Water Availability and Security in Southern EuRope and the Mediterranean
http://www.wassermed.eu

Factsheet No 12

Climate change impacts and adaptation in the Jordan River Basin, Jordan

In brief:

- *The Jordan River Basin already experiences severe water scarcity problems, as a result of reduced flow in the Jordan River Basin*
- *Water scarcity mainly affects agriculture; climate change can exacerbate existing issues, as it can result to higher crop water requirements*
- *Key adaptation options for the agricultural sector include shifts in planting/sowing dates, change of cropping patterns, and deficit irrigation*
- *Water supply enhancement (desalination, reuse, exploitation of untapped water resources) and demand management emerge as policy priorities to address both climate change impacts and current water management problems*
- *Future increases in the volume of reclaimed wastewater might alleviate the water scarcity affecting irrigated agriculture in the Jordan Valley. Nonetheless, this would require addressing the associated quality issues*

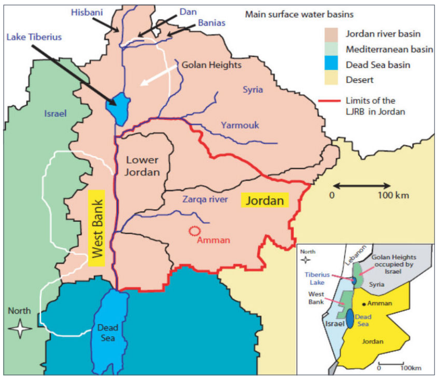
Further Information
Prof. Muhammad Shatanawi
University of Jordan, Amman
e-mail: shatanaw@ju.edu.jo

The Jordan River Basin - An overview of current issues

The lower Jordan River basin is part of the Jordan River system. The total area of the basin is about 18,300 km² of which 7,627 km² are located in Jordan. About 90% of the population of the country is concentrated in the cities of Amman, Zerqa, Irbid, Sult, Ajloun and Jerash. The WASSERMed case study area includes the Jordan parts of Yarmouk basin, Zerqa River Basin and the sub-basins of other side-wadis that feed into the Jordan River. Two topographic units can be broadly distinguished in the Basin, the Jordan Valley and the Highlands. There is noticeable variation in climate from north to south and from east to the west.

The climate of the Jordan Valley varies from semi-arid (precipitation of about 400 mm/yr) in the north, to arid in the south (precipitation of about 100 mm/yr) but is considerably warmer than that of the Highlands. The average temperature varies from 15°C to 22°C during the winter, and between 30°C and 33°C in the summer. Rainfall in the Highland mountains ranges between 400 to 600 mm/yr, with peak values in January and February. Snowfalls are observed once or twice per year in elevations above 700 m.

Currently, the Jordan Valley experiences water scarcity, particularly during the summer. As a response, the Jordan Valley Authority imposed heavy restrictions on water supply during the summer months. In the past, the Jordan River flow (long-term average of 620 MCM) could allow for the irrigation of 54,000 ha at both banks of river. This flow has now declined to an average value of 200 MCM/yr for the Jordanian side of the Valley, which is hardly enough to irrigate 23,000 ha on average. In wet years, an additional 6,000 ha can be irrigated, whereas during droughts, deficit irrigation and water rationing are imposed. The decline of water availability in the Jordan Valley is mainly attributed to upstream uses in riparian countries, and partly to climate changes.



The Jordan River Basin

Employed methods

Climate data were collected for 6 stations representing different climatic zones of the Jordan River basin. Regional climate scenarios were provided for the period 1961-2050, based on a model ensemble (HIRHAM5, REGCM3, RACMO2, RCA), forced by the ECHAM5 GCM for the A1B SRES. Data representing the mean value of simulations from the different models were used to assess climate change and to evaluate direct impacts on agriculture, resulting from changes in crop water requirements. A significant part of the research focused on the mapping of water-related security threats and drivers of change that could further affect vulnerability and water security in the area.

A stakeholder workshop was organized to discuss future scenarios for the Jordan River Basin. Scenarios were further simulated through water balance modelling with the aim to identify potential adaptation options for mitigating potential threats to water resources.

Participants of the Jordan Stakeholder Workshop, Amman, April 2011

Climate change impacts and adaptation in the Jordan River Basin, Jordan

Main results

Impacts and adaptation in the agricultural sector

- An increase in maximum temperature of about 1.5ºC and a decrease of precipitation of about 10-15% by 2050 are expected.
- By 2050, climate change can result in an increase of crop water requirements between 6.4% to 10.3%, depending on the type of crop.
- Earlier sowing dates for winter and spring crops (wheat, potatoes and tomatoes) can be effective in reducing maximum crop evapotranspiration.
- Earlier planting dates can be similarly effective in reducing seasonal evapotranspiration, due to the reduction of the total crop growing cycles), and the fact that growing cycles can thus coincide with high rainfall seasons, shorter daytimes and lower temperatures.
- The use of Late Maturing Varieties (LMVs), which allow total or partial recovery of the crop cycle length, can be effective in increasing crop yields to levels similar to those of 2000.
- Deficit Irrigation (DI) strategies can allow control of the levels of effective evapotranspiration and net irrigation requirements, while achieving satisfactory yields.

Late Maturing Varieties and Deficit Irrigation strategies as adaptation measures in the agricultural sector

- For wheat, the use of best-adapted LMVs in combination with early sowing (November) and supplemental irrigation (about 150-250 mm of Net Irrigation Requirements - NIR), seems effective in ensuring a projected yield of 3-4 t/ha.
- For tomatoes, the use of best-adapted LMVs, together with early sowing and/or a “medium” to “mild” DI strategy (480 -580 mm of NIR), are expected to ensure a relatively high level of 50-63 t/ha.
- For potatoes, the use of best-adapted LMV with early sowing (November) and/or a “mild” DI strategy (450-500 mm of NIR), project a relatively stable level of yield (27-30 t/ha) compared to the current national average (27.5 t/ha).

Water balance modelling and future water security

- The Drivers-Pressures-State-Impacts-Responses (DPSIR) framework was used to map the water-related security threats and drivers of change that can affect the vulnerability of the Jordan River Basin to climate change. Identified drivers were further used to develop a best and a worst case scenario. Subsequently, through water balance modelling, the scenarios were used to quantify future water-related security threats and adaptation measures.
- For the worst case scenario, water security gradually deteriorates in the future, for both the domestic and agricultural sectors. This concerns both the average coverage of water demands and reliability in water supply provision. From 2030 and onwards, the domestic deficit is significantly more pronounced, whereas the situation is considerably worse for the agricultural sector.
- Areas planted with bananas could be reduced by 2.5%/yr up to a maximum reduction of 50%. Similarly, the area of palm trees can be increased by 3%/yr replacing banana cultivations, while the area of all vegetables should be reduced by 1%/yr for the next 40 years. These areas may be used for other fruit trees and vegetables.
- With the implementation of the new cropping pattern and more land conversion between crops types, water balance modelling results suggest that it would take about 30 years to reach water balance.
- This type of gradual, phased changes in agricultural cropping patterns could lead to net water saving. These will likely be more acceptable by the local farming community than suddenly imposed shifts.

Recommendations

- Water supply should be enhanced, through the desalination of brackish water, extraction and conveyance of fossil water, the building of new dams and further use of reclaimed wastewater.
- In addition to the above, different options should be explored in an effort to secure the water rights of Jordan for the shared water resources of the Jordan and the Yarmouk Rivers.
- For the agricultural sector, climate change impacts can be alleviated through shifts to earlier sowing dates and use of early maturing crops.
- Deficit irrigation strategies can be practiced in order to reduce evapotranspiration and net irrigation requirements, without significantly affecting crop yields.
- Based on stakeholder preferences, the cultivation of water intensive crops (e.g. bananas) should be reduced, while palm tree cultivations should be expanded.
- Significant investment should be made in demand management options, such as public awareness programmes, precision irrigation, and the improvement of conveyance and distribution efficiencies.