



**GLOWA**

## Evaluating the impacts of the Red Sea - Dead Sea Canal on the Amman-Zarqa and Jordan River basins: Using WEAP to measure future scenarios under climate change conditions

### Key findings

- The implementation of the Red Sea - Dead Sea Canal (RSDSC) project would help close the gap between supply and demand in the Amman-Zarqa basin (AZB) under current and future business-as-usual conditions.
- The implementation of the RSDSC project may provide flexibility to the Ministry of Water and Irrigation in Jordan to choose among different management options for the basins. These include: cessation of groundwater pumping in the basins, rejecting drinking water imports from more environmentally-sensitive basins such as the Mujib basin in Southern Jordan, the Jordan River basin, and the Al Azraq basin.
- The implementation of the RSDSC project will provide additional treated wastewater for irrigation in the Jordan Valley via the pumping of additional freshwater to Amman and Zarqa, treated at As Samra Wastewater Treatment Plant and then discharged to the Zarqa River, which flows to the Jordan Valley.

### Overview and Objectives

The impact of climate change on both supply and demand of water resources in arid and semi arid regions like Jordan is projected to be severe (Briefing 1.3). Climate change is expected to reduce water availability based on reduced rainfall and increased evaporation under increased temperatures. In addition, runoff as well as groundwater recharge will likely decrease, adding further stress. An increase in both domestic and agricultural demand is expected as a result of increased temperatures and evaporation rates.

In Jordan, a country already struggling to close the gap between limited water resources and increasing demand due to population growth, the reduction in water availability due to climate change could have tragic consequences. Socio-economic development and the well-being of the population are threatened in the absence of proper and efficient adaptation measures. Integrated Water Resources Management (IWRM) in water-limited countries such as Jordan can help to ensure sustainable management of water supplies. IWRM is greatly facilitated by the Water Evaluation and Planning (WEAP) tool (Briefing 2.1).

Here, WEAP was used to develop a model linking the Amman Zarqa basin (AZB) and the Jordan Valley, with the aim of informing water management approaches for both basins under

climate change scenarios. A major project under planning is currently the Red Sea - Dead Sea Canal (RSDSC), which aims to increase water supply in the region. WEAP was used to measure the effectiveness of the RSDSC in counteracting the challenges posed by climate change.

### Research Methods

As in all WEAP models, the GLOWA Jordan River team's WEAP model incorporates supply and demand nodes. The model was used to evaluate the impact of the RSDSC on closing the gap between supply and demand in the Amman Zarqa basin (AZB) and in

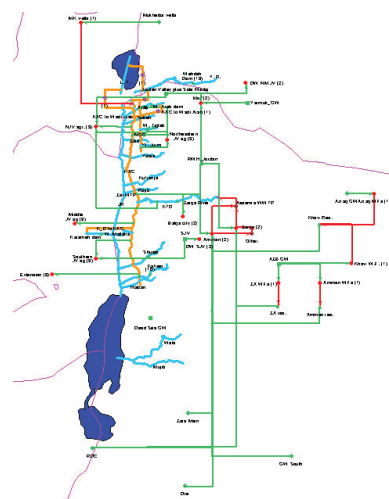


Figure 1: The WEAP schematic of the Jordan Valley and Amman Zarqa basin.



the Jordan Valley under climate change conditions. The two basins are good examples for IWRM, which includes the urban water cycle from the source to the reuse. The WEAP schematic of the Jordan Valley connected to AZB is shown in Figure 1.

Climate change impacts on the availability of water resources (both surface and groundwater) as well as on agricultural water demand (Menzel et al. 2007) were incorporated into the WEAP model.

### Discussion

The WEAP model was run for three scenarios namely: Business As Usual (BAU) scenario, climate change scenario, and RSDSC scenario. In the BAU scenario water demands and resources trends grow as expected or planned. In the climate change scenario, climate change impacts on the resources, runoff and groundwater recharge and on the demands in the valley are imposed. Runoff and groundwater recharge are assumed to decline according to a certain formula and irrigation demand is assumed to increase by 10%. In the RSDSC scenario, the RSDSC project which will provide about 550 MCM of desalinated water per year, assumed to be implemented by the year 2022. The results showed that without implementing the RSDSC project, the gap between supply and demand for Amman and Zarqa for domestic use as well as in the Jordan Valley for irrigation use will continue to grow until the year 2050 for both the BAU and the climate change scenarios. However, by implementing the RSDSC, the domestic demand of both cities will be satisfied starting the year 2022 till the year 2050. Furthermore, the deficit in the agricultural demand in the Jordan Valley for the year 2050 will drop from about 195

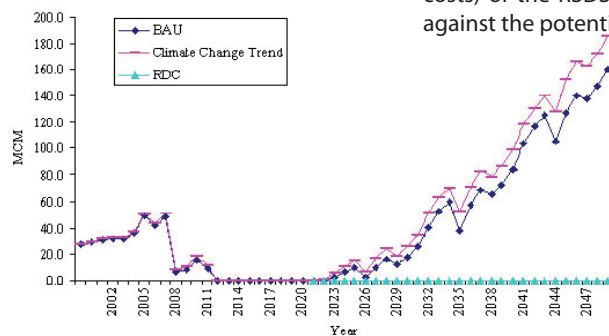
MCM for the climate change scenario to about 85 MCM for the RSDSC scenario as a result of the increased treated wastewater flow to the valley from AZB. The results also showed that groundwater resources that supply Amman and Zarqa from inside the basin as well as from outside the basin can be saved as a result of giving the supply preference to the RSDSC project.

### Conclusions

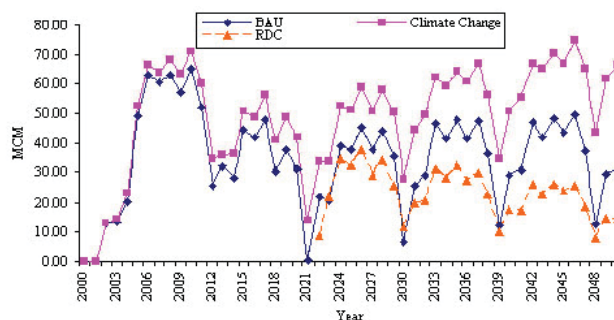
In developing new resources and adopting an integrated approach informed

by modeled scenarios such as those created with WEAP, Jordan will greatly improve its opportunities to endure the severe consequences of natural water scarcity under the projected negative impacts of climate change. The implementation of the RSDSC project has the potential to help overcome the increasing deficit in the domestic demand in Jordan due to population growth and climate change.

Future WEAP studies will implement the environmental impacts (i.e. potential costs) of the RSDSC and balance them against the potential benefits.



**Figure 2:** Unmet domestic demand in Amman for three scenarios. The deficit in the domestic water supply will be met after implementing the RSDSC project. Data for the three scenarios such as future population growth rates and Non Revenue Water levels were obtained from the Ministry of Water and Irrigation. These data were put into the Jordan Valley model, which was included in the regional WEAP model.



**Figure 3:** Deficit in the agricultural water demand in the Jordan Valley (MCM). The deficit will be reduced after implementing the RSDSC project. Data for the three scenarios such as future population growth rates and Non Revenue Water levels were obtained from the Ministry of Water and Irrigation (MWI). These data were input to the Jordan Valley model, which was included in the regional WEAP model. Climatic data for the years 2000 till 2008 were obtained from MWI. Climatic data were repeated for the BAU scenario.

### References

- Al-Omar, A., A. Salman, and E. Al-Karablieh (2011): The Red Dead Canal Project: An Adaptation to Climate Change in Jordan. 1st Water and Environment International Conference, WATEIC-2011, October 26 - 29, 2011, Marrakech- Morocco.
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