PROJECT TITLE:

Hydrometeorology in Tunisia: The Medjerda Basin

COUNTRY :

Tunisia

AN INCUBATION PROJECT SUPPORTED BY:

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VERBATIM OF THE PROJECT LEADER:

« With climate change, Tunisia risks seeing its water resources diminish and its rainfall concentrated on extreme rainfall events, while demand is increasing.
This poses both a problem of water resource management (sharing the resource between domestic consumption, industrial consumption and irrigation), and of management of the hydrological risk associated with urban runoff and river flash floods. NOVIMET is preparing to deploy its innovative hydro-meteorological monitoring and warning system in the Medjerda basin, which drains most of the water resources in northern Tunisia. monitoring and warning system, based on the HYDRIX X-band weather radar, the ZPHI data processing software and the RAINPOL hydro-meteorological services platform. The system will be able to provide real-time, accurate and high spatial resolution rainfall information to The system will be able to provide real-time, accurate and high spatial resolution rainfall information to contribute to the development of effective water resource management practices and protection against flood disasters. The unique feature of the NOVIMET solution is that it provides accurate, high resolution rainfall maps covering more than 10,000 km2 without the need to deploy rain gauges on the ground. The service platform can address all types of applications: flood forecasting, river and tributary management, dam management management, dam management, water resource management, irrigation control.

The Ministry of Agriculture, Water Resources and Fisheries is a stakeholder in the project, and is the beneficiary of a donation from the French Treasury Department concerning The Ministry of Agriculture, Water Resources and Fisheries, beneficiary of the donation from the French Treasury concerning the radar, which implements all the infrastructure to deploy the radar near Djendouba, and organises the operation of the whole system. The National Météorologique is involved in the technical expertise associated with the project and in the exploitation of the data. Other actors are interested, such as the Tunisian Internet Agency Tunisian Internet Agency, and the National School of Engineers of Tunis. »

GEOGRAPHICAL LOCATION :

The project is located in the Medjerda catchment area in the northwest of Tunisia. The meteorological radar, the main object of the project, will be installed on the top of a hill on the roof of a water and forestry vigilance post, 20km south of the town of Jendouba. This geographical situation offers the possibility of a very good coverage of the region.

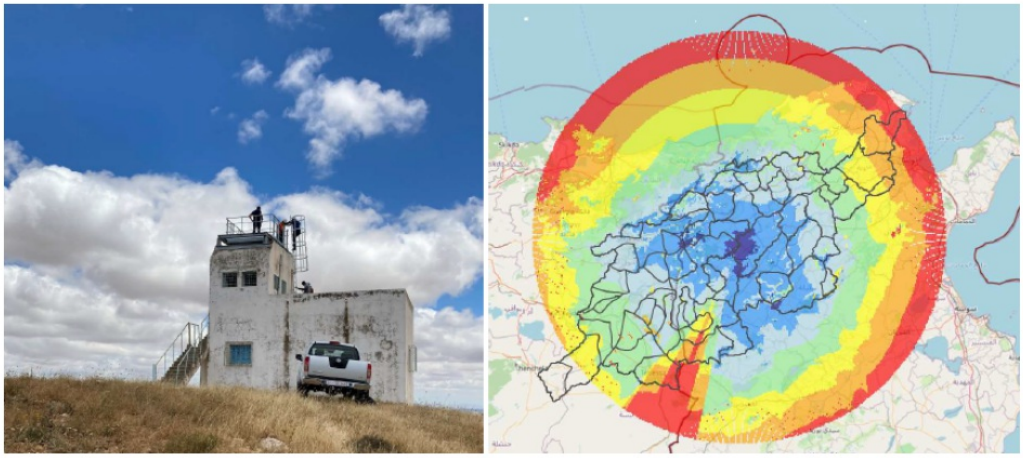

Figure 1: Photo of the radar site with the instrument platform on top of the building (left). Simulated hydrological coverage of the radar (right).

SCALE OF INTERVENTION:

Whether it is a question of water resource management or crisis management in the event of an extreme rainfall event, rainfall information is the essential data.
Today, Tunisia has a fairly dense network of climatic rain gauges (readings taken every 24 hours) but very few high-resolution rain gauges (5 minutes) with retransmission of rainfall data. resolution (5 minutes) with real time transmission of observations, suitable for real time management of hydraulic works in case of floods. Furthermore, Tunisia has no meteorological radar, therefore no means of monitoring rainfall events in real time, nor of "immediate forecasting" (i.e. 1-3 hours ahead). (i.e. 1-3 hours ahead).

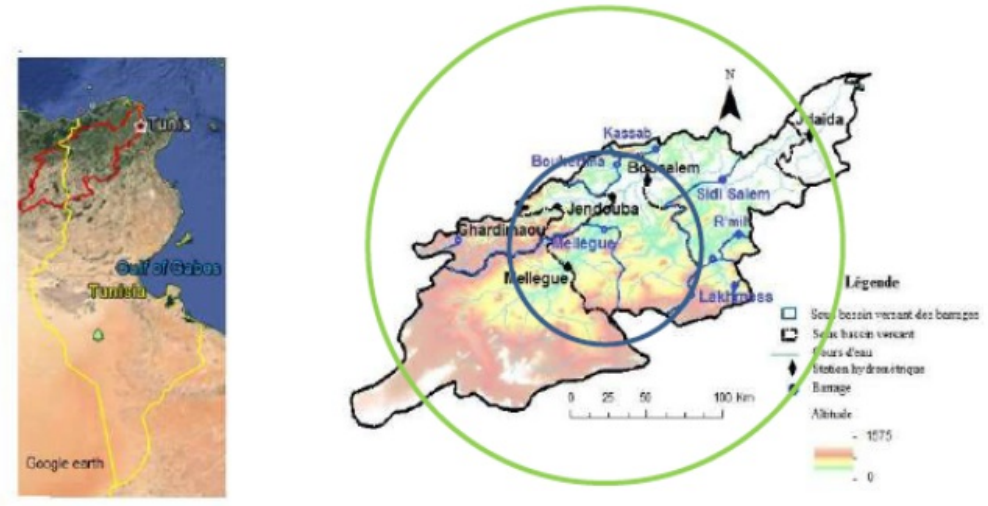

Figure 2: The Medjerda catchment area with its hydraulic works and equipment: Dams (blue circles) and hydrometric stations (black diamonds). The installation of the HYDRIX radar is envisaged near Jendouba. The blue circle (60 km in diameter) delimits the region where the radar will take very precise measurements of rainfall. The green circle indicates the range to which it operates for effective monitoring of rainfall systems.

CONTEXT AND ISSUES OF THE TERRITORY:

Tunisia is a country under great water stress, with groundwater and surface water already 90% mobilised. Moreover, as everywhere in the world, the increase in population and the correlative growing urbanisation are leading to an increase in water demand, soil sealing and a particular vulnerability of certain urban districts, those where runoff is concentrated. Finally, with climate change, Tunisia risks seeing its water resources diminish and its rainfall concentrated on extreme rainfall events. This will not simplify the overall management of water resources, not to mention the amplification of the hydrological risk in urban areas, associated with runoff and flash floods.

Figure 3: Average annual rainfall in Tunisia. It can be seen that the North East is well irrigated (up to 1250 mm/year) while the region of Tunis and Cap Bon receive between 500 and 750 mm/year. The south of Tunisia (Sfax and lower latitudes) has a semi-arid climate.

In Tunisia, the geographical distribution of rainfall is very heterogeneous, as illustrated in Figure 3: The governorate of Jendouba in the north-west is very watered, while in the north-east, the region of Tunis and Cap Bon, with its high population density and highly developed irrigated agriculture, is a major consumer of water resources. The entire northern region of Tunisia is drained by the Medjerda river basin, which has its source in Algeria and flows from west to east with a mouth north of Tunis. Like all Mediterranean rivers, the Medjerda is subject to the vagaries of the weather in these regions, with periods of high and low water. Tunisia has made an effort to equip itself (started before independence) to manage this water resource.
Many dams have been built on the Medjerda and its tributaries, and a system of canals allows for the redistribution of water resources to areas with high demand. The management of these dams and of the water resources is the responsibility of the local authorities. The management of these dams and this system of canals to cope with the management of these dams and this system of canals to cope with the management of water resources and to reduce floods in the event of extreme rainfall is the responsibility of the Ministry of Agriculture, Hydraulic Resources and Fisheries. Hydraulic Resources and Fisheries.

GOAL(S) OF THE PROJECT:

The NOVIMET solution, which combines an X-band weather radar (HYDRIX radar), the ZPHI® rainfall extraction software and the RAINPOL® service platform, meets the needs of both crisis management in the event of extreme rainfall events and water resource management.

1- For extreme rainfall events in rural areas, NOVIMET offers 24/7 crisis management assistance based on
a. one hand, on an innovative weather radar technology allowing very precise and high spatial resolution measurements (0.5 to 1km) of hydrometeors (rain, snow, hail), within a radius of 60 km around the radar,
b. and on the other hand, on an Internet service platform geolocating precipitation, determining its two-hour forecast, and able to hydrological models directly assimilating the observed and forecasted rainfall on the catchment areas of interest, in order to determine with a 1 to 2-hour notice of the flow at the outlet,
For the dam manager, the added value of the NOVIMET solution is to be able to anticipate the reactions of the different sub-basins, in order to manage the crisis as well as possible.

2- In Tunisia, 80% of the water resource is used for irrigated crops. The country has developed an appropriate infrastructure: the dams and canal systems mentioned above, the development of irrigated areas, the development of optimised irrigation techniques.
Irrigation is reasoned according to rainfall, irrigation needs and the environmental concern of allowing groundwater recharge.
a. For the water resource manager, rainfall information within the irrigated perimeters allows (along with other meteorological information such as sunshine etc.) to information such as sunshine etc.) to anticipate demand.

b. For the farmer, precise rainfall information on a scale (typically 25ha) close to his plot, will allow him to reason his water consumption for his crops and to water consumption for his crops and thus reduce his water bill.
Such practices, on the scale of an irrigated agricultural production basin, are likely to optimise the use of water resources.

3- It is also civil protection that the NOVIMET solution can assist in the event of extreme rainfall and catastrophic flooding. The Governorate of Jendouba has more than 400,000 inhabitants. As shown in Figure 4, it is subject to this type of event [a rainfall of 90 mm in 24 hours every ten years].The same applies to the north-eastern coast from Tunis to Sfax. To cope with an extreme rainfall event, one can use the model deployed by NOVIMET in France in the Alpes Maritimes. The RAINPOL platform provides rainfall maps to the civil protection of each locality, sends them to of each locality, sending targeted alerts each time an intense rain cell is about to cross an area or a neighbourhood vulnerable to flooding. The civil protection then applies the emergency plan foreseen in the circumstances. It is also possible to consider issuing warnings to individuals (e.g. motorists for individuals (e.g. motorists to avoid being caught in flooded roads).

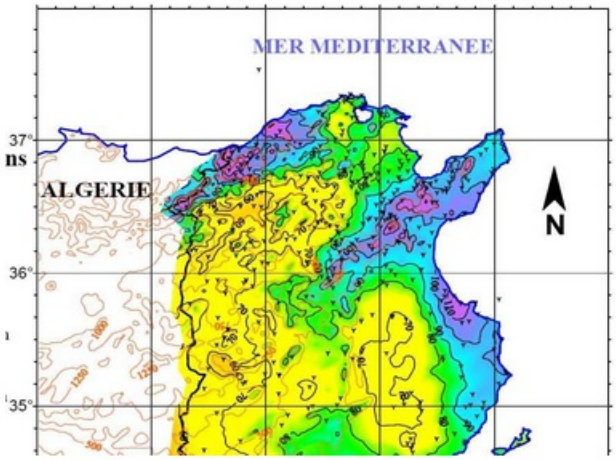

Figure 4: Map of decadal daily rainfall in northern Tunisia. The areas in blue, dark blue and mauve areas correspond to daily rainfall of more than 90 mm.

SDG TARGETED BY THE PROJECT:

Referring to the UN Sustainable Development Goals, the following objectives can be noted:
On the one hand:

SDG 6: "Floods account for 70% of disaster-related deaths caused by natural hazards
MDG 11-5: "By 2030, significantly reduce the number of people killed and the number of people affected by disasters, including water-related disasters, and reduce the number of people killed and the number of people affected by disasters, including water-related disasters, and reduce the number of people affected by disasters, including water-related disasters, by 2030.
by 2030, significantly reduce the number of people killed and the number of people affected by disasters, including water-related disasters, and significantly reduce the amount of economic losses...".
MDG 13.1 "Build resilience and adaptive capacity in all countries to climate-related hazards and natural disasters".
The Flood Warning System planned to be implemented in the HTBM programme is a perfect response to these objectives, as it will help to ensure the safety of people and reduce the impact of disasters.
people and reduce damage to property.

And on the other hand:
SDG 11.a Promote positive economic, social and environmental linkages between urban, peri-urban and rural areas by strengthening
development planning at national and regional levels.

SDG 6.4 By 2030, significantly increase the efficient use of water resources in all sectors and ensure the sustainability of freshwater withdrawals and supplies in order to supply water and to address water scarcity and significantly reduce the number of people suffering from water scarcity.
The sharing of the water resource between irrigated agriculture (80% of the resource) and drinking water (14%) in a country subject to water stress such as Tunisia requires optimal management of the resource, which is the objective of MARHP and its Tunisian partners through this HBMT programme. The aim is to

- To optimise the management of water resources by improving the management of dams and the redistribution of rainwater through canals, and to rationalise irrigation.
- To improve the management of urban water, to optimise the operation of the treatment plants, and to avoid discharges into the natural environment.

PROJECT ISSUES:

The beneficiary of the project is the Ministry of Agriculture, Water Resources and Fisheries (MARHP), and more specifically in this Ministry, the Planning and Hydraulic Balance Office (BPEH), the General Directorate of Water Resources, and the General Directorate of Dams and the large hydraulics works.
The MARHP has set up a strategy to connect the dams with the aim of controlling the water transport network and regulating its distribution
to the different areas. In this perspective, the Sejnane dam was connected to the Medjerda canal, the Sidi Barak dam to the Sejnane dam and the Barbara dam to the Sidi Salem dam.

This connection is intended to develop the 4.1 billion cubic metres of water mobilised through some 21 large dams, 203 hill dams, 580 hill lakes, 2,400 deep wells, 3 desalination plants, 4,000 structures for the spreading of run-off water and the supply of groundwater. 1,140 exploration wells, 1,300 control wells and 1,100 deep wells.
The MARHP is also responsible for:

- SONEDE, whose mission is the production and distribution of drinking water throughout Tunisia and which is thus responsible for the operation and maintenance of water collection, treatment and distribution facilities;
- SECADENORD is responsible for the operation, management, exploitation, upkeep and maintenance of the canal and the conveyance pipes used to transport water from the Sidi Salem, Ichkeul and Extreme North dams to the places where it is used;
- The General Directorate of Water Resources, which has set up the "SYCOHTRAC" system for collecting real-time hydrological measurements to announce floods in Tunisian wadis (130 hydrometric and/or rain gauge stations). It manages a SAPI programme (Flood Early Warning System);
- Early Warning System for Floods).

Today, the Ministry of Agriculture manages the problems of water resources, flood forecasting and flood warning with only a network of 130 climatic rain gauges (read every 24 hours only). There is no weather radar in Tunisia. The INM has planned to equip itself with a network of three C-band radars, but is facing a funding problem. C-band radar is three to four times more expensive than X-band radar, with only slightly greater hydrological range.

HYDRIX data processed by ZPHI® provides a better estimate of rainfall on the ground than a rain gauge, with the advantage of providing a continuous observation in a geographical area of 60 to 70 km around the radar, at a rate of one rain gauge per km2. A HYDRIX® radar associated with ZPHI® is thus the equivalent of a dense network of 11,000 to 15,000 rain gauges. With the advantage over the network of rain gauges that it is able to anticipate the arrival of the rainy system with 2 hours advance, including from the sea.

A network of rain gauges is extremely expensive to deploy and maintain (in France, a network of 50 rain gauges costs 150k€ in annual maintenance).

The RAINPOL platform is a multi-application expert system that can be used

- For water resource management: automatic calculation of integrated rainfall over any catchment area, accumulation over any time frame required by the user.
- For flood forecasting. A hydrological rainfall-flow model can be hosted by the platform which automatically calculates the flow forecast at the outlet of any catchment area;

- For the forecasting of catastrophic urban runoff: on urban districts identified as vulnerable, anticipated calculation of a (e.g. anticipation of accumulated rainfall exceeding a predetermined threshold) and emission of SMS alerts to civil security);
- For sustainable agriculture: estimation of the water stress of the plant from the rain history "at the plot".

SECTORS CONCERNED:

The project will provide public actors in water resource management with innovative tools to help improve performance and practices:

- Flood forecasting based on rainfall-flow models with more accurate and denser data and with 2-3 hour forecasting.
- Rainwater management in urban areas based on hydraulic models fed by a very dense network of rainfall observations.
- Civil protection equipped with a crisis management tool that makes it possible to anticipate measures such as road closures and to send emergency teams at the right time and in the right place.
- to the right places at the right time and to be able to alert the population en masse.
- Management of dams and distribution channels based on more accurate and much denser rainfall information.
- Improvement of agricultural practices (integrated agriculture) in the whole north-eastern zone of Tunisia, both in terms of production to supply the population locally and in terms of
- in terms of production to supply the population locally and in terms of optimising water consumption.
- Historical and real time data for the design and management of urban facilities and developments.
- The project should lead to new players, public or private, to address the market for services to individuals, for example:
- With regard to the risk of flooding, alerting individuals by SMS to enable them to be safe (themselves and their families) and to protect their property.
- For the irrigating farmer, deliver rainfall information "at the plot" that allows him to optimise his irrigation water consumption.

EXPECTED RESULTS:

The implementation of the radar, its data provision platform and the expert system triggering alerts to users, will have a virtuous effect:
it triggers a change in the behaviour of the authorities and users who will, by using the information, adopt new practices, e.g:

- For the managers of dams and canals: anticipate in the management of floods or low water levels in rivers;
- For farmers: irrigate in a reasoned way according to the rainfall received on the plot;
- For individuals living in flood-prone areas, take the initiative to shelter themselves, their relatives and their property in the event of floods announced;
- For civil security: close roads, alert individuals living in vulnerable areas, anticipate the organisation of emergency services;
- For urban sanitation managers and wastewater treatment plant operators: optimise their processes.

STAKEHOLDERS OF THE PROJECT:

Actors involved:

- Ministry of Agriculture, Water Resources and Fisheries (Tunisian)
- NOVIMET
- National Institute of Meteorology (Tunisian)

Project Operator(s):

- Ministry of Agriculture, Water Resources and Fisheries (Tunisian)
- NOVIMET

Technical partner(s):

- Institut National de la Météorologie (Tunisien)

Financial partner(s):

- Direction Générale du Trésor (French)
- Ministry of Agriculture, Water Resources and Fisheries (Tunisian)

ESTIMATED COST OF THE PROJECT :

1,5 M€

SHORT-TERM ACTIONS (3 YEARS):

- Deployment of the HYDRIX® radar near Jendouba, its operating software ZPHI® and the RAINPOL® rainfall data dissemination platform
- Exploitation of the radar system and data produced by the MARHP and the INM for all hydrological and meteorological applications

LONG TERM ACTIONS (10 YEARS):

Duplication of the solution on various other sites in Tunisia subject to hydrological hazard such as the regions of Nabeul, Monastir, and Cap Bon (see Figure 4)