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Assessing water consumption and aquifer discharge by springs based on the joint use of rain and flow data in the Yarmouk River Basin

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The Yarmouk River is the significant flow source of the Jordan River. The study area is the Yarmouk River Basin up to Maqaren Station (6,058 sq. km) including Syrian (more than 80%) and Jordanian parts. Comprehensive use of the consistent data on rain and flow together with the very limited and irregular available data on the use of water resources enabled the: (i) reconstruction of the natural (unregulated) flow at the Maqaren Station and (ii) assessment of the water consumption from the Yarmouk River (1971-2009). Particular attention was given to the significant withdrawal increase since 2000, which led to the dramatic drop in the flow at end of the period.
The reconstructed Natural Flow of the Yarmouk River at Maqaren Station (1971-2009) is in average slightly above 300 MCM/y. During the rainy years it reached up to 400-550 MCM/y. Since 1997 it is possible to observe systematic increased differences between measured and natural flow caused by the increased water consumption. During 1997-2009 the total water consumption was estimated as 76% of the water resources (Natural Flow of the Yarmouk River) vs. 24% for the measured flow at Maqaren Station. Similar estimates for surface water and for groundwater are 82% and 67%. In 2006-2009, annual consumption (total, SW and GW) critically increased and reached to 95%-100% of the Natural Flow.
During the study we estimated the perennial base flow of the Yarmouk River at Maqaren Station caused by springs outflow in the outlet section of the Hreer tributary, which represents the local aquifer discharge. Its mean annual value was assessed as 120 MCM (40% of the Yarmouk flow in the natural regime), but it decreases to almost complete dry-out in the current conditions of the decline in the water level of the basin aquifer and the depletion and drying of the springs (as result of significant increase of groundwater consumption).
Calculation period (1971-2009) is limited by the available data. It is very important to extend it to 2016-2017. According to some sources, in the last years decrease of water consumption and increase of the Yarmouk River flow were observed. Critical discussion and additional data will contribute to the development of the proposed model. It can be adapted to real-time monitoring of the water consumption from the Yarmouk River
According to the published sources, the present study is the first of this kind providing the complete and detailed information on consumption from the Yarmouk River. These results are very useful for water balance estimation, as well as for assessment and management of the water resources at the study area in the current difficult situation.

References

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