Integrated Water Resources Management in the Lower Jordan Rift Valley

Sustainable Management of Available Water Resources with Innovative Technologies

SMART

Work package 3-3, Deliverable D 328

IWRM concept of regional deployment of desalination units

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1. Role of Brackish water Treatment in the IWRM-concept

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In arid and semiarid areas growing population and industrialization on the one hand and increasing water pollution on the other hand have led to a severe shortage of fresh water serving drinking water supply and irrigation for food production. The effect of climate change contributes additionally to this dramatic development. The technical and educational implementation of concepts like Integrated Water Resources Management (IWRM) may help to improve the situation. However, the state of practical art is still insufficient and further research and development are needed to lay a profound basis for daily life operation. The limited availability of fresh water resources asks for technical solutions to treat salty water and/or polluted water and thus keeping it involved in the utilization of the water cycle. The use and re-use of brackish water belongs to the most attractive approaches to meet this aim.

The occurrence of brackish water in arid and semi-arid areas is relatively high. For the Lower Jordan Rift Valley about 49 – 55 Mm^3 (Jordan, Lower part of Jordan Valley and Deir Alla Region), 30 Mm^3 (Israel, Feshcha), 10 Mm^3 (Palestine, Jericho) and 5 Mm^3 from Jordan River has been estimated (SMARTII Final Report, 2013). In addition waste water and waste water treatment plant effluents from industries and population has become a valuable source of reuse of water. Among the different possibilities to treat the salty raw waters properly for application, membrane technologies have emerged as promising methods for fresh water production. One of the major pitfalls of desalination by membranes was the high amount of energy necessary for operation. In the last decades, however, the development of high performance low pressure Reverse Osmosis (RO) membranes have opened the doors to high operational salt rejection at relatively low energy input. This approach has gained additional attractivity in combination with energy recovery systems and the use of renewable energy sources. E.g. decentralized photovoltaic power generation has become available recently and is especially attractive for sunlight intensive areas.

Desalination technology can play and active role in the IWRM concept. Knowledge of the specific influence of brackish water chemistry and reliable local infrastructure are crucial to understand the membrane process and guarantee a proper plant operation. Of course all has to be seen in the frame of a general concept for a safe and efficient water supply system and its essential components like treatment and water transport. Inclusion of resource protection and management of already existing infrastructure has to be considered and powerful strategies for environmental protection have to be introduced to support the sustainability of public water supply. This includes ecologically acceptable solutions for the brine issue and other resulting waste streams, which have become one of the major challenges for the installation of membrane plants by this for a successful IWRM in general.

An additional aspect which needs to be considered for an optimal membrane plant operation is the availability of well-trained operators. They need to understand the entire process and they need to develop rules for a continuously safe operation of the plant. Investigation of cleaning frequencies, selection of suitable antiscalants to minimize specific fouling processes and a meaningful control and monitoring system have to be developed in cooperation with the membrane producers and scientific/technical advisers.

A convincing IWRM concept has also to include an active capacity development. The relatively complicated technical facilities of today and the complexity of the daily life ask for science and technology based education with social and economic competence. Thus, the built up capacity is most promising for coping with the increasing water crisis also in the lower region of the Jordan Valley and to answer urgent questions connected to the over-exploitation of water sources, to the influence of climate change on aquatic systems and to the more pronounced alterations of draught and foods.

In addition to wise political decision towards IWRM concepts, the needs of integration of water saving and water quality protection in industrial production, in daily life products and finally in consumer habits are obvious. In all cases education towards environmental awareness and towards the development of suitable technical tools for keeping the hydrological cycle functioning are indispensable for human life. Brackish water in its bridging function between fresh water and sea water offers an ideal and rewarding interdisciplinary playground with high potential for natural scientist, engineers and ever, sociologist and economist.

2. Desalination of Brackish Water in Jordan Valley for Agricultural Purposes

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2.1 Existing Situation:

In 2010 a survey was done by private sector[1] that showed the number of desalination units were 50 belongs to farmers (private). The total irrigated areas were 4750 dunums; with a total capital cost about 3 million JD.

The resource of desalination water was 85 wells, operates through electricity for about 24 hours in summer and 8 hours in winter. Table 1 shows the water quality of desalination plants.

Table 1[2]: water quality of desalination plants in Jordan

Average quantity of desalinated water	1300 m^3/hr
Quantity of Brine water	450 m^3/hr
Rate of salinity intake water	3000 ppm
Desalinated water salinity rate	250 ppm
Average TDS for water use in irrigation	650 ppm
Average Brine salinity	8000 ppm

[1] Eng. Nayef Seder, Jordan Desalination and Reuse Association, Water Users association.

[2] Brackish water was desalinated 7,592,000 m^3 per year.

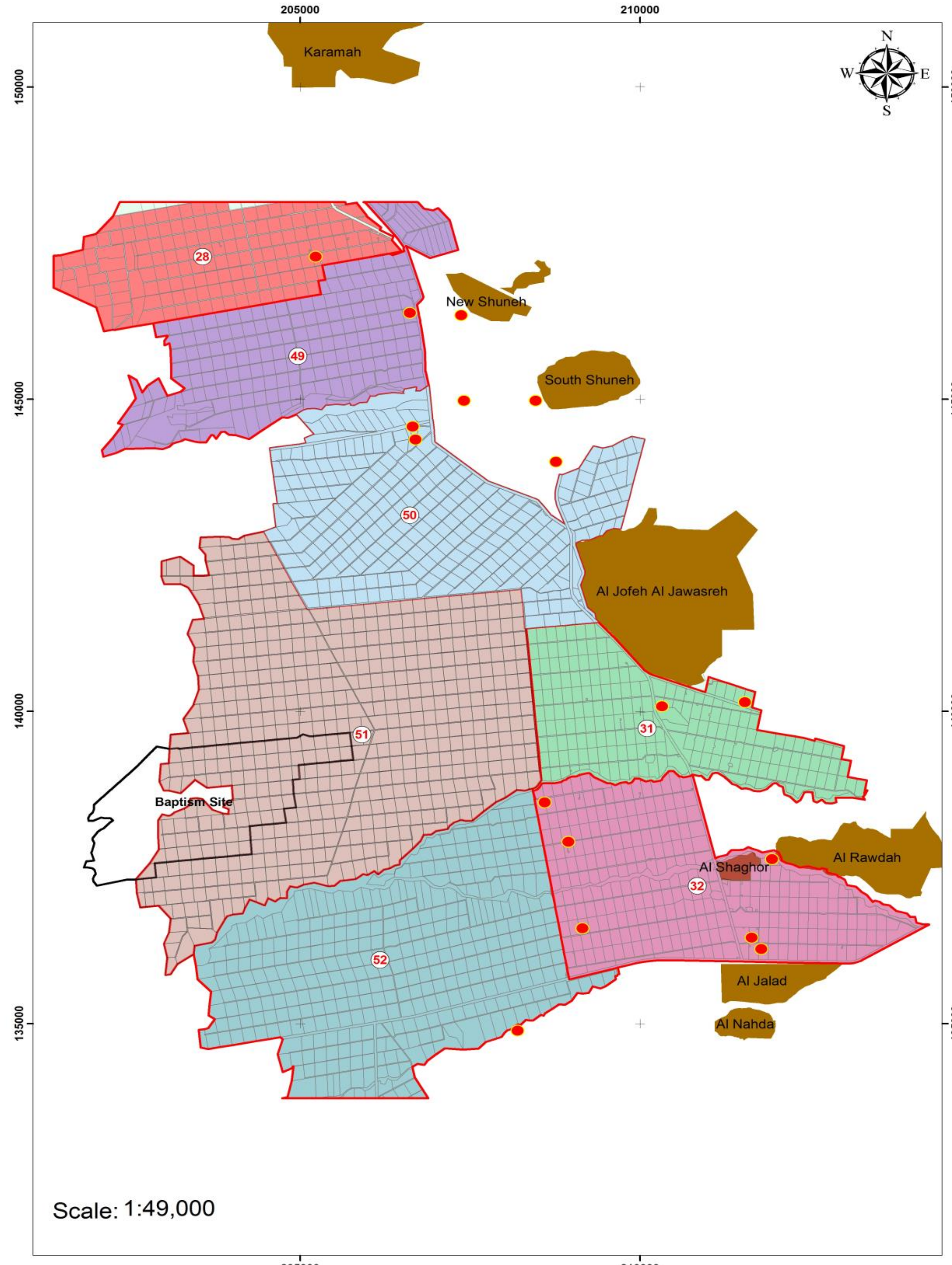

Figure 1: location of desalination plants in the south Jordan Valley

2.2 Justification for water desalination brackish water:

- Scarcity of fresh water and availability of saline groundwater.
- Availability irrigable lands, but no available water for them e.g. (14 km extension irrigation project).
- Farmers irrigate cash crops:
  - Improve plant growth, quality and increase production
  - Prevent calcification in the network of irrigation networks and drippers.
  - Improve the physical soil quality.

2.3 Disadvantages of desalination plants:

- High salinity drainage (brine), that increase the rate of salinity (8000 ppm) which affects the environment. A proper disposal of brine is needed to not cause an environmental impact (human beings, animals, soil, surface and groundwater).
- Lack of qualified operation and maintenance staff.
- Concentration is disposed to wadi and drain.

2.4 Recommendations:

- Conduct the necessary studies of the environmental impact of desalination plants.
- Development of standards and Metrology for desalination of brackish water, brine disposal, limits for effluents.
- Study for use of brine for fish feeding.
- Make feasibility study for brackish water desalination and assess the cost per cubic meter of desalinated water.
- Development of licensing for desalination plants.

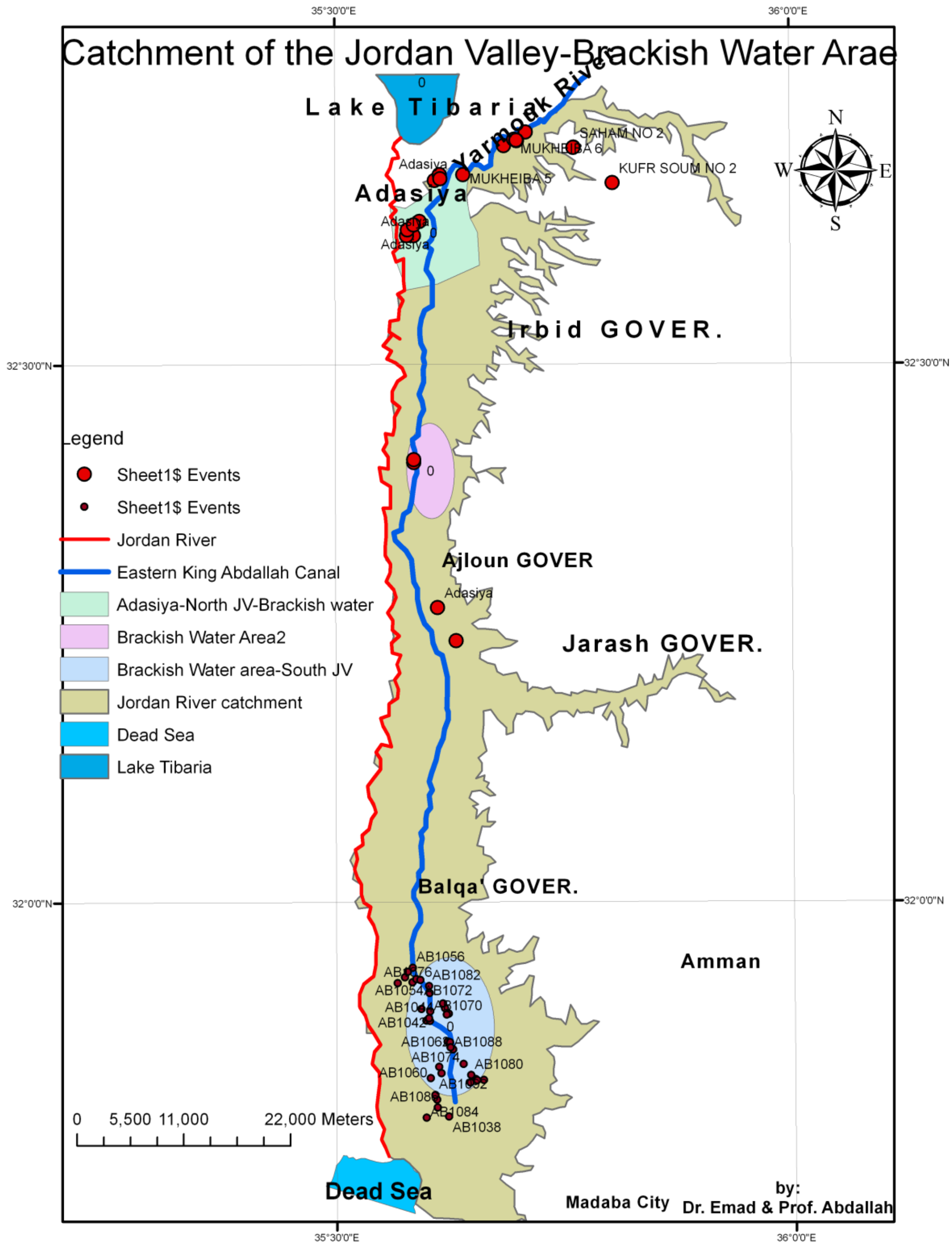

Figure 2: Mapping of potential sites for brackish water desalination