AGREEMed

Innovative Aquifers Governance for Resilient Water Management and Sustainable Ecosystems in Stressed Mediterranean Agricultural Areas

Demonstration site factsheeet

Souss-Massa basin, Morocco

Description

The Souss-Massa basin, covering 27,000 km², is one of Morocco's **key hydrological regions**, characterized by a semi-arid to arid climate with an average annual rainfall of 200-250 mm. The basin is **densely populated**, with 2.56 million people recorded in 2014, projected to exceed 3.31 million by 2030. It includes some of the country's most advanced agricultural areas, positioning it as a **major hub for modern irrigated farming** in the Mediterranean.

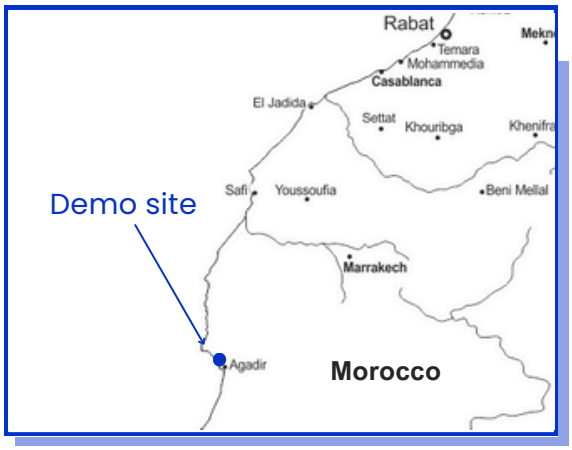

Figure 1. Souss-Massa basin demo site

Specific problems

Over the past few decades, agricultural expansion, urbanization, and climate changes have intensified **groundwater overexploitation**, leading to declining aquifer levels and water supply challenges. Additionally, water quality has deteriorated due to **saline intrusion and pollution** from fertilizers and wastewater.

Stakeholder mapping

- Souss-Massa River Basin Agency
- Regional Multi-service Agency of Agadir
- Dar Si Hmad Foundation
- Ministry of Equipment and Water
- Amane Souss Mineral Water
- National Water and Forestry Agency
- National Office of Electricity and Drinking Water
- Aman El Baraka Construction
- Ministry of Equipment, Transport and Logistics
- Women Cooperatives in Agadir
- Souss Massa Innovation City
- Ministry of Health
- Agro Tech - SM Association
- Fruit and Vegetables Producers Associations
- Farmers
- Almostaqbal Association
- Ministry of Agriculture
- Agadir Delegation of the Office of Cooperation Development

Stakeholder expectations

- **Sustainable Water Use**: Ensure water resources sustain future generations.
- **Water Quality Assessment**: Evaluate nitrate pollution and seawater intrusion.
- **Expanded Water Sources**: Develop new sources for increased water availability.
- **Efficient Irrigation**: Adopt techniques to minimize water loss in agriculture.
- **Stakeholder Involvement**: Engage stakeholders in water management decisions.
- **Environmental Sustainability**: Preserve and protect the basin's natural resources.

SOLUTION #1

SMARTIRRI

Description

SmartIrri is a smartphone application developed for **automated irrigation management**, helping farmers and agricultural managers **optimize water use**. Users can register plots with specific details like irrigation valve flow rates and coordinates.

It supports **multiple languages** (Arabic, French, and English) and calculates essential metrics like **evapotranspiration** (ET0) and water needs based on the crop type.
Daily notifications provide **updates on critical data**. This user-friendly tool aims to promote efficient, sustainable water management in agriculture.

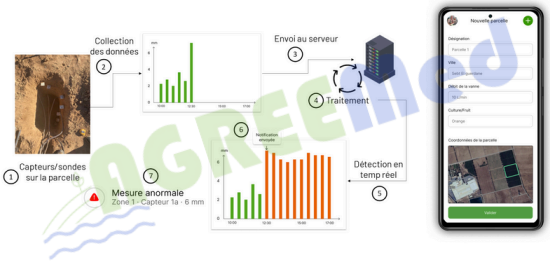

Figure 2. Smartphone application for irrigation management

Methodology

The application's methodology involves integrating **GPS mapping**, **meteorological forecasting**, and **crop-specific water requirements** to automate irrigation.

Users input plot details, such as location and valve flow rate, which the app uses along with real-time weather data to calculate the reference evapotranspiration and water needs for each crop. The app then sends daily notifications and will include an **anomaly alert** system to notify users of irregularities.

This approach combines **location-based data and predictive calculations** to enable efficient, data-driven irrigation management.

Figure 3. Eddy-covariance station for agro-météorological parameters (left), and electrical tomography for soil moisture monitoring (right)

Expected results / Latest outcomes

The expected results of the application include **optimized water use, reduced waste,** and **improved crop yields** by tailoring irrigation to specific plot needs and real-time weather conditions.
Users should see enhanced efficiency in water management, leading to **cost-saving** and sustainable agricultural practices.

Daily and anomaly notifications aim to provide timely interventions, minimizing risks and system malfunctions.

Ultimately, the app is expected to support **healthier crops** and more **sustainable water resource management** in agriculture.

S O L U T I O N # 2

GEODATABASE

Description

The **GeoDataBase** is a uniform and user-friendly database built for the Souss-Massa basin (and the other two demonstration sites).

The database includes data about **water management strategies** and physical aspects such as climate, hydrology (quantity and quality), soil, land use, and crop management. It also contains any relevant data about **freshwater ecosystems in watersheds.**

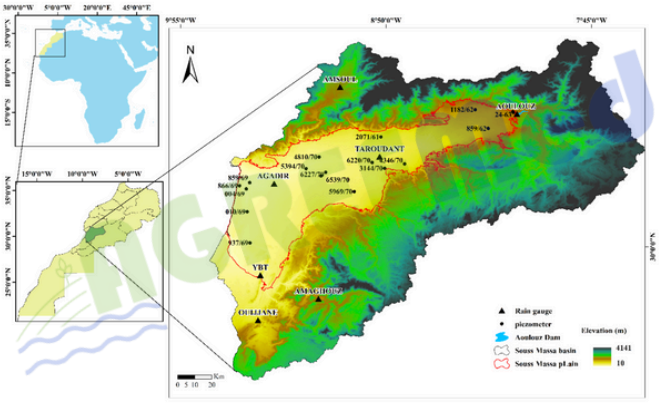

Figure 4. Localization map of the studied area and distribution of the gauged stations

Methodology

The geodatabase is structured on **geographic information system (GIS)** software to organize data across several themes: **human environment** (administrative divisions, infrastructure, etc.), **natural environment** (geology, ecosystems, topography, climate, etc.), **water resources** (hydrology, hydrogeology, quality, etc.), and **water usage** (supply, irrigation, crop management, etc.).

Data sources include previous studies, fieldwork, remote sensing, and documentation. To complete the geodatabase, missing data collection protocols and field missions are planned to fill identified gaps, ensuring a **comprehensive data structure** for informed resource management.

Figure 5. Snow melt rainwater sampling to assess their contribution to Souss-Massa aquifer recharge and to evaluate the quality of surface water in the recharge area

Expected results / latest outcomes

The geodatabase provides stakeholders with a comprehensive **platform for data-driven decision-making**, enabling better planning and resource management across sectors. It supports sustainable water resource monitoring, efficient agricultural practices, and targeted infrastructure development.

By centralizing data on environmental, hydrological, and land use aspects, the geodatabase aids researchers, policymakers, and managers in **aligning projects and policies with community and environmental needs**.

S O L U T I O N # 3

WEB-GIS PLATFORM

Description

A **Web-GIS Platform** has been developed and is currently being improved.
At present, the platform offers the following services:

- **User authentication**.
- **Creation of parcels/zones** on the map.
- **Data download** (from the database).
- **Selection of crop/fruit**.
- Upload of **climate data files** for the calculation and visualization of ET0 and water requirements.
- **Result file download** (Excel format).

Part of the development focused on the **synchronization** between the web platform and the mobile application.

Both applications share the same backend and database to ensure **unified resources and data**.

Methodology

The conception of the platform begins with gathering **requirements from stakeholders**. It focuses on key functionalities such as user authentication, parcel creation, ET0 calculations, data uploads and downloads, and web-mobile synchronization. The objective is to design a **client-server architecture with a geospatial database** (e.g., PostgreSQL with PostGIS) and use technologies like Leaflet.js for mapping, Django or Node.js for the backend, and RESTful APIs for communication.

The features are developed iteratively, ensuring **secure data handling**, seamless synchronization, and **intuitive interfaces**. The platform is deployed on a **scalable cloud infrastructure** while the mobile application uses cross-platform frameworks (e.g., Flutter). Refining and additional features are implemented as needed based on **user feedback**.

Expected results / latest outcomes

The Web-GIS platform has successfully implemented all **key features with visualization**. Seamless synchronization between the web platform and mobile app ensures consistent data access.

Users can generate **actionable insights** through downloadable reports, enhancing decision-making for crop and water management. Feedback from partners is guiding further refinements and the addition of **advanced tools** to improve scalability and functionality.

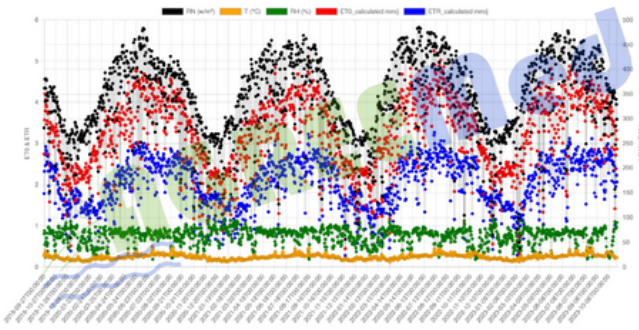

Figure 4. Prediction of irrigation water resources