

temperature

salinity

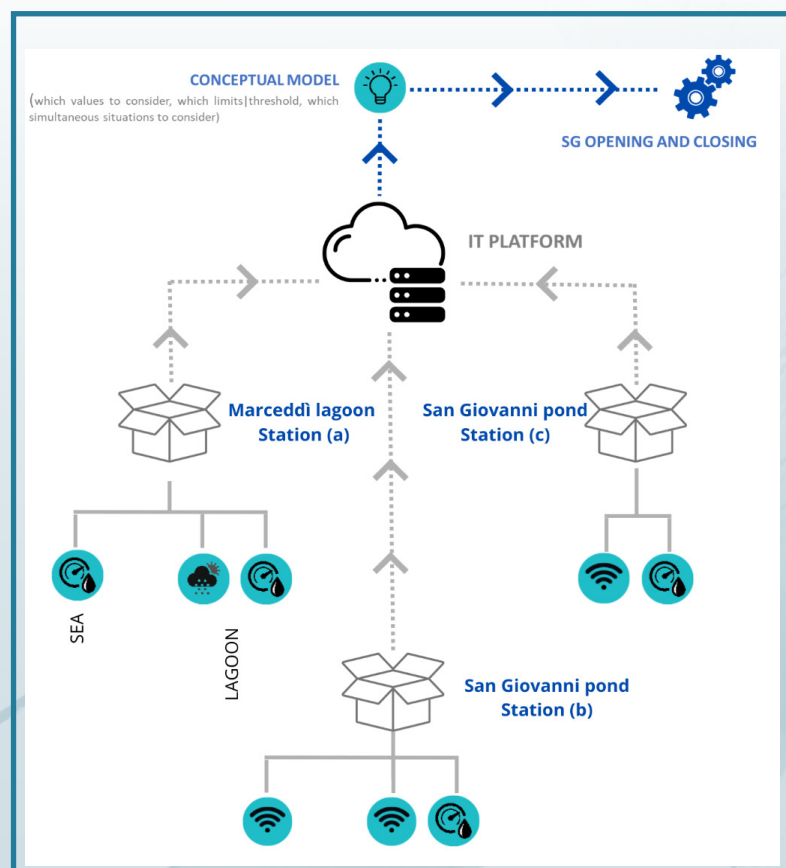
Changes in
water circulation

Pond of San Giovanni
Photo e infographic© CZU, Prague

ENVIRONMENTAL MONITORING NETWORK IN THE MARCEDDI AND SAN GIOVANNI PONDS

INSTALLED INSTRUMENTATION

- 3 multiparametric probes
- 4 piezometric level gauges
- 1 weather station



The environmental monitoring system installed in the San Giovanni lagoon and the Marceddi lagoon aims to acquire real-time environmental and hydrological data to support decisions on climate adaptation and ecosystem management.

Main objectives:

Continuously monitor water quality in lagoon and estuarine environments, focusing on critical parameters for ecological status such as salinity, dissolved oxygen, and turbidity.

Enable adaptive hydraulic management by monitoring water levels and weather-climate conditions, in relation to the operation of regulatory systems such as the smart sluice gate.

Provide up-to-date environmental data to support the management of the lagoon and its productivity, particularly activities related to fishing and aquaculture.

The monitoring network

STATION A – MARCEDDÌ BRIDGE

Located at the interface between the Marceddì lagoon and the sea, this station is designed to collect **hydrometeorological data** useful for assessing **water exchanges and the effect of tides**. Equipped with:

- **Weather station** with sensors for:
 - Wind speed and direction
 - Temperature and relative humidity (thermo-hygrometer)
 - Precipitation (tipping bucket rain gauge)
- **2 piezometric level gauges** to measure water level on both sides of the bridge (one on the sea side, one on the lagoon side)



Weather station on the bridge Weather sensor detail Weather station data logger Piezometric level gauge in a bridge pillar

STATION B – SAN GIOVANNI LAGOON (NEAR THE SMART GATE)

Located inside the San Giovanni Lagoon, this is a strategic point for monitoring the water balance between lagoon and estuary. The data collected here is used to control the centralized opening and closing system of the smart gate. Equipped with:

- **2 multiparametric probes** for measuring:
 - pH, conductivity, temperature, dissolved oxygen, turbidity, redox potential
- The probes are about 10 meters apart.
- **1 piezometric level gauge** to measure water level

STATION C – ESTUARY ZONE (SAN GIOVANNI)

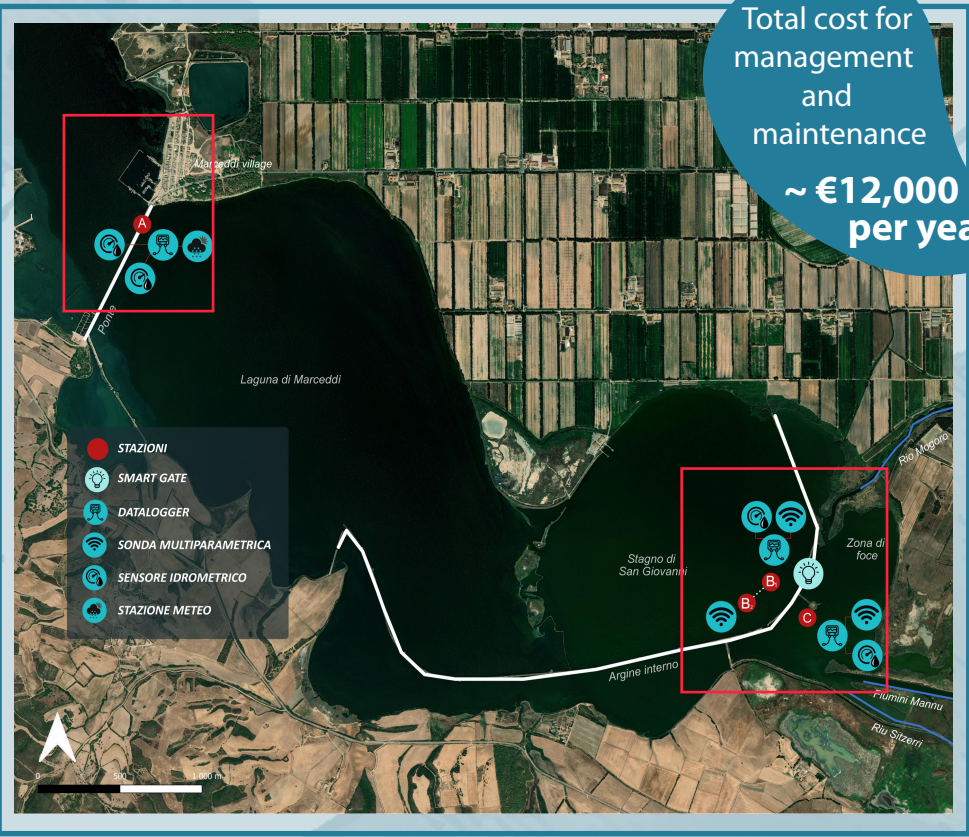
Located near the mouth of the three rivers that bring freshwater into the lagoon, this station monitors the **freshwater-brackish interface** and the **effectiveness of water exchange**. Equipped with:

- **1 multiparametric probe** (same parameters as Station B)
- **1 piezometric level gauge** to measure water level



Probe detail View of Station B Data logger Support structure

All stations are equipped with MicroMET3 multichannel dataloggers for data acquisition and FTP transmission. Power is supplied by photovoltaic panels and backup batteries, ensuring full operational autonomy in the field.



Total cost for management and maintenance
~ €12,000 per year

Maintenance and management

- MONTHLY**
 - Sensor cleaning and check of solar power system and batteries (~ €500)
 - Connectivity and IT interface test (~ €100)
- QUARTERLY**
 - Check of photovoltaic system operation (~ 300 €)
- ANNUALLY**
 - Refurbishment and recalibration of each multiparametric probe (~ 1.100 €)
 - Refurbishment, functional restoration, factory cleaning and inspection of the weather station (~ 600 €)
 - Maintenance of the data platform and control dashboard to keep it active, functional, and updated (~ 1.800 €)

Conceptual model for data analysis

The Smart Gate regulation system is based on a **control algorithm** integrated into a **Decision Support System (DSS)** that processes real-time data from the monitoring stations to determine whether the Smart Gate should open or close.

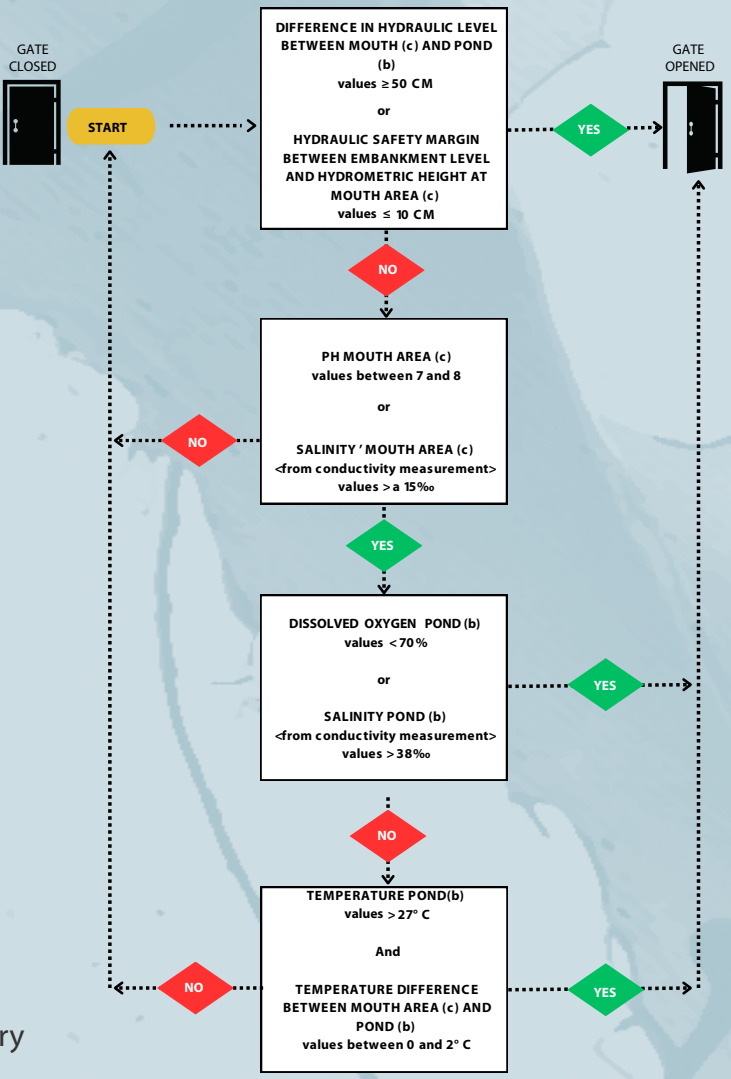
The system logic combines three sources of input:

- **Hydraulic and environmental data** collected by the sensors
- **Ecological and regulatory criteria** derived from Legislative Decree 152/2006 for the protection of fish fauna and shellfish farming
- **Management needs** expressed by local stakeholders, such as requests for water exchange or mitigation of critical conditions for production.

The operational thresholds for water quality parameters are based on Legislative Decree 152/2006 for water intended for shellfish life, and are regularly updated based on measurements and user feedback.

CONTROL VARIABLES

- Fs** (Hydraulic Safety Margin): difference between embankment elevation and estuary water level
- DH** (Water Level Difference): between San Giovanni lagoon and estuary area
- Sg** (Salinity)
- OD** (Dissolved Oxygen)
- T** (Temperature),
- pH** at both monitoring points (Stations B and C)
- ΔT** (Temperature Difference) between lagoon and estuary



LESSONS LEARNED

The experience of installing and managing the monitoring system in the **Marceddi Lagoon** highlighted some **critical aspects** to consider for future implementations in similar contexts:

➤ **Connectivity and data transmission**

Mobile network coverage proved to be unstable in some areas. It is advisable to provide more robust and integrated data communication solutions (e.g., LoRaWAN, mesh networks, or connections with existing regional networks) to avoid data loss and improve system reliability.

➤ **Data integration with other regional networks**

The data transmission system should be checked and aligned with existing regional networks, ensuring full interoperability and integration.

➤ **Operational management and maintenance**

The long-term sustainability of the system requires a well-structured maintenance plan, including regular cleaning, calibration, and verification operations.

Maintaining a digital logbook is useful to monitor equipment status and plan corrective actions.



*Pond of San Giovanni
Photo© Daniele Manca*

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For more info visit:

www.transformar.eu

The Wetland Observatory supports the conservation and sustainable management of wetlands in Sardinia. It collects and analyzes environmental data to monitor ecosystems, threats, and conservation strategies. Through webGIS and technical reports, it disseminates information on ecological status, biodiversity, and ecosystem services, raising awareness of the importance of wetlands in tackling climate change.

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The project received funding from the European Union's Horizon 2020 research and innovation program under grant agreement number 101036683