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Managed Recharge into a Karst Aquifer - Wala Dam, Jordan

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Introduction

Managed Aquifer recharge of groundwater is used in the implementation of Integrated Water Resource Management (IWRM) in the Lower Jordan Rift Valley, within the framework of the SMART II project (Sustainable Management of Available Water Resources with Innovative Technologies, BMBF).

The Wala dam was constructed (1999-2002) to collect floodwater and recharge it into the underlying limestone aquifer, where it is reclaimed for drinking water supply at Heidan well field (Figure 1).

Objective

Obtain a better understanding of the dynamic system of runoff and storage in the reservoir, recharge of the karst aquifer and recovery of the water. This includes the investigation and observation of:

- water level fluctuations in the reservoir and aquifer
- sedimentation in the reservoir

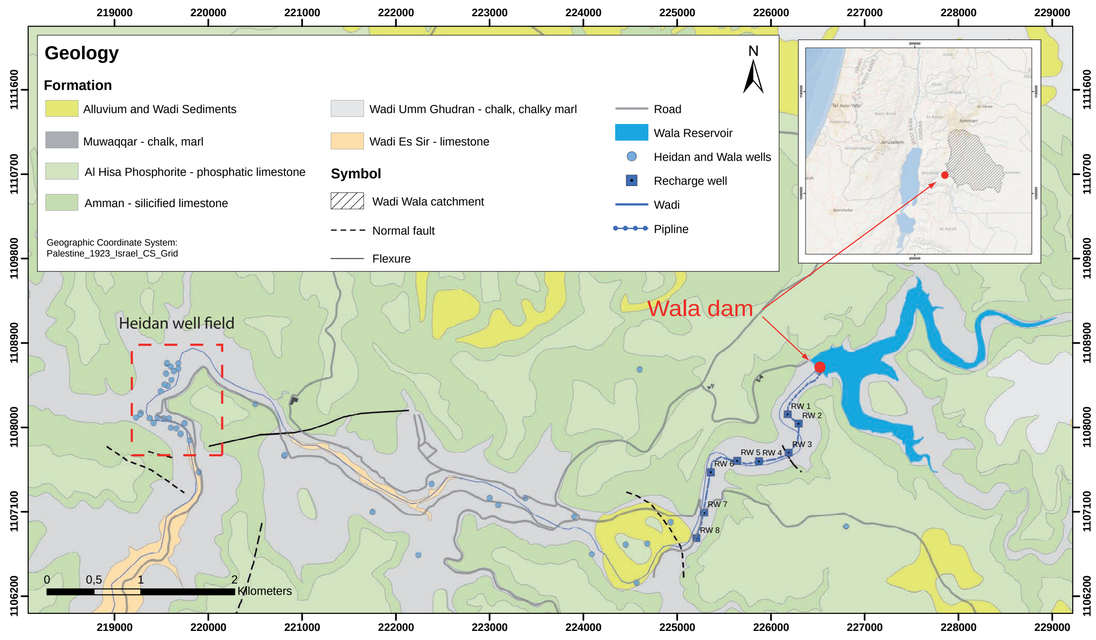

Figure 1: Geological and geographical overwiev about the Wadi Wala area.

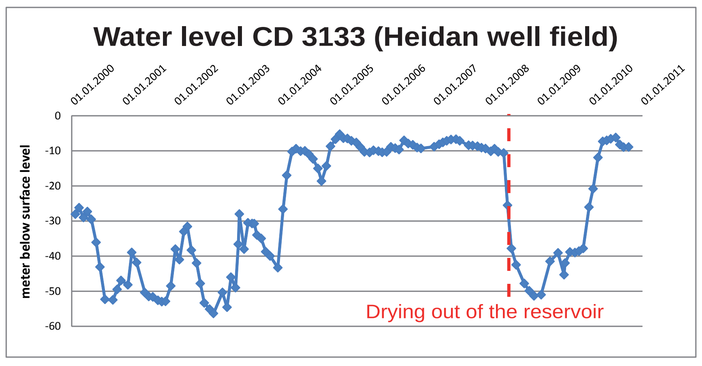

Figure 2: The replenishment of the aquifer is documented in the groundwater level record of the Heidan well field. Mean annual abstraction (2002-2011) is around 11,86 MCM, mostly used for drinking water supply.

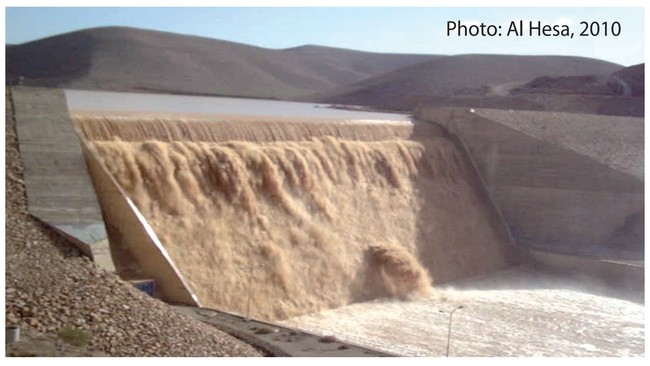

Figure 3: The mean annual inflow into the reservoir is around 10,4 MCM. From 2002-2011 around 73,9 MCM were stored, whereof 64,7 MCM recharged the aquifer and 6,7 MCM evaporated. A part of the inflow was lost by overflow events e.g. in 2010.

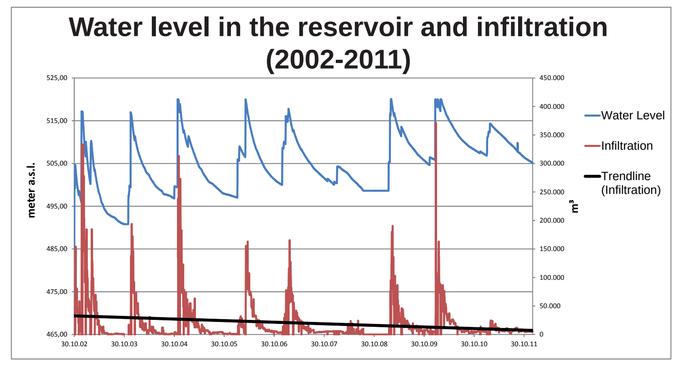

Figure 4: Reduced infiltration rate caused by sedimentation. Most of the infiltration from the reservoir takes place laterally along the vertical and horizontal faults and fractures.

Figure 5: Schematic profile along the Wadi - Groundwater flows from east to west. In the area between the dam and the Heidan well field, several faults crossing the Wadi in N-S direction. The flexure 1 km east of the well field has a vertical displacement of approximately 50 m.

Methods and Results

For recording the water level fluctuation in the reservoir and the aquifer, 5 Divers were installed in selected wells in November 2011 (Figure 5).

CTD Diver - Water level, Temperature, EC
Cera Diver - Water level, Temperature

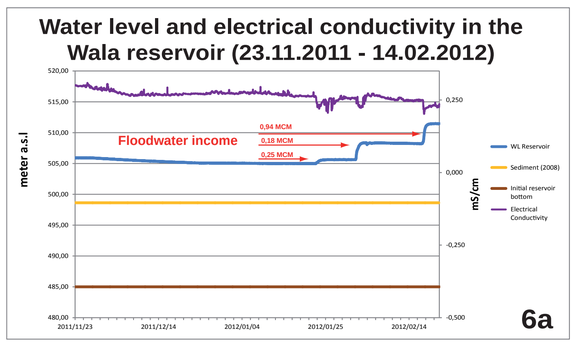

Figure 6a shows the rising water level in the reservoir during flood events and the associated changing of the electrical conductivity.

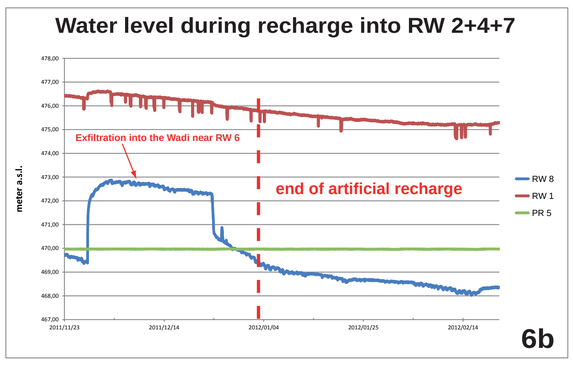

Figure 6b shows the decreasing water level in two recharge wells after the ending of artificial recharge. Hereby, 1000m³ per day were infiltrated by gravitation into the aquifer (Jun. 2011 - Jan. 2012).

Conclusions

- Sedimentation in the reservoir led to a reduction of the infiltration rate (Figure 4), especially during low water level.
- Most of the infiltration from the reservoir takes place laterally.
- The blocked outlet of the dam makes it difficult to controll the water level, which led to overflow events in the past.
- With the installation of water level recorders it is possible to determine the behaviour of the aquifer during artificial recharge. This helps to improve the management of the recharge wells e.g. to avoid overflow of the dam and also the exfiltration from the aquifer into the Wadi near the recharge wells.

Further studies

- Implementation of a tracer test to determine flow path,- and transit times from the reservoir to the well field.
- Numerical simulation (FEFLOW) of the test site.
- Measurements (sediment traps, yard sticks) and investigation (core drillings) of the sediments in the reservoir.
- Observation of turbidity and fecal bacteria in the groundwater.

References

- Database from the Ministry of Water and Irrigation (MWI) and Water Authority Jordan (WAJ), Amman
- Humphreys, 1992. Dams on Wadi Wala and Wadi Mujib, Final Report. Part IV - Site investigation, Volume I - Geology. October 1992. P.52
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