

## Blue economy circular value chains

# Business case: Promoting a sustainable and resource-efficient aquaculture in Tunisia

### Baseline analysis and challenge

The Tunisian aquaculture industry is a rapidly growing sector contributing to food security and trade, accounting for TND 2 billion (EUR 0.63 billion) of the national GDP. However, the sector faces challenges that impede its profitability and sustainability. High operational costs, particularly for fish feed and fingerlings (juvenile fish), are a concern. Many of the inputs are imported, which make the value chain more vulnerable to potential disruptions and currency fluctuations.

A value chain mapping conducted by the United Nations Industrial Development Organization (UNIDO) in 2020 and 2021 identified that conventional aquafarming methods in Tunisia rely heavily on manual feeding and visual monitoring techniques. This results in a higher Feed Conversion Ratio (FCR) compared to international best practices, resulting in wasted fish feed. Consequently, this wastage negatively impacts the farm's profitability and harms the surrounding marine ecosystem.

### The scope of the pilot project

To address some of these issues, a pilot project developed under the European Union funded SwitchMed programme, was launched in 2022 to demonstrate how the adoption of eco-innovative technologies in the Tunisian aquaculture sector could support aquaculture farmers to optimize production performance and reduce their environmental impact. Led by UNIDO, the pilot project employed a dual approach: showcasing resource efficiency through implementing advanced technologies in an industrial setting while simultaneously enhancing capacity and awareness among aquaculture value chain actors regarding innovative technologies pertinent to Tunisia's aquaculture sector.

### The results and key takeaways

**Technology demonstrations:** The project deployed an integrated solution at Hanchia aquafarm, located 14 kilometers offshore from Teboulba, using underwater cameras, Artificial Intelligence (AI), Internet of Things (IoT) antennas, and solar platforms to optimize the FCR.

Underwater cameras provided continuous live streaming from the fish cages, enabling remote monitoring of fish behavior, water quality, and potential threats. This real-time data collection facilitated accurate and timely decision-making in fish feeding.

The AI software was crucial in determining on-the-spot fish biomass, which conventionally is a labour-intensive task. This technology not only saved time but also improved accuracy, reducing stress-related fish mortality. Additionally, AI-calculated FCR enabled more precise daily feed rations, minimizing waste and environmental impact.

The combination of these technologies has demonstrated the potential to reduce FCR by up to 15%. At Hanchia, with an annual production of 2,500 tons of fish, this reduction could save approximately 860 tons of feed annually. Given the average feed cost of TND 4.4/kg (EUR 1.3/kg), this translates to an annual cost saving of TND 3.8 million (EUR 1.1 million) with a payback period of eight months. Additionally, the environmental benefits at Hanchia could include the prevention of more than 110 tons of nitrogen and 16 tons of phosphorus pollution.

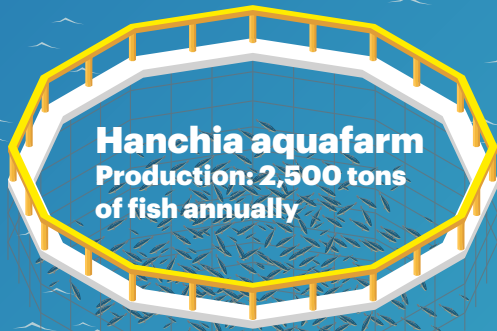
**Training and awareness raising:** A curriculum consisting of eight modules was developed to convey technical knowledge about the economic and environmental benefits of eco-innovative technologies to a wider aquaculture community. This initiative aimed to raise awareness of improving sustainability and reducing the impact of aquaculture activities on the marine ecosystem.

More than 480 participants registered for the online training modules, including representatives from the private sector, R&D, and government institutions. The training activities benefited not only the Tunisian aquaculture community, which accounted for more than 50% of the participants, but also neighbouring Mediterranean countries, with significant participation from Morocco (25%), Algeria (11%), and Egypt (5%). The eight modules were provided as an e-learning package and remain publicly accessible online to interested stakeholders.

**Fostering collaboration between technology providers and the Tunisian aquaculture sector:** The project facilitated business-to-business events to encourage interactions between the Tunisian aquaculture sector and international technology providers. Additionally, a technology catalogue and dedicated website were developed as gateways for Tunisian and international stakeholders, fostering partnerships and investment in sustainable aquaculture technologies.

With a growth in production capacities and a need to advance aquaculture practices towards sustainability, Tunisia is becoming an interesting market for aquaculture applications in the Mediterranean. International technology providers from Denmark, France, Greece, the United Kingdom, Norway, Spain, and Tunisia showed strong interest in offering innovative solutions for sustainable aquaculture practices in Tunisia. The business-to-business interactions engaged over 80% of the Tunisian value-chain actors, resulting in more than 100 bilateral meetings and exposing the private sector to existing funding mechanisms to facilitate access to innovation. As a result, several Tunisian aquafarms have expressed interest in investing in AI solutions and are engaging with international technology providers to implement these innovations in their production sites across Tunisia.

# The use of eco-innovative underwater camera, IoT, and AI leads to:



**Payback period:**  
Eight months

**Annual cost saving:**  
TND 3.8 million  
(EUR 1.1 million)

**Annual feed saving potential:** 860 tons

**An FCR reduction:**  
up to 15%

**Nitrogen pollution prevention:**  
> 110 tons annually

**Phosphorus pollution prevention:**  
> 16 tons annually

Graphic: UNIDO

## Recommendations for advancing eco-innovative technologies in Tunisian aquaculture

Building on the pilot project's outcomes, several recommendations have emerged for advancing eco-innovative technologies within the Tunisian aquaculture sector. To address the connectivity challenges faced by IoT devices, it is crucial to improve the network infrastructure and the long distance between aquafarm zones and the shore appeared as a limiting factor for the integration of eco-innovative technologies. Enhanced 4G, or 5G, network coverage, particularly in offshore areas, is essential for reliable data transmission and should be coordinated with maritime spatial planning.

Engaging stakeholders through regular consultations, workshops, and technical meetings is vital to ensure broad support for eco-innovative applications. This engagement should include aquafarmers, technology providers, national authorities, and environmental groups. Simplifying customs procedures for importing new technologies could also help accelerate their adoption.

Annual technology matchmaking events, such as the project business-to-business events, should be established to foster collaboration between international technology providers and the Tunisian aquaculture community. These events could help facilitate the integration of new eco-innovations in the Tunisian aquaculture sector.

Furthermore, strengthening institutions such as the National Institute of Marine Sciences and Technologies (INSTM) and the Tunisian Aquaculture Centre (CTA) is necessary to continue raising awareness and facilitating technology transfer. Ongoing support for research and development should align with industry needs to ensure that innovations are practical and effective. Engaging a broader audience, including academic and technical institutions, will help integrate eco-innovative technologies across all levels of the sector, preparing the next generation of aquaculture professionals.

The pilot project has demonstrated the transformative potential of eco-innovative technologies to enhance the efficiency, sustainability, and profitability of Tunisian aquaculture. By addressing the identified challenges and implementing the recommended strategies, Tunisia could develop a more sustainable aquaculture in the Mediterranean. Coordinated efforts from government agencies, industry stakeholders, and technology providers are required to foster a collaborative and innovative ecosystem. Such efforts will not only benefit the local economy and foster a more prosperous and environmentally responsible future for the Tunisian aquaculture industry.

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Integrating eco-innovative technologies in the Tunisian aquaculture sector is crucial for enhancing its economic performance while preserving the marine environment, thus ensuring a transition to a more sustainable and resilient production model for the future.

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