

EFFECTIVE IRRIGATION MANAGEMENT IN TUNISIA

Tunisia, one of the most water stressed countries in the world is using the FAO'S satellite-based WaPOR portal to improve the efficiency of irrigation for cereal growing so improving the efficiency of water use and national water and food security.



THE CHALLENGE

Tunisia is one of the most water-stressed countries in the Mediterranean region, with renewable freshwater resources estimated at around 420 m³ per capita per year^[1] —well below the international threshold of 500 m³ defining absolute water scarcity. Water management has therefore become a strategic national priority, particularly for agriculture, which consumes approximately 80% of the country's available freshwater. Climate change, population growth, urbanisation and increasing competition between agricultural, industrial and domestic users are placing additional pressure on already limited resources, making efficient irrigation management central to Tunisia's long-term water security. On average, Tunisia has around 4.9 billion m³ of renewable water resources annually, derived mainly from surface water (55%), groundwater (45%), and a growing contribution from treated wastewater reuse and desalination, with agriculture consuming the majority of available supply^[2].

Tunisia's water resources are unevenly distributed both geographically and seasonally. The humid northern regions represent 30% of the country but receive the majority (80%) of annual rainfall^[3] and contain most of the country's surface water resources. Central and southern regions are predominantly semi-arid to arid, receiving less than 200 mm of rainfall annually. Surface water provides about 55% of the country's total but rainfall is highly variable from year to year, with frequent multi-year droughts that have become more severe and prolonged over the past two decades. During 2024, which was the 5th consecutive year of reduced rainfall, the inflow was reduced to around 36% of the normal level indicating the challenge to maintain irrigation levels.

Today, groundwater provides about 45% of the total but depletion represents one of the country's most significant water management challenges. Excessive abstraction for irrigation has led to falling groundwater levels across many agricultural regions, particularly in central and southern Tunisia. Coastal aquifers are increasingly affected by seawater intrusion, reducing water quality and limiting their suitability for irrigation. In inland areas, over-extraction has also contributed to rising groundwater salinity, requiring farmers either to accept lower crop yields or invest in more expensive water treatment and irrigation technologies. Tunisia uses approximately 75–80% of its water resources for agriculture, 15–20% for domestic supply, and less than 6% for industry. This makes agricultural water efficiency the single most important factor in improving national water security.

[1] [Tunisian Water Sector Inventory, November 2025.](#)

[2] [National Report on the Water Sector 2024.](#) Pp24-25.

[3] [National Report of the Water Sector 2021](#)

In Tunisia, irrigation is concentrated on high-value horticultural and perennial crops. Although irrigated land accounts for only 7–8% of agricultural land, it contributes around 35–40% of agricultural production value, reflecting the concentration of irrigation on intensive, commercially valuable crops such as olives, citrus fruits, dates, vegetables and fruit orchards. Agriculture employs around 12–15% of the workforce directly and in rural regions, dependence is much higher when including informal and seasonal labour.

Cereal production relies largely on rainfall, but increasingly, irrigation is being used to increase production. This reflects the importance of the crops to the Tunisian population as well as reducing external dependencies. Water for irrigation is coming from ground water (77%), surface water (22%) and treated wastewater (1%). The latter is expected to increase in the future as well as water from desalination plants.

For farmers who have access to irrigation water, the income per hectare from the irrigated system is not only much higher than that from rainfed farming, but also has the immense advantage of being, a priori, resistant to climatic hazards. Thus, irrigated wheat typically produces about twice the yield of rainfed wheat, while irrigated barley can produce more than three times the yield of rainfed barley^[4].

Not all agriculture in all parts of the country requires irrigation and the challenge is primarily one of irrigation efficiency. Climate change is expected to exacerbate the challenges. Rising temperatures increase crop evapotranspiration, while declining precipitation reduces natural recharge of reservoirs and aquifers. More frequent droughts and extreme weather events will increase uncertainty in water availability, making traditional water allocation approaches less effective. At the same time, demand for irrigation is expected to increase as farmers seek to maintain crop yields under hotter and drier conditions.

Consequently, developing a better understanding of where and how irrigation is being applied is a key input to determining policy on water use. By informing farmers directly of crop stress, local decisions can be taken, set within a national framework. Country-wide data on crop irrigation levels and crop yields are the essential components required to improve water and food security. The crops that depend most heavily on irrigation—vegetables, citrus, dates and fruit trees—are also those with the highest economic value per unit of water. Consequently, improving irrigation efficiency through drip irrigation, soil moisture monitoring and satellite-based crop water stress assessment offers substantial economic benefits. Earth Observation can help estimate crop evapotranspiration, identify water stress, optimise irrigation scheduling and support water allocation decisions, enabling Tunisia to maximise agricultural production while conserving its increasingly scarce water resources.



Figure 2: Water reservoir in Tunisia. Credits: INGC.

The GEO Work Programme Activity

GEOGLAM (Global Agricultural Monitoring Initiative) is an international partnership that uses Earth Observation to monitor global agricultural production. It was established under GEO to improve transparency and coordination in global food security monitoring. GEOGLAM provides near-real-time information on crop conditions, yields, and drought impacts using satellite data and ground observations. It supports early warning systems for food crises by helping governments and international organisations anticipate supply risks.



<https://geoglam.org/>

[4] National Report on the Water Sector 2021, pp65

HOW SATELLITES CAN HELP

In order to address the above challenges, the National Field Crops Institute (INGC) in Tunisia has developed the IREY (Irrigation Reference to Enhance Yield) platform as a means to provide irrigation planning advice to cereal farmers. The tool provides plot-scale irrigation recommendations directly to farmers, particularly for wheat.

IREY integrates meteorological data, Earth Observation products and agronomic models to support irrigation management. Building on the first generation platform developed by the INGC, IREY has progressively integrated the satellite-based Water Productivity through Open access of Remotely sensed derived data platform (WaPOR)^[5] which is a global tool developed by the FAO. IHE Delft and the International Water Management Institute (IWMI) are partners to the project along with 13 countries*. WaPOR uses satellite Earth Observation data to provide near real-time information on land and water resources. It is hosted on the FAO Agro-informatics platform and is freely available to all countries wishing to improve the management of their agriculture land and water resources. FAO through WaPOR and other initiatives, is actively involved in GEOGLAM, a GEO flagship which focuses on EO for agriculture monitoring. WaPOR data and tools are also accessible through the GEO Open Knowledge Hub.

Today, IREY 3rd generation^[6] integrates high resolution satellite products giving improved spatial and temporal resolution and advanced decision-support capabilities. It provides information on actual evapotranspiration (crop water consumption), crop water requirements, irrigation scheduling recommendations, crop water productivity, soil water balance, and irrigation performance assessment for every 10 days, monthly, seasonally or yearly at different scales 20m, 100m and 300m.

Because the data is derived from satellites, it can cover entire river basins, irrigation districts, and countries consistently, including areas where ground measurements are limited. Copernicus Sentinel data is an important and growing component of WaPOR. Originally developed using primarily Landsat and Modis data, Sentinel 2 and Sentinel 3 data now provide the backbone of the service by offering the higher resolution and wider and more frequent coverage needed to improve irrigation management, crop monitoring, and water productivity assessment in water-scarce countries such as Tunisia.



The satellite data



Sentinel-2 carries an innovative wide swath high-resolution multispectral imager with 13 spectral bands. The combination of high resolution, novel spectral capabilities, a swath width of 290 km and frequent revisit times provides unprecedented views of Earth.

Copernicus Sentinels data are available under an open and free data policy.

Sentinel data can be accessed at <https://dataspace.copernicus.eu>

More info:

<https://sentinels.copernicus.eu>

The Service Provider

The International Water Management Institute (IWMI) was established in 1984 with its headquarters in Sri Lanka. The Institute has the goal to drive global transformation in water management, supporting informed decision-making from grassroots communities to international policy forums.

Based on evidence and knowledge drawn from our science, innovative technologies and testing of business models, IWMI works with governments, policymakers, farmers, civil society, water managers, development partners and businesses to solve water problems and scale up solutions.

IWMI is a partner to FAO which has developed the WaPOR tool.

IWMI International Water Management Institute

<https://www.iwmi.org>

[*] Algeria, Colombia, Egypt, Ethiopia, Iraq, Jordan, Kenya, Mali, Mozambique, Pakistan, Palestine, Sudan and Tunisia

[5] WaPOR flyer

[6] IREY



Figure 3: WaPOR Training in Tunis. Credits: INGC.

WHO IS CONCERNED?

Water scarcity is a national priority in Tunisia and affects a wide range of stakeholders. Overall responsibility for the protection and management of water resources in Tunisia is shared among several institutions. The Ministry of Agriculture, Water Resources and Fisheries is the lead authority for water resources planning, management, conservation, and the development of water-related strategies and policies, including groundwater and surface water resources. The Ministry of Environment contributes through pollution prevention and control, environmental monitoring, wastewater-related environmental protection, and the enforcement of environmental regulations affecting water resources.

The primary user and focus of the case is the Institut National des Grandes Cultures (INGC) which is Tunisia's national institute dedicated to field crops ("grandes cultures"). The INGC's mission is to improve the productivity, quality, and sustainability of Tunisia's field crop sector, which is central to the country's food security.

At the INGC, WaPOR-derived evapotranspiration and water productivity indicators are used to support irrigation scheduling, estimate crop water requirements, identify water stress, and improve irrigation advisory services through the Smart app IREY and IREY platform. At the institutional level, WaPOR information can support irrigation performance assessment, water productivity analysis, and planning of water allocation strategies. Before IREY, irrigation recommendations were mainly based on weather station data, empirical crop coefficients, field observations, farmer experience, and conventional water balance calculations. While useful, these methods lacked the spatial coverage and near-real-time monitoring capabilities provided by satellite-based observations.

Water utilities, local authorities, community leaders, and civil society organizations also have important roles in ensuring equitable access to water and supporting public acceptance of reforms. Success will depend on close collaboration across all stakeholders to achieve the strategic objectives of reducing water losses, improving agricultural water productivity, expanding the use of treated wastewater, ensuring transparent and equitable water allocation, and reducing illegal abstractions.

[7] *National Report on the Water Sector 2021*, pp65

The Service Enabler

The **Food and Agriculture Organization of the United Nations (FAO)** is a specialised agency of the United Nations that leads international efforts to combat hunger and improve food security. It works with governments to develop sustainable agriculture, fisheries, and forestry practices worldwide. FAO provides technical expertise, data, and policy guidance to help countries manage natural resources, including water and land. It plays a key role in promoting climate-resilient agriculture and improving efficiency in food production systems. FAO also supports global monitoring tools such as WaPOR to help countries optimise water use in agriculture.



Food and Agriculture
Organization of the
United Nations

www.fao.org

The Primary User

The **Institut National des Grandes Cultures (INGC)** is Tunisia's national institute dedicated to field crops ("grandes cultures"), including cereals (durum wheat, soft wheat, barley), grain legumes and oilseed crops. Established in 2009 as a public institution under the Tunisian Ministry of Agriculture, the INGC is essentially Tunisia's national centre of expertise for cereal and field-crop development, combining applied research, farmer support, technology transfer, and policy input to improve agricultural productivity, food security, and climate resilience.



www.ingc.com.tn

WHAT ARE THE BENEFITS?

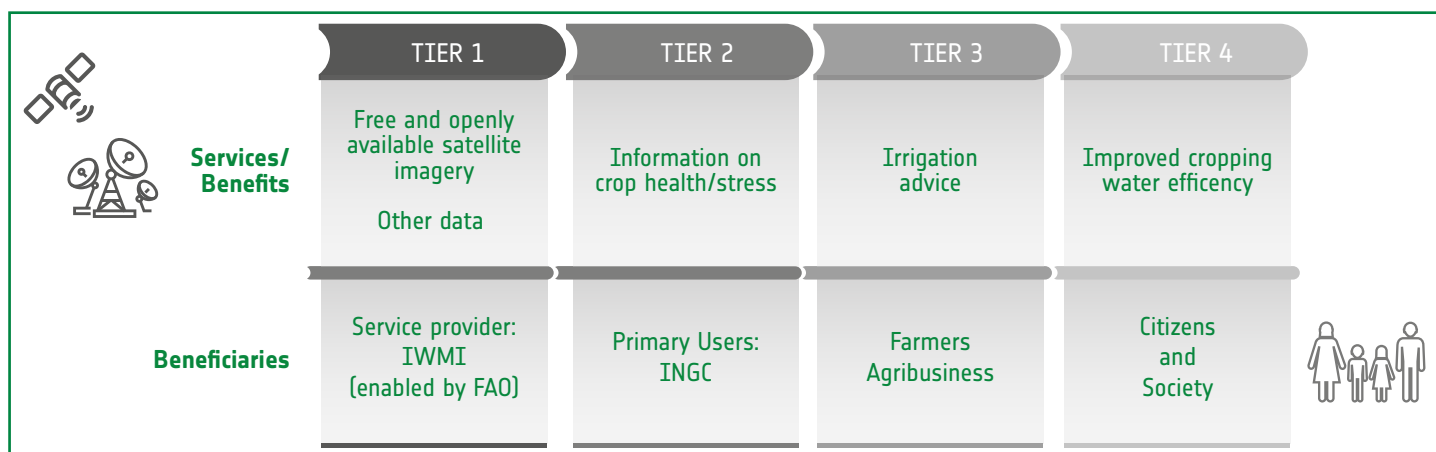


Figure 3: Value chain of the main stakeholders and beneficiaries

The integration of WaPOR data into the IREY irrigation advisory platform has enabled Tunisia to move from traditional irrigation practices to data-driven, site-specific irrigation management. By providing accurate information on crop water use, water productivity and crop stress, the system supports more precise irrigation scheduling, leading to significant improvements in agricultural efficiency, water management and resilience to climate change.

At the farm level, the benefits are already evident. In Tunisia, the IREY cereal irrigation application has been reported to increase water productivity from approximately 0.9 to 1.9 kg of grain per cubic metre of water. Better irrigation management also has the potential to reduce national losses from inefficient irrigation^[8] ^[9]. A research paper in 2019 reports that:

The value of total direct economic losses, at the country level, of both types of water inefficiencies – under and over irrigation - was estimated to be around 470 million Tunisian Dinars. Therefore, an improvement of water use efficiency at field level through dissemination of information/knowledge on irrigation scheduling and crop water requirements by extension services to farmers is needed to reduce this huge economic loss, reach higher sustainability in water use and improve food security^[10].

Although there is currently no robust estimate of the proportion that could be recovered through IREY, even a 5–10% reduction in these losses would represent a potential economic benefit of approximately TND 24–47m (€7m-15m) per year.

Improved irrigation scheduling can also increase wheat production. A modest 5% increase in yields across Tunisia's 60,000–70,000 ha of irrigated wheat would generate an additional 10,000–12,000 tonnes of wheat annually, strengthening food security and reducing dependence on cereal imports, particularly during drought years.

An equally important long-term benefit is the conservation of Tunisia's increasingly stressed groundwater resources. By reducing unnecessary irrigation, WaPOR and IREY help limit groundwater abstraction, slowing the depletion of aquifers that supply much of the country's irrigated agriculture. This contributes to maintaining groundwater availability, reducing salinisation and seawater intrusion in coastal aquifers, lowering pumping costs as water tables stabilise, and protecting the long-term sustainability of agricultural production.

Beyond benefits to individual farms, WaPOR provides objective, spatially consistent information that enables public authorities to monitor irrigation performance, assess drought impacts, optimise water allocation and support evidence-based planning and investment in irrigation infrastructure. The resulting reductions in water use, energy consumption and groundwater abstraction are increasingly valuable as Tunisia faces growing water scarcity and more frequent droughts associated with climate change.

The benefits extend across society. For INGC, WaPOR strengthens analytical capability and irrigation advisory services. For government agencies, it improves water planning, drought monitoring and policy development. For farmers and agribusinesses, it increases productivity while reducing water and energy costs. For Tunisia as a whole, it supports more sustainable management of scarce water resources, enhances food security, strengthens climate resilience and helps secure the long-term viability of irrigated agriculture.

[8] World Bank Country Climate and Development Report, November 2023.

[9] Developing Decision Support Tools for Irrigation Scheduling in Tunisia. Bouselmi et al. Proceedings of the 2nd International AgroecoInfo Symposium (AGROECOINFO 2022), held in Volos, Greece, 30 June–2 July 2022.

[10] Estimation of the Economic Loss due to Irrigation Water Use Inefficiency in Tunisia. Ali Chebil et al. Environmental Science and Pollution Research, February 2019.

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The key benefits can be summarised as follows:



Economic

Lower irrigation costs, higher yields and reduced import dependence can yield significant economic benefits for the Tunisian economy.



Environmental

Reduced aquifer depletion and Improved groundwater conservation, improved water productivity, lower energy use, improved ecosystem resilience



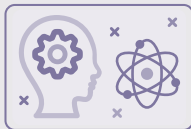
Regulatory

Better irrigation advisory services, evidence-based planning and stronger national capacity.



Innovation and Entrepreneurship

IREY is helping to extend the use of digital technologies to support agriculture in Tunisia.



Scientific/Knowledge

Data from IREY is helping a number of research activities including optimising the EO data in use, improving yields, extending IREY use to other crops.



Societal

Improved food security, greater drought resilience, more sustainable agriculture as well as increased farm incomes impacting rural livelihoods

EXTENDED IMPACT

Recent pilots in Tunisia have demonstrated that even greater benefits can be achieved through higher-resolution WaPOR products .

In Jendouba, FAO tested:

- improving spatial resolution from 20 m to 10 m;
- increasing temporal resolution from 10-day to daily products; and
- reducing data latency from approximately 15 days to about 2 days.

Using these enhanced datasets within IREY produced more accurate field-scale differentiation and more timely irrigation recommendations, improving the quality of irrigation advisory services.

Further research is likely to focus on:

- extending IREY beyond wheat to other irrigated crops such as vegetables and orchards;
- integrating additional satellite products, including soil moisture and higher-frequency observations;
- incorporating seasonal weather and climate forecasts.



Figure 4: Farming in Tunisia. Credits: INGC.

ABOUT THE PROJECT

The SeBS4GEO project is a spin-off of the Sentinel Benefits Study (SeBS) and is conducted by EARSC (European Association of Remote Sensing Companies) for the European Space Agency (ESA). The project has the goal to support the GEO Work Programme Activities to showcase their benefits derived from the use of Sentinel data.



The impact analysis of this case has been conducted in the context of the GIAT development and validation.

We acknowledge that the understanding of the case was supported by discussions with Anis Bousselmi Associate Director General at INGC, Livia Peiser, Virginie Gillet and Rahma Brini from FAO. We thank them for their valuable insights and availability.

Do you know an interesting case demonstrating the benefits derived from the use of Sentinels data?

Email info@earsc.org

More Information on Sentinels Benefits Studies:

www.sebs360.eu



European Union



The Sentinels Benefits Study is funded by the EU and ESA.

The views expressed in this study cannot be taken to reflect the official position of the EU or of ESA.



Figure 5: A reservoir in Tunisia. Credits: INGC.



WaPOR enables us to transform satellite observations into practical decisions for farmers.

By integrating near-real-time evapotranspiration data into the IREY platform, we improve irrigation efficiency, enhance water productivity, and support more resilient agricultural systems under increasing water scarcity in Tunisia.



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