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GLOWA Jordan River

# Hydrology in the Lower Jordan River Basin (LJRB)

*About actual water resources and new water sources - an analysis based on the TRAIN-ZIN model*

## Actual Water Resources

No detailed, basin-wide overview of naturally available surface water resources currently exists for the LJRB. We assess all elements of the water balance (surface runoff, percolation, and evapotranspiration) are assessed. For this purpose, the TRAIN-ZIN model is applied with rainfall radar as input and a high spatial and temporal resolution (250x250 m², 5-7 minutes). Estimates of seasonal water availability excluding anthropogenic impacts are delivered, i.e. water flows without human abstractions, diversions and sewage disposals.

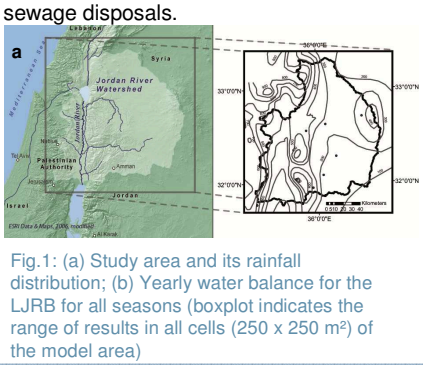



Fig.1: (a) Study area and its rainfall distribution; (b) Yearly water balance for the LJRB for all seasons (boxplot indicates the range of results in all cells (250 x 250 m²) of the model area)

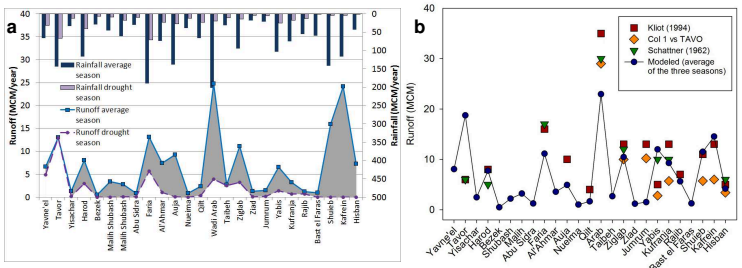
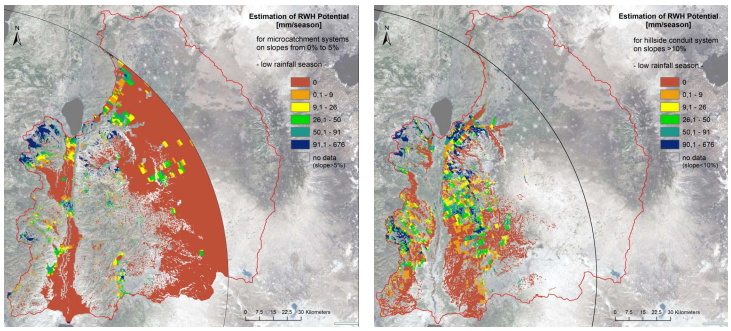



Fig. 2: Runoff at the outlet of 25 sub-basins of the LJRB (a) in average and drought conditions and (b) observed vs. modelled data

Three hydrological years were simulated: drought (1998/99), average season (2002/03); wet extreme (1991/92). Basin averages of seasonal water balance components range considerably (Fig. 1b). The high spatial and temporal variability of the region is also visible in the runoff at the outlet of 25 sub-basins of the LJRB (Fig. 2a). Since gauged stream flow data are rare and, if available, only reflect a heavily altered regime including abstractions and diversions, model results had to be checked against long term estimates of natural wadi runoff volumes. These estimates differ substantially, but modelled volumes lie within their order of magnitude (Fig. 2b).

## Rural Rainwater Harvesting (R-RWH)

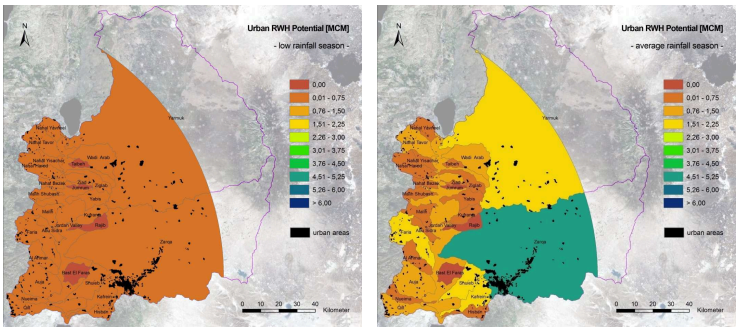
We estimate R-RWH potentials during drought 1998/99. Generated hillslope runoff is assumed as maximum potential and different R-RWH techniques are considered depending on slope. Slopes between 0% and 5% are suitable for microcatchment systems, whereas slopes > 10% are suitable for hillside conduit systems.




Maximum R-RWH potentials for the drought season 1998/99 for two different techniques, left: microcatchment systems, right: hillside conduit systems

## Urban Rainwater Harvesting (U-RWH)

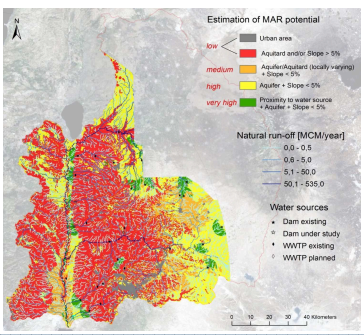
Maximum potentials were calculated based on the rainfall radar data for the average and drought season. Urban areas were derived from different data sources and were partly completed by digitizing aerial photos. Rainfall on urban areas is multiplied by 0.2 because 20% of urban areas in the Middle East are estimated as roof areas[1]. The data was multiplied by 0.75 for the drought season and by 0.8 for the average season to account for evaporation losses from roof surfaces.




Maximum potentials of U-RWH in the sub basins of the LJRB, left: drought season, right: average season

## Managed Aquifer Recharge (MAR)

For a MAR-suitability map, the input parameters geology, slope and urban areas processed to thematic layers and combined in a GIS. Potential water sources to be utilized for MAR are existing and planned reservoirs or wastewater treatment plants, their location was obtained from the SMART-Project. A 5 km buffer around these water sources is used to visualize the most suitable areas, whereby only sites at a lower altitude than the respective water source are considered.
Wadi runoff as direct response to rainfall is simulated by TRAIN-ZIN and included along the channel network. It may serve as an additional water source for MAR facilities.




| Potential | Factor | Area [km²] | Area [%] |
|---|---|---|---|
| LOW | Urban areas | 290 | 3 |
| | Aquitard and/or slope > 5 % | 5171 | 54 |
| MEDIUM | Aquifer/Aquitard + slope 0 % - 5 % | 1129 | 12 |
| HIGH | Aquifer + slope 0 % - 5 % | 2654 | 27 |
| VERY HIGH | Proximity to water source + Aquifer + slope 0 % - 5 % | 419 | 4 |
| Total | | 9663 | 100 |

Map and statistics of MAR potentials via surface infiltration


**References**

- 1 Grodek, T., Lange, J., Lekach, J., Husary, S. (2011): Urban hydrology in mountainous middle eastern cities. Hydrology and Earth System Sciences, 15 : 953-966
- Gunkel, A., Lange, J. (2011): New insights into the natural variability of water resources in the Lower Jordan River Basin. Water Resources Management. In press.



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