institutional challenges. As a result, it was chosen as a focus for an MSP, aimed at co-developing a shared vision and action plan to support its development.

Preparatory Phase (Early 2020 to November 2021)

- An MSc thesis and a participatory diagnosis were conducted with producers to identify the strengths, weaknesses, opportunities, and threats (SWOT) facing the saffron sector.
- A film was produced to highlight the key issues and challenges related to the local saffron industry for regional stakeholders.
- Two workshops were organized with producers and spice sellers to: 1) consolidate the results of the SWOT analysis, 2) validate the content of the film, and 3) identify the main strategic objectives for saffron sector development, as well as the associated issues, challenges, actions, and key stakeholders.

Photo 6. Discussions to prepare the MSP on saffron value chain

Implementation phase (December 2021-June 2024)

- A multi-stakeholder workshop was organized, bringing together saffron growers and government representatives, to co-develop an action plan for the saffron sector. For each objective, the workshop aimed to identify key issues, challenges, actions, stakeholders, and the necessary resources to be mobilized in the short, medium, and long term.
- An experimental plot was established to improve agricultural practices and provide training for new saffron producers.
- Training sessions were conducted for young saffron entrepreneurs on online marketing strategies.
- Workshops were held to raise awareness and provide training on Global Gap certification, organic certification, and the packaging of organic products.

Photo 7. Experimental plot at a vocational training centre to improve saffron production farming practices

- Training modules were organized for producers, including a field school day at the National Institute of Vocational Training (INSFP) campus in Ghardaïa.
- A national workshop was organized to discuss strategies for expanding saffron production and developing its international marketing.

Example of the MSP on income-generating activities for women

In Ghardaïa region, social and cultural norms are deeply influenced by patriarchy, which significantly limits women's access to public spaces.In response to economic challenges, such as the saturation of local markets for traditional products, some women entrepreneurs have developed strategies to better utilize their products and create new goods and services to cater to emerging consumer demands. Despite these efforts, their entrepreneurial activities remain limited, isolated, and fragile.

To support these women, the Massire Project organized training sessions on online marketing for women entrepreneurs. Additionally, the project distributed 28 tablets to assist women in developing their websites and engaging on social media platforms. Follow-up support was also provided to help women further develop and enhance their online marketing efforts.

Photo 8. Training on on-line marketing in Ghardaïa

2.4.3. Multistakeholder processes in Tunisia

Table 3 presents the 7 MSPs implemented in Tunisia.

Table 3. Multistakeholder processes in Tunisia

Groundwater and solar energy	This MSP focused on past and possible future trajectories for more sustainable water management in agricultural extensions, on ways of improving water management in traditional oases, and on the issues surrounding the development of solar energy for irrigation.
Territorial observatory	This MSP helped irrigators' associations develop new data acquisition mechanisms to control irrigation.
Common dates and composting	This MSP experimented with different initiatives to enhance biodiversity and to diversify income sources in oases.
Introduction of new forage crops	This MSP tested forage species adapted to southern Tunisian conditions, particularly in terms of soil and water salinity.
Support to youth entrepreneurs	This MSP supported young entrepreneurs in developing innovations that can support more sustainable oasis development.
Agricultural value chains	This MSP analysed agricultural value chains that can support more sustainable development pathways of oases.
Rural women	This MSP strengthened coordination between women's development groups and helped improved marketing strategies.

Example of the MSP on groundwater and solar energy

In the Kebili region of Tunisia, numerous new agricultural plots, known as "extensions," have been developed over the past thirty years. This expansion has led to intensive exploitation of water resources, driven by an increase in boreholes and the use of photovoltaic panels for water pumping.

However, these areas are not officially recognized by the authorities and remain legally unacknowledged. Facilitating a dialogue between stakeholders regarding the future of these areas has become urgent.

The MSP facilitated collective discussions among local actors to explore various scenarios for the sustainable management of groundwater resources in the Kebili region.
Activities carried out included:

- A preliminary diagnosis with local actors, identifying three key areas of interest where stakeholders were motivated to participate.
- Participatory diagnostic workshops conducted separately with the Ministry of Agriculture, farmers, and irrigation associations.
- A national workshop involving agricultural development actors, energy stakeholders, and researchers to: 1) present the current situation regarding challenges, strategies, and the regulatory framework for using solar energy for irrigation pumping, 2) identify the barriers and difficulties associated with solar energy use, 3) propose potential solutions.
- A multi-stakeholder workshop at regional level to: 1) present the results of previous workshops, 2) discuss the sustainability challenges of the Kebili oases, the underlying factors, and their interconnections, and 3) collaboratively develop scenarios for a sustainable oasis and identify innovations for implementation.
- Exchange visits to explore innovations in water management and irrigation implemented in other regions, with local actors from Kebili.

Photo 9. Solar energy system in palm groves in Kebili region

Example of the MSP on support to young entrepreneurs

Tunisia has many entrepreneurship support programmes, but young people—especially women—face numerous challenges in accessing assistance for starting and growing their entrepreneurial ventures. The goal of this MSP was to: 1) gain a better understanding of the existing challenges and opportunities, and offer recommendations for improving support for young entrepreneurs, and 2) assist three projects led by rural youth in Kebili region.

During the preparation phase, initial contact was made with various actors involved in supporting young people in the region, such as associations, government agencies, and financial institutions. Following this, an introductory workshop was held to present the approach. In mid-2022, over 80 interviews were conducted with young project leaders from the region to gather insights into their needs and challenges.

During the implementation phase of the MSP, a committee was established to select and support three youth-led projects, while also connecting them with existing support structures and mechanisms.

The three projects chosen for support were: 1) the recovery and transformation of palm waste into fences and decorative items; 2) a website for marketing handmade products by women from the oasis; and 3) a coal briquette production unit.

Several workshops and training sessions were organized to assist the youth in developing their projects. These included creating personalized support plans, writing business plans, and providing training in digital marketing and graphic design.

Each project also received individualized follow-up. For example, for the project on the recovery and transformation of palm waste into fences and decorative item, support included acquiring necessary equipment (such as electric saws and iron supports), setting up a workshop, providing technical training on making decorative items, and offering guidance to improve the designs of the products produced.

Photo 10. Date syrup prepared by women producers from Kebili Region

2.5. Innovations considered

2.5.1. Methodological innovations

The Massire project innovated in the way to work with actors. A specific methodology was developed to design, in each work area, a series of multistakeholder processes, involving collectives of actors who shared a common objective and designed and implemented together an action programme. This methodology is described in detail in Hassenforder et al. (2024).

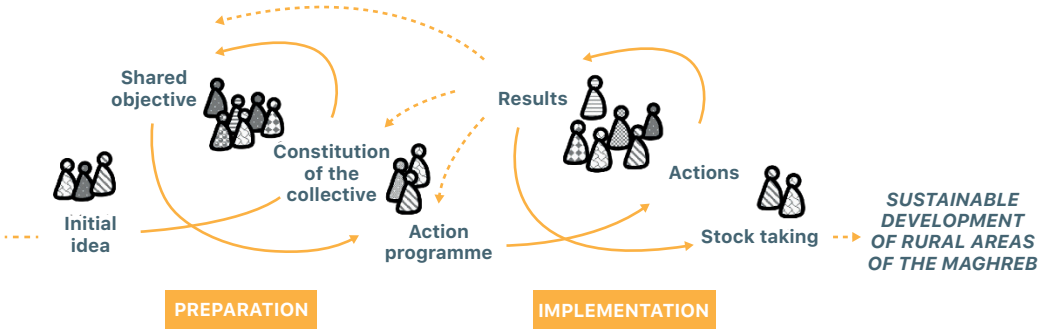

Figure 5. Main scheme of Multi-Stakeholder Processes (Hassenforder et al., 2024)

A staff member from the Regional Directorate for Agriculture in Ghardaïa shared: *"The approach proposed by Massire stands out from previous initiatives I've been part of. In contrast to other projects where actors had to approach donors or project coordinators for assistance, Massire went directly to the actors. This approach has created opportunities for listening, exchanging ideas, and providing support through training, learning, and identifying the needs of local stakeholders who are not accustomed to such engagement. It fosters inter-sectoral coordination by enhancing collaboration among various stakeholders, promoting smoother implementation of actions. The Multi-Stakeholder Process is an ongoing process of discovery and learning, not a fixed state. It is a relational journey. This approach has facilitated the establishment of strong ties with local partners such as the water authority, the Office for Wastewater Treatment, as well as national entities like CREAD, universities, and research centers, and internationally with organizations such as Cirad."*

A farmer producing organic dates in Morocco commented: *"From my understanding of the Multi Stakeholder Process, I view it as a chain that brings together various stakeholders, all working towards the common goal of development. Everyone is encouraged to participate and contribute, which helps create complementary actions between development efforts, research, and local knowledge."*

2.5.2. In-field innovations

Innovations considered in the Massire project can be categorised according to the following typology.

See elsewhere to imagine or test here

Innovations in this category are not yet present in the project area, but they have been successfully implemented elsewhere, leading to positive results. Stakeholders are interested in exploring their potential application in the project area or in conducting pilot tests. Activities undertaken as part of the MSPs focused on local experimentation or reflecting on how these innovations could be adapted and implemented within the specific context of the Massire work areas.

Improving innovations

Innovations in this category are already present locally and actors consider them generally as beneficial. . However, actors are interested in finding ways to improve them. Activities in the MSPs focused on: 1) local experimentation on how to enhance these innovations, followed by analysis of the results, and 2) reflection on the constraints and opportunities for scaling up these innovations.

Measuring effects

Innovations in this category are already implemented locally, but their impacts and effectiveness are either insufficiently understood or controversial. Activities undertaken as part of the MSPs aimed to: 1) understand and measure the effects of these innovations at various levels, based on indicators defined by the collective, 2) reinforce the positive effects identified by the collective or minimize the effects deemed negative or problematic.

Table 4 below shows the main innovations considered in MSPs according to this typology.

Table 4. Main innovations considered in Massire

Domain	Innovation	Morocco	Algeria	Tunisia	General approach			Experimentation done during the project
					See elsewhere to imagine or test here	Improving innovations	Measuring effects	
Reuse of waste water	Low-cost treatment plant of small tourist units + irrigation	×			×			×
	Low maintenance treatment plant + irrigation		×		×			×
Irrigation systems	Probes to enhance drip irrigation	×		×	×			×
	Solar energy for individual and collective irrigation systems	×		×			×	
	Automation of collective irrigation systems	×			×			
	Improvement of collective irrigation management	×	×	×		×		
Aquifer recharge	Artificial aquifer recharge	×					×	
	Evolution of ancient recharge systems and coordination at river basin level		×			×		
Territorial coordination platforms	Territory project for mountain oases	×			×			×
	Coordination between actors to produce and disseminate information (observatory)	×		×	×			×
Support to entrepreneurship	Support to young entrepreneurs	×	×	×		×		×
	Coordination between women producer organisations			×		×		×
	On-line marketing		×	×		×		×
Sustainable farming	Organic date production techniques and value chain	×				×		×
	Compost production techniques in oases	×		×		×		×
	New forage crops in oases and arid areas	×					×	×
	Saffron farming practices and value chain development			×		×		×
	Local variety dates and impact on resilience of farming systems		×	×		×		

2.6. Evaluation

In order to assess actors' views on the implement and achievements of Massire, 57 interviews were undertaken between March and July 2024. Interviewees were: 9 farmers, 2 actors of value chains, 14 leaders of farmers organisations, 8 young entrepreneurs, 7 women producers, 1 hotel manager, 1 person from rural municipality, 1 director of a school for young professionals, 3 members of NGOs, 9 staff members from the administration of the ministries of agriculture, 1 researcher of a local research institute. Fifteen interviewees were women. These persons were chosen to cover almost all multistakeholder processes undertaken by Massire. The quotes mentioned in the present report are taken from these interviews.

03

ACTIVITIES AND RESULTS

Photo 11. Farmer field school in Medenin region, Tunisia

3.1. Activities and results for all participants

The main target groups of Massire were: family farmers, women entrepreneurs, and young entrepreneurs in rural areas. We present in section 3.1 activities and results that are common to all participants. Results that are more specific to women and young entrepreneurs are presented respectively in sections 3.2 and 3.3.

In total, the various MSPs set up during the Massire project involved 180 farmers who were members of irrigation collectives, 100 cooperative members and 297 farmers from family farms outside the water user associations and cooperatives, 62 members of NGOs and local associations, and 199 local government officials (see details in Appendix 1). Hereafter, activities and results are typified into: equipment and infrastructure; creation and strengthening of networks; changing perceptions, learning and skills development.

3.1.1. Equipment and infrastructures

Diverse equipment and infrastructures have been co-designed and installed in the three work areas (Table 5).

Table 5. Main materials distributed to participants and tested with them

Topic	Morocco	Algeria	Tunisia
Water management	Wastewater treatment plant for isolated households or hotels	Low-maintenance wastewater treatment plant	Soil moisture measurement probes for irrigation management
Promotion of biodiversity and sustainable farming	Palm frond shredder	Low-maintenance wastewater treatment plant	Palm frond shredder, composter
		Gardens to improve the development of traditional palm tree	
		Garden using treated wastewater	
		Experimental plot to test new organic farming practices for saffron productions in a vocational training centre	
Supporting women entrepreneurs	Tablets for rural women to facilitate digital marketing		

The equipment to be tested was selected or designed collaboratively with the participants of the MSPs. For example, as part of the "Common Dates and Composting" MSP in Tunisia, discussions among participants revealed that existing shredders were not suitable for shredding palm fronds because the wood was too tough for the blades. After several rounds of discussion, a list of technical specifications was created for a shredder specifically adapted to palm fronds.

This shredder was then designed in collaboration with a shredder company, researchers, and farmers. The materials used to build the shredder are readily available in southern Tunisia, making it easy to repair and reproduce locally.

The farmers who participated in the design process understand how the shredder works, enabling them to repair it and train other users.

Photo 12. The shredder developed in Tunisia

3.1.2. Creation or strengthening of networks

Bringing together different actors and providing them with the opportunity to travel to other regions, and even abroad, allowed them to meet new people and form networks or collectives. As a result, several of these networks led to the creation of WhatsApp groups—around ten groups were formed across the three work areas. These groups are primarily used for exchanging technical information and staying informed about regional events such as fairs, exhibitions, markets, and more.

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The financial manager of a Tunisian water user association, who is also a farmer, shared: *"One of the key benefits I've gained from the Massire project is the creation of a network with other farmers. For example, one farmer shared his fertilization method with me and offered training to other farmers at no cost. This year, I've adopted his method for my own plot."*

A saffron farmer in Ghardaïa remarked: *"The network formed through Massire has enabled us to stay connected with other saffron producers, local administrations, and researchers, who have provided us with scientific support based on their studies on saffron. It has also helped us communicate with institutions during workshops, allowing us to raise our concerns."*

Several trips were organised. At international level, there were (see details in Appendix 2):

- training on strategic planning involving leaders of farmers' organisations and young entrepreneurs from Morocco, Tunisia and Algeria;
- training on on-line marketing involving women entrepreneurs and young saffron producers from Algeria and Tunisia;
- participation of local actors from Algeria, Tunisia and Algeria in Massire annual meeting in Kebili;
- visit about organic value chains and sustainable farming practices in Tunisia, involving Moroccan and Algerian participants;
- visit about organic value chains and sustainable farming practices in Morocco, involving Tunisian and Algerian participants.

Other visits also took place at national level, for instance leaders of water user associations from Kebili Region visited a well-functioning water user association in Cap Bon Region and another association using solar energy in Gabes. Members of women's producer organisations visited a women's cooperative in Souss region.

During these visits, exchanges were mainly between "peers". Participants were able to discuss concrete aspects such as the resale of solar energy produced by an association of irrigators to the national electricity company, participatory organic certification, efficient water management and the direct sale of organic baskets, etc. This enabled to discuss many questions about the operating and governance of innovations, the barriers encountered and the conditions for their success.

The president of a local development association in Tinghir shared: *"The Massire project has provided me with significant networking opportunities, both locally and internationally. Locally, I gained firsthand insight into the activities of several associations and cooperatives in Tinghir. On a national level, we created a network that brought together scientists from various institutions and cooperatives from Kelaat M'Gouna. Internationally, we had the chance to meet farmers and cooperative leaders from Algeria and Tunisia."*

3.1.3. Changing perceptions, learning and skillsdevelopment

The training provided in the various MSPs, as well as the workshops and other participatory events organised, triggered changes in perceptions, learning and skills.

Learning new farming practices

Interviewed farmers put forward the concrete approach used in MSPs to share new farming practices.

A Moroccan organic date producer remarked: *"I've participated in several research programs with objectives similar to those of Massire, but what sets this project apart is its grassroots approach. The workshops on organic farming were particularly impactful because they provided concrete opportunities to apply theories at all levels of education. Beyond the participatory approach, the project makes it easy to share information with all participants, no matter their educational background. The most impressive innovation from the Massire project is mulching, which offers many benefits, such as eliminating weeds, reducing transpiration, and improving water retention in the soil. Before mulching, we had to hire workers for weeding, which was a significant financial burden. Now, this technique helps cut labour costs, reduce water consumption, and maintain soil moisture—especially important during droughts. Another noteworthy technique is shredding palm waste to create compost, which not only supports soil health but also reduces the risk of fire."*

In Tinghir, the president of an association overseeing the collective planting and irrigation of palm trees stated: "*Attending the workshop in Douz, Tunisia, was very enriching. I used video calls to share the farming techniques we learned in Tunisia with our association members, such as palm tree maintenance, irrigation practices, and the necessary water usage. The wealth of agricultural knowledge gained through Massire has inspired us to improve several of our practices. For instance, we've enhanced the quality of irrigation water for our date palms, following a master's thesis that included a detailed diagnosis of all plots in our association. We've started implementing drip irrigation and plan to incorporate irrigation meters as part of the innovation."*

Farmers interviewed also highlighted the way new knowledge and practices were shared at the local level. A Moroccan organic date producer shared: *"I participated in three training sessions on treatment and prevention techniques for a fungus that attacks the heart of palm trees. We also tested treatments against the mealy bug, which has been increasingly common in summer, as well as treatments for mites. These sessions helped raise awareness about the potential damage caused by these pests. Afterward, I shared what I learned with neighbouring farmers to make them aware of the importance of being vigilant against these risks. We've created a local dynamic for exchanging ideas and farming techniques, particularly focusing on raising awareness about converting to organic farming. We also shared our mulching techniques and demonstrated how it improves resilience to desertification, conserves moisture, and enhances soil quality."*

Learning soft and planning skills

In June 2023, a one-week training session was held in Tunis, bringing together 22 leaders of farmers' organizations and young entrepreneurs.

The training focused on strategic planning, teaching participants how to create plans for the development of farmers' organizations or entrepreneurial projects.

A manager of a farmers' association in Tinghir shared: *"During the strategic planning workshop in Tunis, I learned how to use tools like SWOT analysis and the problem tree, which follow a diagnostic approach. This helped us create an action plan to address challenges such as irrigation, particularly during drought periods."*

New interpersonal and communication skills

Several interviewees, especially association managers, shared that their participation in the MSPs made them realize the significance of relational and communication aspects.

They noted that they had become more open and attentive to the needs of their association members, leading to an improvement in the support they provided to them.

> The president of an irrigators' association who participated in the 'Groundwater and Solar Energy' MSP in Tunisia shared, *"After this first experience, I'm now better equipped to discuss issues with farmers and work towards collective solutions." Similarly, the president of a dairy cooperative in Morocco reflected: "Above all, Massire helped me change my approach towards my staff. The open-mindedness and participatory methods I learned through workshops with scientists allowed me to reconsider how I interact with cooperative members and farm workers. For me, Massire provided interpersonal and soft skills rather than just technical ones."*

3.2. Gender focus

3.2.1. Activities relative to gender issues

The gender focus was integrated in three key ways.

- **Dedicated MSPs for women's entrepreneurship:** Two specific multistakeholder processes were organized to support women entrepreneurship initiatives, one in Algeria and one in Tunisia.

- **Involvement of women in all MSPs:** Efforts were made to include women in all multistakeholder processes whenever possible. For example, a training session on strategic planning for leaders of local development organizations and young entrepreneurs included 30 participants, 11 of whom were women. In total, 301 women benefited from the project, representing 32% of all participants (see Appendix 1).

- **Female student participation:** Among the 215 students who participated in collective in-field internships or completed their master theses, 128 were women, constituting 60%. Additionally, 4 of the 6 PhD students supported by Massire were women. All internships were conducted within the framework of MSPs, ensuring that many female engineers were trained to understand the dynamics and challenges in oases and arid regions of the Maghreb, and to collaboratively develop solutions with local actors.

Moreover, **40% of the 79 members of Massire core teams** from the 9 research and education organisations were women.

The number of women engaged in economic activities (having an individual entrepreneurial project or working within a cooperative or association for income generation) that were supported by Massire are indicated in Table 6. In Morocco, overall 24 women were involved in the activities of Massire, mostly as farmers participating in MSPs related to agriculture.

Table 6. Activities with a specific gender focus

Activities	Country	Participating women entrepreneurs
MSP on income-generating activities for women	Algeria	31
Activities with young entrepreneurs	Algeria	7
MSP on rural women	Tunisia	49
MSP on young entrepreneurs	Tunisia	26
Strategic planning workshop	Morocco	3
Total		**116**

3.2.2. Key results of the project

Capacity-building

Women participants first learnt **about how to organise collective action.**

The president of a women's cooperative shared: *"I had the chance to attend a strategic planning training workshop in Tunisia. It was a valuable experience, with each participant bringing their knowledge to the group. Visiting other cooperatives in Tunisia inspired us and gave us new project ideas. The most striking innovation for me was the use of soft skills tools like SWOT analysis and problem trees in creating a strategic plan. These tools are essential for launching a project and can be used at various stages of its development. After attending the workshop in Tunisia, we were able to create a clear action plan that clarified our project's vision. We identified our strengths to build on and weaknesses to address to move our cooperative forward. This process helped us realize the untapped potential of M'semrir and the resources available to our cooperative."*

Another president of a women's cooperative stated: *"Participating in the strategic planning workshop boosted my confidence and communication skills. It inspired me to organize working sessions within our cooperative, where we created a strategic plan to address challenges like the decline in rose production. We also learned the importance of being transparent with our customers, sharing our production challenges with them."*

Second, participants developed skills in managing websites and virtual social networks. A woman entrepreneur explained: *"Online stores are primarily visual... The Massire training taught us how to use tools like Canva to create eye-catching and customized posts, which helps attract potential customers. Scheduling posts also helps me maintain a regular online presence, which is key to drawing in my audience. I included my son in this process because he's more familiar with digital tools than I am. Announcing promotions before events through posts on social media generates interest from customers even before the event, sparking curiosity and encouraging them to visit my booth."*

"This strategy also boosts sales, making it very effective. Additionally, by linking my Facebook and Instagram accounts, I expand the reach of my posts and enhance my visibility on social media."

A young woman entrepreneur in Ghardaïa shared: "Massire was a turning point for many of us. The project transformed the way we use social media. We shifted from using social networks purely for personal purposes to using them professionally and strategically, focusing on promoting our products and services."

Changes in relations

In the 'rural women' MSP in Tunisia, many women from the Kebili Region engaged in individual craft activities that involved processing oasis products. While six women's agricultural development groups already existed in the region, the women members of these groups had not met one another before.

These groups met for the first time at a workshop organized as part of the MSP. Since then, three more groups were established, and the women from the different groups now regularly exchange information about fair dates, ways to present their products at fairs, group management, strategies for securing funding, and the administrative steps needed to form new agricultural development groups.

They also share common challenges and difficulties. In Algeria, the 'Income-generating activities for women' MSP organized a series of training sessions aimed at helping women entrepreneurs with online marketing. **These activities fostered exchanges that went beyond their usual social circles.**

A craftswoman from the Ghardaïa Region shared: *"A manager of a djelaba (interior dress) shop in Ghardaïa reached out to me on Messenger after seeing the dress designs I posted on my online shop [created during Massire's training workshop]. We agreed on a price per piece. Everything is handled online, with us exchanging voice messages, screenshots, and photos.". A young woman entrepreneur in Ghardaïa remarked: "The Massire project has allowed us to form friendships with other women from different ethnic groups. Without Massire, I would never have had the chance to talk to a chaamba [local community group]..."Another young female entrepreneur added: "I've built a network with women from the Tunisian women's producer associations. We share new information with each other, and I've learned so much. I'm a housewife with few friends, and Massire gave me the opportunity to work and relax at the same time."*

At the international level, a president of a women's cooperative in Morocco commented: *"I exchange ideas with an Algerian participant whose project is similar to ours. She offers me innovative suggestions for our cooperative's products, based on her own experiences. Nationally, I stay in touch with other cooperative presidents to exchange advice and best practices."*

A woman entrepreneur in Ghardaïa shared: *"The online store allowed me to overcome a major social issue: the criticism and skepticism from society toward my beauty products and essential oils. When I displayed my products at local exhibitions in the ksar of Berriane—where I'm from—women initially showed interest in purchasing them. However, as soon as they saw me, the same comment would come up: 'What kind of studies have you done to make and sell these products?' They would put the products down and leave the stand. I faced this problem multiple times, which led me to look for other sales alternatives. The virtual and anonymous nature of the online store helped me overcome these social constraints, as the focus shifted to the products themselves, rather than on the person making or selling them."*

The project also supported the creation of **networks between women entrepreneurs** via WhatsApp.

A female entrepreneur from Ghardaïa said: *"The WhatsApp group has made it easier for participants to stay connected, exchanging ideas, advice, and mutual support. For example, when one woman organizes an exhibition, she encourages the other women in the group to participate. The group also allows us to ask questions when we encounter technical problems while managing the online shop." Another female entrepreneur shared: "The WhatsApp group provides us with a virtual space to exchange ideas, announce upcoming events, discuss problems, find solutions, and, most importantly, encourage, support, and inspire each other." A third woman added: "The Massire project gave us the chance to meet professionals who helped us believe in ourselves and our projects, develop new skills, and most importantly, connect women entrepreneurs with each other... We realized that we were facing the same challenges."*

These activities have also contributed to **increasing income**. An Algerian female entrepreneur shared: "Thanks to digital tools (tablets + online sales store), I've been able to reach new markets outside Berriane [a subdivision of Ghardaïa region], diversify my partners and customers, and thus boost my sales."

Finally, women entrepreneurs have gained more **self-confidence**. A female entrepreneur in Ghardaïa expressed: "Before, I was afraid of the unknown, but Massire has empowered us (myself and the other women) to overcome our fears, surpass our limits, and trust in our abilities. It gave me the strength and courage to explore new opportunities. Before, I was seen as the widow needing financial help to raise my children. But now, my family sees me as a business owner. They are proud of my social and financial independence. My journey has earned the respect and admiration of my children. I've shown them that they too can achieve their dreams and ambitions, no matter the obstacles they face."

Photo 13. Handicraft produced by women producers in Ghardaïa

3.3. Youth focus

3.3.1. Activities with regards to the youth

Youth was addressed in three ways. First, many young farmers **participated in multis-takeholder processes and training.** A total of 152 young people (defined as under 35) took part in the project. Nearly all MSPs included activities with participants under 35. For example, in Algeria, eight young saffron producers participated in online marketing training in April 2022.

Second, Massire engaged more directly with **young people involved in individual entrepreneurial projects:** 15 in the youth entrepreneur MSP in Tunisia, 1 in the rural women MSP in Tunisia, and 32 in activities with young entrepreneurs in Algeria. Among them, 8 young entrepreneurs—who participated in Massire—were interviewed at the end of the project. These entrepreneurs were working on individual income-generating projects and benefited from Massire's training, equipment, and networking support. Four of these entrepreneurs were women.

Third, Massire supported the **training of over 200 young professionals** on the functioning and dynamics of oasis and arid region areas, focusing on sustainable development challenges and methods for building solutions with local actors.

The project fully or partially supported the following PhD theses:

- Innovations in mobilizing water resources to cope with water shortages in oases: the case of the Todgha basin (Morocco);
- Youth socioeconomic integration in the Tinghir region (Morocco);
- Analysis of the impacts of crop extension and changes in crops on the sustainability of pastoral livestock in mountainous areas: the case of the Dades mountain oasis, Tinghir Province (Morocco);
- Unlocking unconventional waters for new hydro-agricultural models in arid environments (Algeria);
- Renewal of community-based artificial recharge and its principles of circularity and water: the case of an oasis in the M'zab valley (Algeria);
- Improving the agricultural value chains of local date varieties in the Kebili region (Tunisia).

3.3.2. Key results of the project

The young entrepreneurs were able to **clarify and refine their projects.** A young entrepreneur who produces handicrafts from palm date wood explained: "The idea of supporting young people or those with ideas and improving their knowledge of soft skills is sometimes better than subsidies, because with this knowledge, you can learn how to get the money to invest and, above all, take the right path and be realistic."

A young female entrepreneur from the Kebili Region shared: "In the diagnostic phase, we were contacted and presented our idea to the jury and were selected, along with two other projects, to receive training and equipment. With the Massire team, we started to draw up a work plan for 18 months (identification of activities, duration of activities, identification of needs and tools to achieve our objective) and in February 2023, we had a 3-day training course on drawing up a business plan. I'd like to mention that before the 'digital marketing' training course, we had some confusion about the usefulness of a website, but then everything became clear."

A young male entrepreneur from Algeria said: "The strategic planning training taught me how to manage a project more effectively. Before this training, I would always always start at the end, focusing directly on financial profitability. But now, I've learned to study my project thoroughly and address minor issues early on to avoid getting stuck. For example, I couldn't get my compost to work, and I didn't understand why. I discovered that the problem was with the raw materials, which I then changed, and it worked. Massire helped me adopt a clearer and more rational approach."

Young entrepreneurs also developed their **marketing capabilities and skills.** A young Algerian female entrepreneur shared: "I couldn't afford to buy a smartphone... In my entourage, I was the only one who didn't have one... The Massire project changed my social situation by providing me with a tablet that allowed me to integrate the digital world for the first month."

3.4. Other participants

The project interacted with 461 local actors who were not farmers, being from local administrations (199 persons), NGOs (62 people), from other professions (local researchers, private companies, hotel managers, members of local municipalities, etc.), and from traditional jmaa community management committees.

> An engineer from the Moroccan Department of Agriculture explained: *"On a personal level, this project has allowed me to collaborate with researchers from diverse disciplines. Initially, as an agricultural engineer specialized in plant production, I believed strongly in the importance of focusing on commodity chains. However, through discussions with other specialists in the Massire project, I came to understand the limitations and drawbacks of this approach. I have learned that it's crucial to tap into the full potential of an area, not just focusing on specific value chains but by involving all stakeholders, especially the regulatory bodies."*

Networking was also mentioned as an important result of the project. A president of a rural municipality in Morocco said: "The network I built up at the Tunis workshop remains active via WhatsApp, encouraging collaboration and the exchange of ideas with participants from other countries."

04

IMPROVING LIVING CONDITIONS

Photo 14. Training on strategic planning in Tunis

4.1. Water resource management

4.1.1. Sustainable water management at catchment or aquifer level

In Morocco and Tunisia, the project team facilitated multistakeholder discussions to identify **strategies for enhancing water resource management at the catchment or aquifer level.** In Morocco, workshops were held with farmers and other stakeholders involved in water resource management to address water scarcity at the catchment level and develop potential solutions (Khardi et al., 2024).

In Tunisia, workshops were organized to address the rapid expansion of agricultural extensions, which are currently illegal, and the corresponding sharp decline in groundwater levels (Mekki et al., 2024; Ferchichi et al., 2024a).

4.1.2. Improved irrigation practices at farm and collective level

In Morocco, Algeria, and Tunisia, training sessions were conducted to help farmers **improve their irrigation practices.** In Morocco, the project primarily collaborated with an organization in Tinghir, which manages a 100-hectare collective plot and operates the associated irrigation system. Studies were carried out to assess the performance and challenges of this irrigation system, and in 2023, training was organized to improve collective irrigation practices (see Hassenforder et al., 2024, p. 53-54).

In Algeria, an MSP focused on the management of water user associations in Ghardaïa, where each association oversees a borehole and its corresponding irrigation network. In Tunisia, soil moisture probes were installed in three water user associations to assess current irrigation practices and collect data, which would later be used to discuss potential improvements in collective irrigation management.

The manager of a water user association in the Kebili Region said: *"We installed probes in our study area to monitor various parameters and several workshops were held with different stakeholders (researchers, farmers, administrative staff). The probes enabled us to track changes in several factors: accumulated water, water salinity, soil salinity, and temperature. Managing irrigation water in a scientific manner, as introduced in Massire, is very interesting. The probes installed by the Massire project have been helpful in advising farmers on how to reduce irrigation frequency or better fertilize the soil."*

A staff member from the Office for Agricultural Development in the Kebili Region said: *"A particularly interesting aspect is the organization of water user associations, which is considered innovative due to the improvements it brings for efficient management and resource control, as well as the fight against fragmentation in traditional oases. As part of Massire activities, we created a map of our oasis, which didn't exist before. Additionally, we prepared a database that includes plot identification, area delineation, and improvements to the water allocation system based on the surface areas recorded in the water user association's documents."*

4.1.3. The use of solar energy in a sustainable way

Analyses were conducted to explore more sustainable options for using solar energy for irrigation powered by groundwater pumping (Mekki et al., 2024). A staff member from the Office for Agricultural Development in the Kebili Region said: "The innovations developed by the project include crucial actions such as the water-saving system represented by the installation of water meters at irrigation points, environmental monitoring of palm trees through soil humidity measurements at several pilot stations, and exploring ways to reduce electricity costs for water user associations by promoting and facilitating the use of solar energy."

4.1.4. Treatment and reuse of waste water

In Morocco and Algeria, two pilot units were installed and tested for wastewater treatment, with the treated water being used for irrigation. One of the plants, located in a district of the Ghardaïa Region, has low maintenance costs and produces no odour nuisance. The treated wastewater is used to irrigate a 2,500 m^2 garden, which is planted with 372 trees of 17 different varieties.

Photo 15. Pilot treatment plant and garden in Ghardaïa Region

A representative of a local development foundation in the Ghardaïa Region shared: *"The PhD thesis work and the involvement of experts gave us a valuable opportunity to acquire and share detailed knowledge about the various decentralized technical processes for treating wastewater. These exchanges helped us understand the pros and cons, as well as the implications, of different approaches, making collective decision-making easier. In addition to evaluating the proposed process initially, the treated wastewater reuse experts also assisted in resolving technical issues after the decentralized wastewater treatment plant was commissioned, such as adjusting the inlet pipe (...). By treating wastewater from two schools before it is discharged into the environment, the plant, established through the Massire project, helps reduce water pollution, benefiting human health, local flora and fauna, and the overall sustainability of the eco-district. The implementation of the decentralized wastewater treatment plant has allowed local authorities to explore smaller, more affordable alternatives to large, conventional treatment plants. These larger plants often face technical, maintenance, and management challenges that undermine their reliability and productivity."*

Another wastewater treatment plant was set up in Tinghir. This system is specifically tailored for isolated households or hotels. It is designed to be low-investment and low-maintenance, and it also enables the irrigation of a small plot using treated water (for further details on the two pilot wastewater treatment plants, see El Meknassi Youssoufi et al., 2024).

Photo 16. Pilot treatment plant in Tinghir

The hotel owner where the pilot unit was installed in Morocco shared: *"After the treatment plant was introduced, we began noticing improvements, such as the disappearance of the sewer smell and mosquitoes. I no longer worry about the wastewater's impact on the land, the river, or the environment in general. Looking ahead, I am confident that the treated water will be of good quality for irrigation. If all goes as planned, we're considering expanding the project, producing compost, and leasing more land to cultivate crops. I'm very hopeful that my hotel will become a scientific research test station. My goal is to focus on organic farming. Following the installation of the treatment plant, several other tourism establishment owners reached out to me to learn from this experience and install the system at their properties."*

Discussions also concerned environmental management within traditional oases of Ghardaïa.

A farmer responsible for managing groundwater recharge in Ghardaïa shared: *"The project brought various stakeholders together in participatory workshops, allowing everyone to share their opinions and gain a multidisciplinary perspective on the water challenges in the oasis. Together, we worked on finding solutions."*

"For instance, during the workshops,we addressed the sanitation issue in the oasis and the importance of dry toilets. Since then, several farmers and tourist lodges have built new dry toilets. We also required tourist lodges to install tanks to collect wastewater, aiming to protect the oasis. This decision followed quality analyses conducted by the Massire team, which revealed contamination of wells near septic tanks."

Photo 17. Installation of the pilote waste water treatment plant in Ghardaïa

4.1.5. Artificial groundwater recharge

In Morocco, a PhD thesis examined the operation and hydrogeological impact of an **artificial groundwater recharge system** (Khardi, 2023). Workshops were conducted to explore various methods of artificial groundwater recharge (Zein Taleb et al., 2024).

In Algeria, discussions were held in workshops about the development of new agricultural expansions upstream of traditional oases, which constructed weirs along the river to capture floodwater, negatively impacting the ability of farmers in traditional oases to also access this water (Saidani et al., 2024a). A policy brief outlines the key issues and potential solutions regarding groundwater recharge (Khardi et al., 2024b).

A farmer responsible for the traditional management of groundwater recharge through floods explained:

"Before the Massire project, there was no real recognition of the traditional water-sharing system. People didn't value the importance of the seguias [traditional irrigation canals], the wells, especially the infiltration wells. Even in research, most students or researchers visiting the region were more interested in the architecture of the ksour [traditional villages] rather than the traditional water management system.

There were also no meetings or gatherings that brought together different stakeholders to collectively address oasis issues, particularly the water challenges. The contact with researchers at Massire allowed us to produce a wealth of knowledge, especially regarding water quality and quantity. This collaboration enabled us to combine our knowledge and experience with scientific research, creating collective knowledge."

Photo 18. Basin part of a groundwater recharge system that was studied as part of a PhD thesis

4.2. New farming systems and practices

4.2.1. Enhanced biodiversity and soil management

Activities carried out within the project highlighted the added value of **preserving biodiversity** in farming plots.

A staff member of a water user association in Kebili and also a farmer shared: *"Farmers have become more aware of the benefits of returning to traditional farming methods that involve growing three layers of crops (date palms, fruit trees, and market crops/fodder) based on water availability and soil type. The water user association has been crucial in providing farmers with valuable information on this approach."*

In Tunisia, a grinder was developed to process palm fronds and convert them into compost. Similarly, grinders were created and distributed in Morocco to promote new agricultural practices aimed at transitioning to organic farming.

In both Algeria and Tunisia, the project supported the reintroduction of common date tree varieties, which require less water than the Deglet Noor variety and are more resilient to water scarcity and heatwaves.

A Tunisian farmer stated: *"I've improved my skills in organic farming, changing some of my practices, such as moving away from monoculture and diversifying my crops. I've learned the economic and environmental benefits of common date varieties. They yield more than Deglet Noor dates, are more disease-resistant, and require no treatment. In previous years, I planted only 10 to 15 common dates, but now I've planted an entire plot with Kentichi common dates. I also purchased 150 common date plants for another plot." In Morocco, farming field schools and experiments were conducted to demonstrate organic methods for controlling palm tree pests.*

Photo 19. Common dates in Ghardaïa

4.2.2. Development of more resilient value chains

A saffron producer in Algeria shared: "The activities organized through the Massire project have allowed me to expand my technical knowledge of innovations applicable to the saffron sector. For example, we learned how to modify a shredder to process palm fronds into compost." Another saffron producer added, *"I view the Massire project's activities as an accelerator for the saffron sector's development in the region. Although the cultivation of saffron and agroecological practices may have local and ancestral origins, the Massire project's actions bring significant value by enhan cing organizational aspects and introducing innovations, such as organic certification and palm frond shredders."*

A staff member from a professional agricultural college in Ghardaïa remarked: *"In the Sahara, young people are moving away from agriculture, believing it to be unprofitable. However, the Massire project has shown the importance and profitability of agriculture. For instance, saffron was once seen as a challenging crop to grow and produce. Thanks to Massire and the experimental plot, we now realize that growing saffron is not that difficult, and it can be profitable."*

4.3. Area-wide management

The project encouraged reflection on how to plan the development of an entire area. A staff member from the Regional Office of Agricultural Development in Morocco said: *"The diagnostic results from the MSP on oasis mountain development were shared in a participatory manner with all local stakeholders. This approach enabled us to conduct a structured analysis of the M'semrir area, identifying all the issues related to the plant system, water use, livestock farming, tourism, climate change, and resilience. "*

These results have formed a solid foundation for a new development project, which is currently being developed. We have engaged in detailed discussions with various partners, particularly farmers' organizations and academic institutions, to apply for funding for this project, using a concept note based on the diagnostics carried out through the Massire project."

Photo 20. Animal breeding in mountain areas of Msemrir

05

PROJECT ORGANISATION AND IMPLEMENTATION

Photo 21. Workshop with farmers in Kebili region

5.1. Partnerships and policy

The 18 MSPs implemented by Massire facilitated the creation or strengthening of partnerships between various stakeholders, including producers (farmers, women, young entrepreneurs), local development organizations, public administration staff, and researchers.

These collaborations predominantly occurred at local and regional levels, with one exception being the work on the saffron value chain in Algeria, where discussions and networking took place at the national level.

Throughout the MSPs, there was frequent interaction between researchers, students, and actors in work areas.

Researchers addressed the concerns and questions raised by oasis stakeholders, a dynamic not always present in some other contexts. These interactions fostered a climate of trust and transparency throughout the entire process.

> A manager of a farmer association in Morocco said: *"One of Massire's major innovations is the participatory approach. Thanks to Massire, I have come to understand the significance of information and research mechanisms. For instance, the study conducted by a Master's student uncovered crucial details about our field, such as the amount of water required per plot of date palms depending on the season and the age of the trees. We also learned about the importance of drip irrigation in maximizing water efficiency and addressing drought. This information was presented scientifically, in contrast to our previous methods, which were based on inherited knowledge."*

At the conclusion of the MSPs, a key element that consistently emerged was the creation or strengthening of networks for dialogue and exchange between actors who previously had little to no opportunity to communicate.

Almost all the individuals interviewed praised how the MSPs facilitated the establishment of relationships between local authorities, farmers, associations, and researchers—relationships that had either not existed or were barely present before.

These connections were fostered particularly during various participatory events such as workshops, field schools, and field visits.

They not only enabled exchanges of knowledge and expertise but also played a crucial role in facilitating the implementation of collectively planned actions.

A member of a local development foundation in Ghardaïa shared: *"The dedication of the Massire team at the local level has allowed our foundation to broaden its professional network by establishing connections with state and academic institutions, particularly with the Department of Agriculture, the University of Ghardaïa, and the National Agricultural College of Algiers. A charter is currently being prepared between our Foundation, the CREAD research centre, and ENSA. This expanded network presents opportunities for future collaboration and the exchange of expertise to support the initiatives of our Foundation."*

Photo 22. Massire workshop in Douz, Tunisia, May 2022

5.2. Knowledge management and communication

5.2.1. Knowledge management

Various guides, films and policy briefs have been produced based on the results of the MSPs (see Table 7 for examples, full list in Appendix 3).

They were written in different languages, depending on the readership: French, Arabic, Tamazight, and English. All knowledge products are available on Massire website.

Table 7. Types of knowledge products prepared

Type of products	Example
Guides	Techniques for the production of saffron using organic practices (in Arabic, Tamazight and French)
Videos	Opportunities for the development of local variety dates in Kebili (in French, Arabic, English)
Policy briefs	The sustainable development of mountain oases in Morocco (in French)

Figure 6. Examples of practical guides (in Arabic and in Tamazight) and of a policy brief (in French)

Some knowledge products also served as a foundation for dialogue between stakeholders. For instance, in the 'groundwater and solar energy' MSP in Tunisia, several maps were created with farmers to show the evolution of palm grove expansions from 1985 to the present.

These maps allowed the synthesis of knowledge that was previously held individually by various stakeholders. They also made visible the changes in the area and the factors driving these changes.

Through these maps, stakeholders were able to engage in an exchange of perspectives, which was previously challenging due to the fact that these expansions are officially considered illegal.

Furthermore, these maps enabled the creation of a shared understanding of the current development of these extensions and helped formulate potential future scenarios for the area's development (Ferchichi et al., 2024b).

5.2.2. Project communication

Communication of project activities was organised along 5 main components:

Organisation of workshops at local level to initially present the project, during the project to communicate about its implementation and at the end to show project results;

A **facebook page**, where posts were written in Arabic;

Posts on **Massire webpage**, where posts were written in French;

Posts on Linkedin. These posts were produced and disseminated by Cirad Innov team as part of the **thread "natural resources and territories".** They presented the main project knowledge products;

Participation at international events, among which the 9th world water forum (Dakar, 2022).

5.3. Scaling up and sustainability

Scaling up was approached in two ways. First, public policy advice was developed from the knowledge acquired throughout the project. A series of nine policy briefs were produced, offering recommendations for potential public policies aimed at promoting more sustainable development pathways, based on the results of the MSPs. Second, in the MSP focused on the saffron value chain in Algeria, workshops were organized in 2024 to discuss the evolution of the saffron value chain at the national level.

The sustainability of project activities was ensured along two axes:

- First, many of the networks supported or created continued to function after the project concluded in June 2024. By that time, most collectives involved in the MSPs had already identified opportunities to continue collaborating. For example, a new research project was initiated to continue work on systems for the treatment and reuse of wastewater in Moroccan oases. Additionally, at the conclusion of the MSP on the saffron value chain in Ghardaïa, an agreement was signed between INSFP (National Institute for Vocational Training), CREAD, and a saffron producer organization to manage a plot for experimenting with saffron farming practices.

In September 2024, after the Massire project ended, INSFP distributed saffron seeds to producers and vocational training centres as part of a "seed bank" initiative. Another agreement was signed between CREAD and a local development foundation to continue monitoring the implementation of the pilot water treatment unit in Ghardaïa.

- Second, in post-project interviews, stakeholders confirmed their willingness and ability to continue using the innovations tested during the project, such as: 1) pilot systems for wastewater treatment; 2) soil moisture probes to enhance irrigation practices; 3) progress on an organic certification process; and 4) the development of online marketing.

5.4. Limits, uncertainties and proposals for improvement

5.4.1. Limits

Several entrepreneurs acknowledged the valuable training provided by Massire but expressed that **financial support was essential** to advance their projects. A young entrepreneur in Algeria mentioned: *"The project offered us training, but there was no support or follow-up for the young people during the project."* Another entrepreneur stated: *"One of the disadvantages of the Massire project is the lack of regular monitoring of the identified projects, particularly individual monitoring for each project. While Massire allowed us to gain new knowledge and share experiences, the project did not provide regular follow-up. There was also not enough training."* More generally, some farmers had higher expectations of Massire as a development project, hoping it would provide funds for the large-scale distribution of materials.

Some interviewees pointed out the lack of concrete implementation of certain solutions discussed within the Massire framework. A farmer from Ghardaïa stated: "In the framework of Massire, we organized many meetings and workshops to discuss the problem of production in Ghardaïa and propose solutions together. However, none of the solutions discussed have been applied on the ground. We received promises during the project, but they were not realized."

A saffron producer in Ghardaïa shared: *"At the moment, I have not yet put into practice the innovations tested or initiated within the framework of the Massire project. My financial situation does not allow me to invest in a shredder or in organic certification."*

Similarly, other stakeholders noted that **while decisions were made, they had not yet been implemented.** A rural municipality member in Ghardaïa said: *"During the final workshop, which brought together various institutions (Directorate of Agricultural Services, Directorate of Water Resources, Agricultural Chamber, etc.) as well as farmers, a new internal regulation was established. They also resulted in a final decision stipulating the need to create a national office dedicated to the management of Albian boreholes, due to the lack of time and training of farmers to manage these associations. However, no measures have been implemented to date. This requires continuous follow-up after the project."*

This challenge was also due to the relatively short time span of the project, which limited time for testing innovations and scaling them up.

5.4.2. Uncertainties

Several participants highlighted uncertainties regarding **who will take over the coordination of future activities.** They emphasized the need for both human and financial resources to continue testing and upscaling innovations. A member of the Tafilalet Regional Office for Agricultural Development in Morocco remarked: *"The process [MSP] itself is a success, and the approach is commendable, but there was perhaps a lack of planning regarding the person or entity that will steer the planned activities to ensure the harmonious participation of all the stakeholders and the sustainability of the project over time. There is still uncertainty as to who will take over from the Massire project to coordinate all these actors."*

A staff member of the Regional Office for Agriculture in Ghardaïa added: *"In the case of collective borehole management, problems persist despite reports sent to higher authorities. As for saffron, I don't know if this activity will continue in the future. The sustainability of this crop in Ghardaïa is very uncertain, as the majority of producers have already moved their activities to other regions outside Ghardaïa. Regarding the workshops and communication between the different actors, it is unclear whether this will continue after the end of the project. The women's activity was very interesting, but no one was appointed to ensure its sustainability after the end of the project, in particular because no women from institutions were involved to ensure its continuity."*

A staff member of a local office of the Ministry of Agriculture in Tunisia noted: *"At our local level, we don't have the resources—staff, equipment, or finance—to continue. But the project is very important, so we are discussing the project's objectives with the relevant officials in order to program it and request the necessary funding."*

Furthermore, several actors pointed out that it **was too early to assess the impact of Massire.** A farmer in Ghardaïa remarked: *"I can't yet judge how much change the project will bring, as it's still too early to assess its impact. We have to wait and observe to draw conclusions."*

5.4.3. Proposals by interviewed actors

At the end of the project, several interviewees proposed ways to improve the approach in the future. One key suggestion was to more systematically distribute reports and documents produced during the MSPs to all participants involved, ensuring that all stakeholders had access to the information generated.

Additionally, there was a call for each MSP to build a clear strategy for sustainability at the end of the project.

A staff member of the Regional Office of Agricultural Development in Morocco emphasized the importance of planning for the future by stating: *"There is still uncertainty as to who will take over from the Massire project once it is completed, to coordinate all these actors. It would make sense to plan on the person or entity that will steer the planned activities to ensure the harmonious participation of all stakeholders and the sustainability of the project over time."* These proposals reflect a desire for clearer coordination and more structured follow-up, aiming to ensure the long-term impact and sustainability of the initiatives initiated by the Massire project.

06

CONCLUSIONS AND RECOMMENDATIONS FOR FOLLOW UP

Photo 23. Saffron harvest in Ghardaïa region

A "research and education for development" project

The Massire project aimed to address the challenges of collective commitment in rural areas of the Maghreb by proposing an innovative approach that combined research, pilot development activities, and training. This approach emphasized the importance of overcoming divisions, encouraging the participation of all stakeholders, and leveraging local knowledge. The integration of research activities, education of young engineers, and development initiatives proved to be highly effective, as each strand contributed meaningfully to the other two. A staff member of the Regional Office of Agriculture in Morocco highlighted a key decision made during the project: *"The crucial question is whether to wait for the results of the scientific studies carried out by the Massire Project before applying them, or whether to do so simultaneously."*

"This question was discussed at a workshop in Tunisia, as each option has its advantages and disadvantages. Waiting until the end of the project before starting the application will take time, while starting the application without having scientifically approved information risks compromising the results. In the end, the decision was taken to work simultaneously on research and development."

This decision to work in parallel—combining research with immediate application—was crucial for the project's flexibility and responsiveness to local needs. It ensured that progress could be made on the ground while scientific studies were still underway, allowing for real-time adaptation and implementation of innovative practices in the region.

The relevance of "open" approaches to jointly build activities with local actors

Approaches for research and development have to evolve to overcome the current limitations of collective commitment in the rural areas of the Maghreb.

One of the key successes of the project has been the ability of the MSPs to "break down silos" and strengthen agricultural and rural innovation systems at the local level. By fostering a collaborative environment, this approach has bridged gaps between different sectors (e.g., water management, agriculture) and connected distinct "worlds", such as research, training, and development support.

This integration allowed for synergies to emerge, facilitating more holistic and sustainable solutions to the region's challenges. In a context where traditional models for disseminating knowledge are no longer adequate, the project's approach has helped create more open, collaborative networks of actors. These networks have enabled the inclusion and valuing of local knowledge in the innovation process, ensuring that innovations are not only scientifically sound but also culturally relevant and practically applicable to local contexts. By doing so, Massire has promoted a more inclusive and adaptive innovation ecosystem that can better respond to the diverse needs and challenges faced by rural communities in the Maghreb.

An "enabling" logical framework

The Massire project's logical framework (logframe) played a crucial role in facilitating the project's open and flexible approach.

Donors often require robust frameworks to justify funding, and the Massire logframe met this requirement while providing space for adaptability and exploration by local stakeholders.

Performance indicators focused on both quantitative measures, such as the number of participants, the diversity of innovations explored, and the scope of training programs, as well as qualitative assessments, such as improvements in networks and learning outcomes within the MSPs.

However, while the logframe provided general themes, it did not rigidly tie performance evaluation to specific pre-identified innovations.

This flexibility enabled stakeholders to identify and prioritize the issues most relevant to their local contexts, allowing for more dynamic and responsive project execution.

The absence of overly prescriptive indicators encouraged collaboration and the organic evolution of ideas based on real-world needs, fostering innovation in ways that might not have been possible with a more rigid framework. In the future, using this type of flexible logframe would be highly beneficial.

It allows for a balance between accountability to donors and the autonomy of local actors to shape the project in ways that best fit their contexts, ultimately leading to more effective and sustainable development outcomes.

Photo 24. Discussion around compost practices in Errachidia region, Morocco

07

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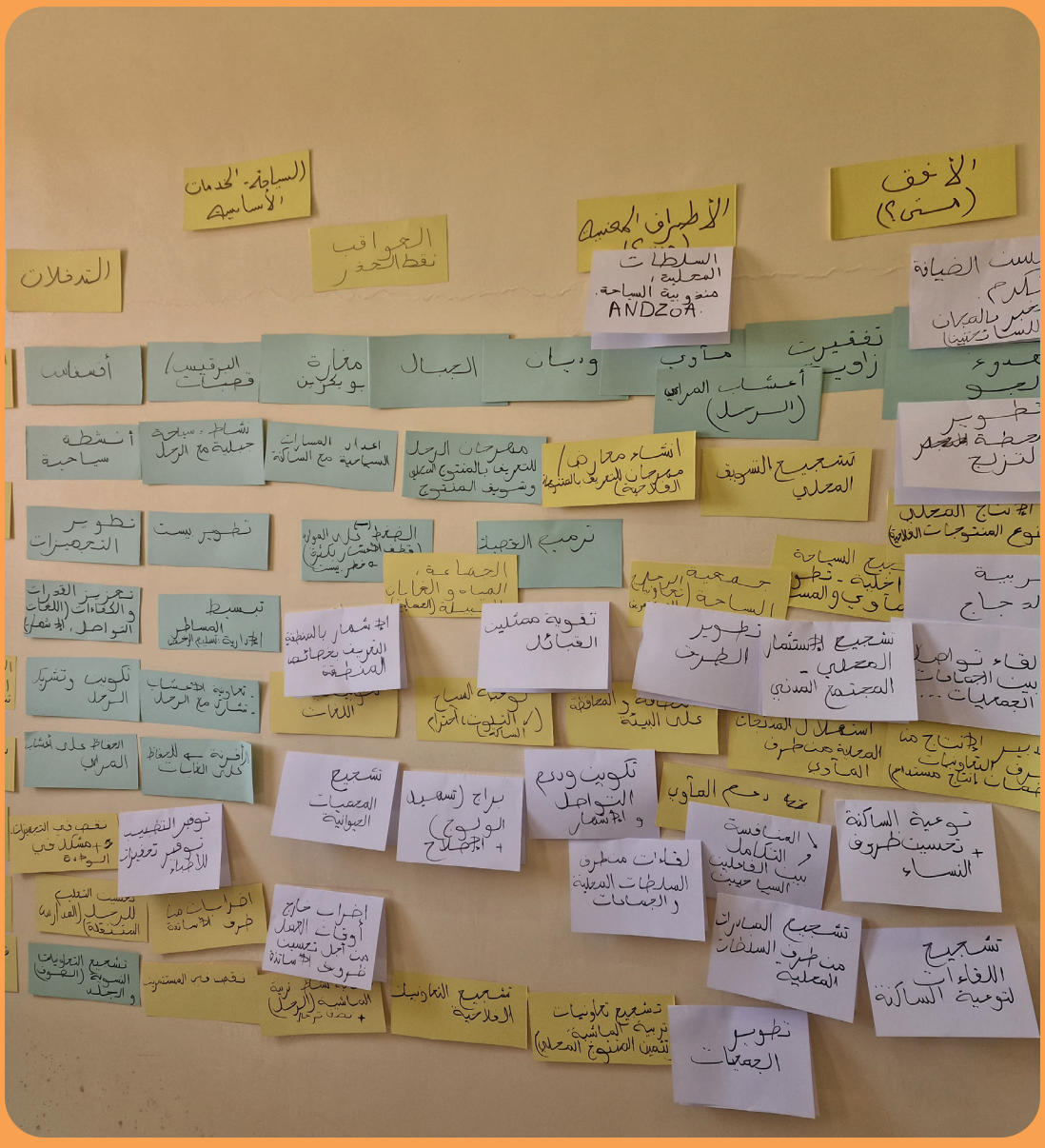

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08

APPENDIX

Photo 26. Mountain oasis landscape in Morocco

8.1. Appendix 1. Participants

Table 8. Participants in the activities of Massire

Category			Morocco	Algeria	Tunisia	Total
Local professional actors	Gender	Women	27	98	176	301
		Men	248	366	191	805
	Age	Youth (18-35)	30	80	42	152
		Intermediary age (36-45)	101	53	89	243
		46 and more	144	331	236	711
	Professional Category	Farmers who are members of water user associations	13	137	30	180
		Cooperative members	27	7	66	100
		Family farmers not members of cooperatives or water user associations	194	19	84	297
		NGOs	12	18	32	62
		Staff of local administration	17	83	99	199
		Other professionals	9	200	56	265
Total professionals			**275**	**464**	**367**	**1106**
Students	Gender	Women	95	5	24	124
		Men	54	4	20	78
	Training type	Collective in-field training periods	88	0	30	118
		Master thesis	59	19	13	91
		Phd thesis	3	2	1	6
Total students			**149**	**21**	**44**	**215**
Start-ups			**1**	**1**	**2**	**4**
Participants in Massire			**436**	**473**	**411**	**1320**

8.2. Appendix 2. Capacity-building

8.2.1. Training courses

Table 9. Training courses implemented

	Topic	Location	Date	Participants	Number of participants
1	Geographic Information Systems	On line	November 2021	Members of the agency for land management in Tunisia	7
2	On-line marketing	Ghardaïa	May 2023	22 Algerian women and 5 Tunisian women	27
3	On-line marketing	Ghardaïa	April 2022	Saffron producers	9
4	Water management	Ghardaïa	February 2024	Members of water user associations	70
5	Organic certification	Ghardaïa	February 2024	Saffron producers and others.	50
6	Farmer field school	Ghardaïa	April 2024	Saffron producers	42
7	Packaging	Ghardaïa	April 2024	Saffron producers	64
8	Organic date production	Errachidia	2023	Farmers	176
9	Strategic planning	Tunis	May 2023	Leaders of farmer organisations and young entrepreneurs from Morocco (8), Tunisia (10), Algeria (12)	30
10	Entrepreneurial projects	Kebili	From March 2021 to February 2023	Young people	37
11	Training of members of women producer associations	Kebili	5 workshops from Sept 2022 to May 2023	Women	21
12	Training on on-line marketing for saffron producers	Ghardaïa and Algiers	2 workshops in August 2022	Saffron producers	10
13	Farmer field school on use of non-conventional source of water	Kebili	December 2022	Farmers	20
19 to 21	Farmer field schools on new farming practices	Kebili and Medenine	Three events between March 202 and May 2023	Farmers	49

22	Irrigation techniques	Tinghir	November 2023	Members of Afanour water user association	23
23	Water resource management at catchment level	Tinghir	February 2023	Farmers	17
24	On-line marketing	Ghardaïa	May 2023	Women producers and young saffron producers	18
25	Management of Water User Associations	Ghardaïa	February 2024	Farmers and managers of Water User Associations	68
26	Design and use of small-scale unist for treatment and reuse of waste water	Tinghir	April 2024	Hotel managers and owners	8
27	Farmer field schools on organic farming practices	Tinghir and region	10 farmer field schools between May 2022 and May 2024	Farmers	173

8.2.2. Internships or training courses on project themes in academic curricula.

The Massire project supported the organisation of 8 collective training courses (one at INAT, 4 at the National School of Agriculture of Meknes, 3 at the Agronomic and Veterinary Institute Hassan II).

These courses involved each the participation of 10 students on average for a period of 10 days to 2 weeks.

These collective training periods took place in study areas.The students were divided into groups and made interviews to understand a specific topic.

At the end, a meeting with local actors was organized to present and discuss the finding of the students (see Kouissi et al., 2024 for more details).

Photo 27. Extension areas in Kebili region

8.2.3. Local actors taking part in study and networking trips

Table 10. International trips

Topic	Location	Date	Participants	Number of
International trips				
Training on strategic planning	Tunis	May 2023	Leaders of farmer organisations and young entrepreneurs from Morocco (8), Tunisia (10), Algeria (12)	30
Training on on-line marketing	Ghardaïa	May 2023	Women entrepreneurs from Tunisia	5
Participation of local actors in Massire annual meeting	Kebili	May 2022	Actors from Algeria (3) and actors from Morocco (5)	8
Visit about organic value chains, sustainable farming practices	Kebili	November 2023	Farmers and staff from Ministry of agriculture, from Morocco (14 people) and Algeria (4)	18
Visit about organic value chains, sustainable farming practices	Errachidia (Morocco)	February 2024	Farmers and staff from Ministry of agriculture, from Tunisia (12 people) and Algeria (1)	13
National trips				
Visit to a water user association managing groundwater, one using solar energy and one using a performing information system	Gabes and Cap Bon (Tunisia)	May 2023	Farmers and staff from the Ministry of Agriculture of Kebili	23
Visit to women producer cooperatives	Souss (Tunisia)	July 2023	Members of 6 women producer organisations from Kebili	24

Photo 28. Oasian landscape in Morocco

8.3. Appendix 3. Knowledge products

8.3.1. Videos on agricultural and rural dynamics, and on innovations

A total of 7 videos are available on **Massire Youtube channel**.

Table 11. Videos produced by Massire (FR: French, AR: Arabic, EN: English)

Title and languages
Presentation of Massire project (FR subtitled EN, AR subtitled AR)
Organic dates, an opportunity for the sustainable development of oases (versions in FR, AR and EN)
A second life for water in oases: the reuse of treated waste water (versions in FR, AR, EN)
Trajectories of development of farming extension in Kebili region in Tunisia (AR/FR)
The future of farming extensions in Kebili region, Tunisia (AR/FR)
Dates of local varieties in Tunisia (AR subtitled EN, AR subtitled FR)
The promotion of women entrepreneurship in oases and digital marketing (AR, AR subtitled FR)
A pilot system for waste water treatment and reuse in Ghardaïa" (versions in AR, FR).

8.3.2. Practical guides on implementing innovations and methods for supporting multi-actor processes

The following guides were produced.

1) Production of compost for farmers (in FR and AR)
2) Production of compost for technicians (FR)
3) Saffron production (FR, Tamazight and Arabic versions)
4) Conception of a compartmentalized anaerobic reactor (FR)
5) Methodology to design a multistakeholder process (FR)
6) Field schools for students or researchers (FR)
7) Improvement of irrigation practices in Moroccan oases (FR and AR)
8) Improvement of collective irrigation practices in Algerian water user associations (AR)
9) Crop diversification in oases of Kebili (FR)
10) Analysis of resilience (FR)

Policy briefs on territorial dynamics and innovations

The following policy briefs were published (in French).

1) The sustainable development of mountain oases
2) Resilient agricultural value chains enabling a strong impact on local development
3) New systems for treatment and reuse of waste water in oases
4) Controlling the development of solar energy for irrigation in Morocco and Tunisia
5) Improving the values of local date varieties in Tunisia
6) Developing groundwater recharge
7) Legalisation of agricultural extensions in Kebili, Tunisia
8) Economic activities of women in oases of the Maghreb
9) Young entrepreneurs in oases of the Maghreb

8.3.3. Scientific articles on territorial dynamics and innovations

More than 40 scientific articles were produced (see **https://massire.net/publications/**). Some of them were published in a special issue of New Medit in 2022, a special issue of Cahiers Agricultures in 2024/2025, and in a thematic section in Issue 10 of Alternatives Rurales in 2024/2025.

Photo 29. Saffron plant in Ghardaïa region

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