SMART

Work package 4, Deliverable D 412

Report on implementation of SMART I/II recommendations on new drilling sites

Western side of the Lower Jordan Rift Valley

Dr. Annat Yellin Dror [1]
Dr. Joseph Guttman [2]

[1] Tel-Aviv University
[2] Mekorot, The Israeli National Water Company, Ltd.

October, 2013

Corresponding author:

Dr. Annat Yellin-Dror
General Manager
Geohydrological Information Center (GIC)

Department of Geophysics and Planetary Sciences
Faculty of Exact Sciences, Tel Aviv University

Tel Aviv 69978, Israel

Tel: 972-3-6407667
Cell: 972-52-3485269
Fax: 972-3-6409282

Sponsored by

Federal Ministry of Education and Research

.

Sponsored by the German Federal Ministry of Education and Research (BMBF):

FKZ 02WM1079-1086 and FKZ02WM1211-1212

Project Coordination:

Main Coordinator:	Assistant Coordinators	
Prof. Dr. Nico Goldscheider & Dr. Jochen Klinger Institute of Applied Geosciences, Karlsruhe Institute of Technology Adenauerring 20b 76131 Karlsruhe Germany Phone: +49 (0) 721 608 43096 Fax: +49 (0) 721 606 279	Prof. Dr. Martin Sauter Department of Applied Geology Göttingen University Goldschmidtstrasse 3 37077 Göttingen Germany Phone: +49 (0)551 39 79 11 Fax: +49 (0)551 39 93 79	Dr. Roland Mueller & Dr. Stefan Geyer Helmholtz Centre for Environmental Research (UFZ) Permoserstr. 15 04318 Leipzig Germany Phone: +49 (0)341 235 30 00 Fax: +49 (0)341 235 2885

http://www.iwrm-smart2.org/

CONTENTS

1 INTRODUCTION

The main goal of the SMART2 project is to increase the total amounts of water for domestic and agriculture usages in the area of the Lower Jordan Rift Valley (LJRV). The major and most important local water resources are fresh water from shallow and deep aquifers. However, due to lack of fresh water resources in the region, secondary origins of brackish and saline water are taken into consideration for local usage. These potential water reservoirs are found in relatively large volume in the shallow and deep aquifers, mostly coexisting with fresh water.

The main economic activity in this region is agriculture (predominantly palm trees), which naturally and primarily depends on local water resources. The way to ease the water deficit is to consider using water sources of different qualities such as brackish water and treated effluent.

Agriculture in the Lower Jordan Valley and the Arava Valley is partially based on relatively small amounts of brackish water which are used either for direct irrigation and/or by diluting with secondary effluents for Palm trees and/or by desalination for drinking purposes as well as for dilution. Small desalination facilities were constructed for this purpose in both Lower Jordan Valley and the Arava Valley.

The source of salinization is salt concentration in the aquifer systems within the Jordan Valley sediments which were covered by the Lisan Lake (ancestor of the Dead Sea). Increasing salinity concentration in the lower part of the Jordan Rift Valley acts as high risk for the local groundwater resources. In addition, salinity increase can damage the stability of the whole system in the area. The saline water is coexisting with the fresh water and utilization of the brackish water should take in consideration the effect on the fresh water body.

A concept for the sustainable utilization of the brackish water in the IWRM framework is required.

The results of the scientific research were reported under deliverable D-324. Some outcomes of this report are under implementation by the Israeli stakeholder (Mekorot, The National Water Company) and by the Palestinian stakeholder (PWA together with local usages).

Chapter 2 describes the potential saline water sources that were reported in the deliverable D-324 and are mature for future implementation.

Chapter 3 described the implantation activities that were taken by the stakeholders so far in order to utilize brackish water for the local usages.

2 RESULTS

2.1 General

The reports of Hassan and Guttman (2011) and Flexer, Yellin-Dror and Inbar (2011) resulted in summarizing the brackish resources within the study area.

Unfortunately, only few of the suggested sites are available as sustainable resources for direct irrigation and/or desalination usage. Two sources of brackish water were found suitable in the regional aquifer (Judea/ Ajlun Group aquifer) and two other sources which were located in the alluvial aquifer of the valley-fill. In addition, one of the D-324 report conclusion is that the surface water of the Jordan River itself can act as an additional source for sustainable brackish water in the area (today there are few pumping stations along the river banks).

2.2 Brackish water in Feshcha Springs (Marsaba- Feshcha basin)

Ein-Feshcha spring group which is located on the upper north-western shore of the Dead-Sea is the major outlet of the calcareous regional aquifer (the Judea/Ajlun Group aquifer). The spring discharge towards the Dead Sea is estimated between 62-67 MCM/year (measured by the Israeli Hydrology Survey). The springs present large storage, characterized over the years by stable discharge with only small annual fluctuations. The springs cover a relatively large area of 3-4km along the

Dead Sea shore. The water emerges from the alluvial deposits which are in direct connection with the major aquifer.

The spring's water maintains the local natural reserve. After crossing the natural reserve, the brackish water is flowing to the Dead Sea and lost there. Our recommendation is to locate the pumping points between the eastern border of the natural reserve and the Dead Sea shore. We believe that capturing the brackish water after it crosses the natural reserve and before it flow into the Dead Sea will not make any damage to the natural reserve.

Hasan and Guttman (2011) assumed that yearly amount of 30 MCM with salinity between 1500-2000 mg/l Cl. The brackish water can be used as raw water for desalination facilities or for direct irrigation of the palm trees in Northern Dead Sea and Jericho area.

2.3 Brackish water in Fazael area

The most important structure having a significant effect on groundwater resources exploitation is the eastern monocline flexure that runs along the western foothills of the Jordan Valley. Most of the pumping wells are located inside this monocline, which is characterized by a lower permeability and behaves as a dynamic border between fresh water and saline water bodies.

The fresh water is coming from the recharge area in the west while the saline water exists in the aquifer layers within the rift (east of the monocline structure). Fazael 1 is the first deep well that was drilled to the Judea Group aquifer in the Jordan Valley and his located a few hundred meters east to this monocline flexure. The water in the well was saline (1600- 3300 mg/l Cl-). The second well, Fazael 2, was drilled in a closer wadi aperture that cuts the monocline flexure. The water in this well is fresh and stable (45 mg/l Cl-). The salinity gap between the fresh and saline water bodies is because the low permeability of the monocline acts as a buffer zone that delays the movement of the saline water towards the fresh water body.

All pumping wells, such as Fazael, Gitit and Uja boreholes, drilled to the Judea/Ajlun Group aquifer in Fazael-Uja region, are situated within the monocline and are aimed to pump the fresh water before it flows and lost within the deep basin-fill sediments of the Jordan Valley.

The sources of salinization in the LJRV are residual deep seated brines as well as salt layers and bodies that were deposited during various sea transgression events and penetrate deep formation inside the valley. Some wells are characterized by seasonal fluctuations with a high correlation to the monthly pumping. The cause for salinity rise in several pumping wells is due to hydraulic connection between formations containing fresh water and deep formations containing saline water. The available current knowledge, absence of deep investigation wells inside the valley, makes it difficult to delineate the exact location and nature (fault, wedge-out, inter-fingering etc.) of contact zones between the fresh water and the saline water. It is suggested that pumping the saline water for desalination use will eventually reduce the pressure of the saline water body from the fresh water body and will decrease salinity hazards of the fresh water body.

2.4 Brackish water in Jericho and Uja areas

The shallow aquifer in the in Jericho and Uja areas consists mainly of alluvial deposits i.e. clay, silts, conglomerate, chalk, marl and gypsum layers of the Lisan formation. Due to the high water demand in the area of Jericho and Uja as well as consequently high groundwater abstraction rates. Groundwater quality in the alluvial aquifer has been considerably deteriorated.

Detailed geochemical study carried out by Marie et al. (2001) and Khayat et al. (2006) were suggesting that the high chloride contents in the local aquifer of Jericho are derived from several sources which include:

- Up-conning of deep brines.
- Leaching of surface salt crusts within the aquifer.
- Anthropogenic contamination of agriculture return flow and waste water infiltration.
- Residual saline water (brines) resulting from ancient higher Dead Sea water levels. The salts penetrate into the aquiferial formations within the alluvial sequence.

The amount of fresh water that recharge into the alluvial aquifer is limited and unable to push backward the saline water from the well fields. During pumping, the saline water move towards the wells and the salinity rise. This means that the shallow formations that contain fresh water and the deep formations that contain the saline water are hydraulically connected.

The fresh water acts as a lens or a thin layer that is overlaying the saline water body. In many wells the perforated section causes an artificial connection between the fresh water horizon and the saline water layers. Furthermore, in many wells the permeability is low resulting in large dynamic drawdown. Those conditions (up-conning and lateral movement of saline water) are the origin of salinity rise in this aquifer.

Interpretation of seismic lines carried out in the framework of the SMART-1 indicates that within the Jordan Valley there are areas where the Judea/Ajlun Group aquifer is at a shallow depth (Ankar 2007). These sites are favorable places for prospecting and drillings for brackish water reservoirs within the upper part of the Judea/Ajlun Group aquifer. The PWA drilled in 2011 a deep well into the Judea/Ajlun Group aquifer west to the Uja village. The water are brackish. The drainage of the Judea/Ajlun Group aquifer in Uja village area is into the alluvial deposits.

3 Implementation

There are large amount of palm trees plantations in the Lower Jordan Rift Valley (in the Palestinian and Israeli land). In addition, due to the high economic success and revenue, it is planned to expand the plantation in the next years. Eventually we will face a situation that the available water sources will not be sufficient to supply the increasing demand.

Researches as well as years of experience and observation proved that the product (date) of the Palm trees irrigated with brackish water of around EC of 2000 ms/cm is quite high. The result is top out for brackish water (between 1800-2500 ms/cm).

As mentioned before, the sources of salinization in the LJRV are residual deep seated brines as well as salt layers and bodies that were deposited during various sea transgression events that penetrated into the shallow and deep formation inside the valley. The results and conclusions of the hydrogeological conceptual models that were carried out during SMART 1 and 2 initiated Mekorot to look for sites for the development of brackish water resources.

In the first stage, three new sites were considered for drilling within the Judea/Ajlun Group aquifer in the vicinity of the valley itself (Fig. 1). Each of the future wells is planned to pump about 1 million cum/year of brackish water with salinity of 2000-2500 mg/lit Cl. The brackish water will be used for irrigation of palm plantations, either directly or by mixing with treated effluence.

Difficulties or Mekorot in receiving the final approval from the JWC (Joint Water Committee) caused re-checking the possibility and the profitability of reuseing two abundant wells in Fazael area that were penetrated into the saline body (Fazael 1 and 11).

During last couple of month, hydrologists and drilling engineers from Mekorot are considering how to chance these abundant wells to production wells. In parallel Mekorot prepares a design program to connect the two wells (after repair) and the new sites to the brackish network.

According to our knowledge, the PWA (Palestinian Water Authority) is willing to utilize brackish water In Jericho – Uja area for Palm plantations. In the report D-324, (Guttman, 2012) proposed to locate 5-6 new wells in the eastern part of the Jericho area (an outer ring) and about 2-3 wells in the eastern part of Uja village. The hourly discharge of each well is expected to be around 100-120 m3/hr and the calculated yearly amount is estimated to be between 0.8-1.0 MCM/yr per well.

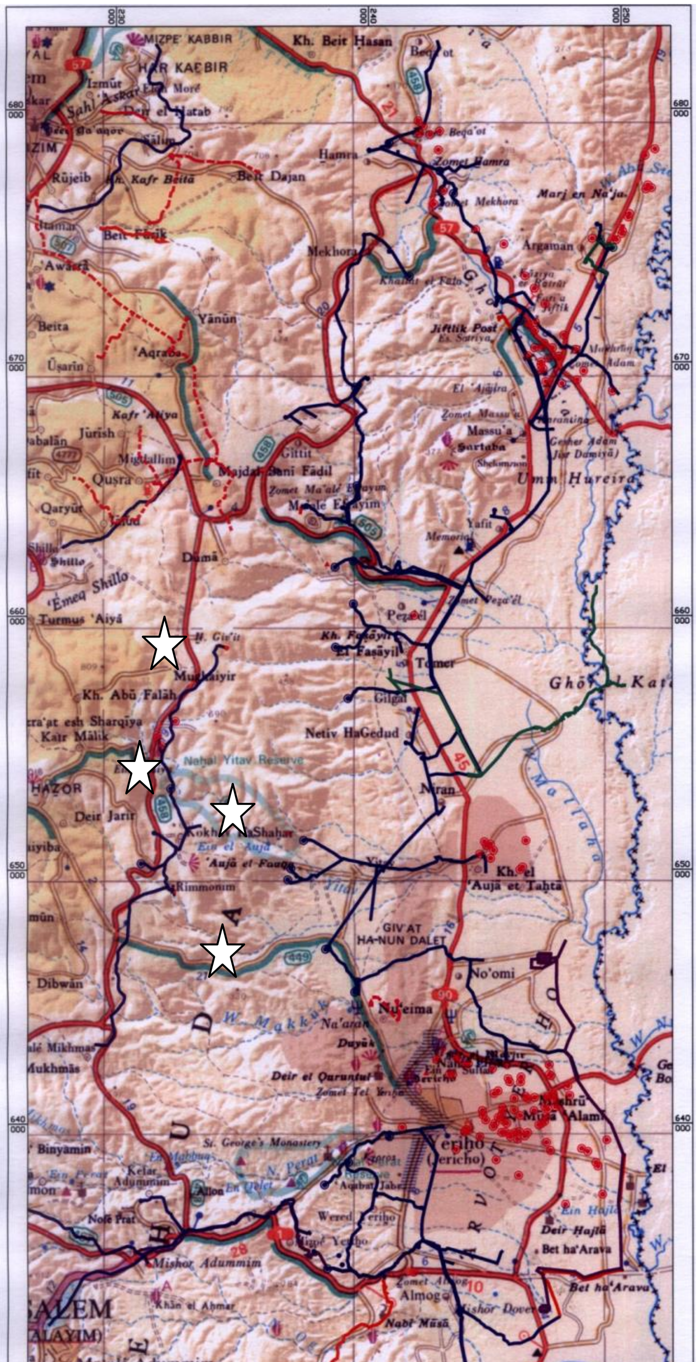

Figure 1: Location map of new sites for brackish water wells (stars) implemented on well (black circles) and pipe line black lines) location map of Mekorot.

4 SUMMARY

In several researches that was conducted during SMART 1 and 2 projects the existing and the future potential of brackish water as an additional source to the region was raised. In the report on potential sites for brackish water usage (Guttman, 2012) there are recommendations about the yearly amount and average quality of the brackish water in the potential sites.

Base on the results of the SMART projects, stakeholders (such as Mekorot) located new sites for drilling and pumping the brackish water from the Judea/Ajlun Group aquifer. The timetable for bas water drilling as well as supplying depends totaly on the approval of the JWC. Meantime, Mekorot is considering the technical aspect in order to determine either to repare abandant wells that penetrated saline water body or to drill new well at the suggested sites.

5 REFERENCES

Anker, Y. (2007). Hydro-geochemistry of the Central Jordan Valley. Ph.D. Thesis, Tel Aviv University, 130pp.

Anker, Y., Shulman, J., Guttman, J., Yellin-Dror, A. And Flexer, A. (2008).Geophysical Investigations of the Hydrogeological Basins in the Central Jordan Valley. In: Hötzl, H., Möller, P. and Rosenthal, E. (eds). The Water of the Jordan Valley. Scarcity and Deterioration of Groundwater and its Impact on the Regional Development. Springer Pub., pp 181-198.

Farber, E. (2005). The Lower Jordan River: River Salinization, Relationship with adjacent groundwater and future management. PhD thesis submitted to the Ben-Gurion University.

Flexer, A., Yellin-Dror, A., Inbar, N. (2011). Brackish water resources and their physico-chemical characteristics. Report submitted to WP 3.3 in SMART2 project.

Gafny, S., Talozi, S., Al-Sheikh, B., Ya'ari E.(2010). Towards a living Jordan River: An environmental flows report on the rehabilitation of the Lower Jordan River. Publication of "Friends of the Earth, Middle East".

Guttman, J. (2012). Report on potential sites for brackish water usages: Marsaba-Feshcha sub-basin. Report submitted to WP 3.3 D-324 in SMART2 project.

Hasan, J., Guttman, J. (2011). Report on potential sites for brackish water usages: Marsaba- Feshcha sub-basin. Report submitted to WP 3.3 in SMART2 project.

Hötzl, H., Möller, P., Rosenthal, E. (2008). The Water of the Jordan Valley. Scarcity and Deterioration of Groundwater and its Impact on the Regional Development. Springer edition 531 pages.

Khayat, S. Hoetzl, H. Geyer, S. Ali, W. (2004). Hydro-chemical Investigation of Water from the Pleistocene Wells and springs, Jericho Area, Palestine. Hydrogeology Jour. Springer Verlag, Published online, 2005.

Khayat, S. Hoetzl, H. Geyer, S. Ali, W., Knoller, K., Strauch, G. (2006). Sulfur and Oxygen isotopes characters of dissolved sulfate in groundwater from Pleistocene aquifer in the southern Jordan Valley (Jericho area, Palestine). Isotopes in Environmental and health studies. Vol. 42 No. 3. Pp 289-302.

Marie, A. and Vengosh, A. (2001). Sources of salinity in groundwater from Jericho area, Jordan valley. J. Ground Water. 39, 240-248.