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# **POLICY, RESEARCH, AND DEVELOPMENT (MENA NWC PR&D) GRANTS**

## **PARTICIPATORY PLANNING FOR IMPROVING WATER USE EFFICIENCY IN RIVER BASINS**

**FINAL REPORT**



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# EXECUTIVE SUMMARY

Due to its geographical location and to the natural features of its climate, the MENA region figures historically among the most water scarce areas of the world and water management issues have always represented significant challenges. However, the region now faces an increasing and alarming water scarcity due to the growing pressure on water resources induced by the economic development and demographic growth. Aware of this pressing issue, all countries are now developing national water strategies and plans oriented towards the integrated water resources management and the improvement of water use efficiency. Unfortunately, these plans often underestimate the impact of uncertainty and this may lead to inefficient and unsustainable water management strategies. In addition, this region, where the national economy often relies, to a big extent, on agriculture and especially irrigated farming, still encounters constraints and difficulties related to the on farm irrigation management. These are mainly associated with the low level of technical supervision and instruction and the low rate of rational irrigation steering.

In this context, this research project aimed to develop first an innovative approach for robust decision making in uncertain conditions based on WEAP (Water Evaluation and Planning System) model. In fact, “XLRM” which is the robust decision making framework, supports the evaluation of management options and promotes long-term sustainable integrated water management strategies at the basin level. The second objective is to design and produce a manual of irrigation best practices which key output would be to identify a checklist of improved tools and practices. This helps to optimize on farm agricultural water use and maximize water use efficiency. In order to achieve those objectives, the project was implemented in pilot catchment systems in Jordan (Zeqlab basin), Morocco (Souss-Massa Basin) and Tunisia (Mejerda basin).

In Jordan, Wadi Zeqlab catchment is located within an area that extends from the Highlands of Northern Jordan, to Eastern mountains bordering Jordan Valley. The study area, although small, reflects the major problems of rainfed and irrigated agriculture in Jordan.

In Morocco, the Souss-Massa basin, located in the south-western part of the country was retained as a case study. The latter, displays strategic importance while it is currently facing, as a consequence of the irrational use of water resources during the last decades significant water resources management challenges. We particularly mention the overexploitation of ground water resources, the increased of water demand due to the irrigation development, the urban and industrial growth and the expansion of tourism.

In Tunisia, Mejerda is the most important river. It plays a crucial role in the hydrology of the country and holds the main hydraulic infrastructure. The river is providing more than 50% of the

total water resources mobilized by dams in northern Tunisia. The watershed is home to 14% of the total population and the agriculture sector absorbs a substantial labour force. While, the main water management challenge in the Mejerda River Basin is the lack of decision support tools for the improvement of water resources management.

The project activities were conducted following a similar approach in each basin. On one hand, regarding the development of the innovative decision making tool, a four step methodology were followed. First, during the inception phase, a set of hydrological, meteorological, pedologic, agronomic and socio-economic data were collected in order to construct and calibrate, during the second phase, the WEAP model. During that inception phase, a project internal on-line portal that structures all of the information collected to support the model building was constructed by all the project partners. Then, in a third phase, a XLRM participatory workshop gathering the basin main stakeholders were organized in order to identify the following components: 1- the Exogenous factors (key uncertainties confronting water managers in the basin), 2- the Levers (management actions aiming to improve the system outcomes in the face of the identified uncertainties), 3- the set of Metrics that can be used to evaluate the ability of specific actions to improve water management outcomes in the basin. In a fourth and final step, the R (Responses) component of this XLRM framework was given by the WEAP model that was iteratively used to capture the identified uncertainties, represent the identified strategies and produce the metrics. On the other hand, the best practices for irrigation manual were conceived as a practical document that may be used easily by extension services and farmers to improve irrigation management at the farm level.

Results and outcomes of this project can be expressed at various levels. On the scientific level and regarding development perspectives, the project allowed providing each basin's stakeholders with an innovative water management planning tool. This tool's efficiency and strength was demonstrated thanks to the construction for each basin of specific scenarios analyzing how selected management strategies would behave under specific uncertainties. Findings were also crucial for farmers and technical department in terms of providing materials related to irrigation best practices.

# 3 PROJECT OPERATIONS AND OUTCOMES

**Were there changes to the project operations or its objectives?**

Yes  No

- 1- For the NCARE Jordan, the project was primarily planned for Wadi Al Taibeh, but when analyzed we found that little irrigated areas are found in the study area. Moreover, no water reservoir is available on the stream. Wadi Zeqlab, was chosen instead, because it is near to Wadi Al Taibeh and have similar characteristics. The latter, has a reservoir (Zeqlab dam). Meanwhile, wadi Zeqlab catchment is suffering from reduction in water supply and decrease in dam storage due to increased domestic demand which made it a good choice.
- 2- Assembling a Research Advisory Committee was unfortunately not managed as stated in the technical proposal. The limited funding could not allow meetings of the committee members from 4 countries. The PIs tried to involve locally, time to time key members (academia, development and experts) to discuss on the methodology and the progress of the project.
- 3- Only limited scenarios were studied. In fact, more time and means are needed for that

## **Results and Key Outcomes of the Project**

- **Promotion of international networking and cooperation:**

The current project is a joint project conducted in partnership between three countries of the MENA region (Morocco, Jordan and Tunisia) with the technical support of an external collaborator (SEI- Stockholm Environment Institute, USA center). This partnership contributed to build strong links between the involved institutions by offering opportunities for researchers to meet each other and to share interests on water and exchange all along the project different experiences, knowhow and specific scientific findings. This networking is considered a great

opportunity for involved scientists to strengthen their collaborations in the near future via new research projects.

- **Capacity building:**

Capacity building is a key component of development projects. In the framework of this project, stakeholders from the key institutions in charge of water management in each river basin had the opportunity to follow trainings on the WEAP model. Moreover, the key stakeholders (Engineers, decision makers, academia, NGOs, etc.) were also introduced to the XLRM robust decision making approach through their participation to specific workshops.

- **Website Design and portal construction:**

One of the main outcomes of the project is its website: <http://water-useefficiency.com>. The website presents the project, its partners, the main events and the modeling effort. It also has a section dedicated to the project reports

- **Enhancing and strengthening R&D:**

As a part of the R&D program, this project led to relevant results promoting better water planning and management in a context of limited resources. It helps to consider the following aspects:

- Construct the model at different studied river basins while valorizing several kinds of data bases, describing the main agricultural features and characterizing the current water context. This effort was followed by the calibration and the validation processes related to the WEAP model at basin scale.
- The combination of the WEAP model with the XLRM robust decision making framework in order to be able to suggest to decision makers an innovative decision making tool that takes into account future trends of uncertainties and their impacts on water resources while consider the offer, the demand and the management options.

- **Extension and Dissemination**

The three countries organized local workshops during which stakeholders were invited to know about the outputs of the «Participatory Planning for the improvement of water use efficiency at the river basin level » project. The participants took actively part in these events while the three involved institutions (IAV Hassen II, NCARE and INRGREF) did their best to cover the extension and dissemination components.

All over the three countries, the above mentioned events have been proved to be a useful management steps for interacting between stakeholders and local farmers, and discussing possible scenarios. In fact, these workshops were great opportunities to present the modeling tool, its calibration process, the validation step and the XLRM framework related to robust decision making under uncertainties.

Moreover, the guide of irrigation best practices was shown and delivered to the participants under different format (summary version, flyers, etc). Finally, the corresponding work and

references were distributed in a CD format (e.g., electronic files of the WEAP model, guidelines on irrigation best practices). Besides, edited flyers, handouts and printed copies of the different presentations were made available to the participants.

The project team is currently working on scientific papers related to the findings of the project and plan to submit them in specialized journals.

The Moroccan partner already submitted an abstract to the forthcoming European GeoScience Union (EGU) General assembly in Vienna (Austria, April 2016), to be presented either as an oral presentation or a poster under the Hydrological Sciences discipline and session HS 5.2. The latter session is entitled: "Water resources assessment, management and allocation in (semi-) arid regions". The abstract has been accepted.

In this same framework, Tunisian students were supervised. One of them could already defend her work at ESIER-rural engineering high school in December 2015. She succeeded to use the WEAP model in one of the sub-catchments of Tunisia called Siliana.

The project could also support ongoing publications related to water at the following journals: Middle East Critique, les Annales de l'INRGREF, Hydrological Sciences Journal.

- ***Women and Youth involvement:***

In this project, partners succeeded to involve women and young engineers.

## **Actual Results Compared to Expected Results**

The project succeeded to meet all the expected results thanks to the strong involvement and commitment of all the partners.

## **Project Impact**

The main impacts of the project are expressed at two levels:

- **Public policy:** Thanks to this innovative decision tool materialized by the combination of the WEAP model / XLRM approach, stakeholders and especially decision makers were given an innovative decision making tool for the improvement of water resources management and planning. This tool can therefore contribute to enhance, refine/reorient water policies and the water master plan developed for each basin.
- **Environment and natural resources:** Through a better management of water resources and the improvement of water use efficiency at the river basin level, the project may also have an impact on the preservation of the environment and natural resources and water in particular.
- Water can be better managed thanks to the WEAP model. In fact, when this hydrological tool will be in hands of decision makers and the technical staff, optimal allocation of resources will become possible to put on the ground for users as well as for the different development sectors. This could obviously prevent conflicts between stakeholders while covering the main needs. This might have a direct effect on **society**

welfare, **stability** and **economy** growth. Consequently, the **national security** can be then insured as well as the **quality of life**.