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SALAM Information and Expert System

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KEY FINDINGS

An information platform gathers the geographical data of the SALAM concepts.

The Water Budget Tool allows the user to compute future freshwater deficits and visualize the results in graphs.

Stakeholders can calculate the costs of a desalination plant using the SALAM Economic Tool.

The cost-minimal solution to cover the freshwater needs of the region is computed for a given set of constraints in the Macro-Model Tool.

The water production and transfer alternatives are compared on various criteria in the Performance Matrix.

Choosing between various planning alternatives is made easier using Multi-Criteria Analysis in the PROMETHEE-Cloud.

MOTIVATION

The methods and results developed in the SALAM Initiative should be easily accessible for decision-makers in the region. Knowledge transfer relies among other things on the establishment of a complete and well-organized database. The SALAM project partners produced geographical data at regional and national scale, which needs to be displayed and shared properly to enable the transboundary management of water resources. Decision Support (DS) tools can be of great help to facilitate short and long-term strategic planning. Developing these tools required a constant dialogue with the regional stakeholders to ensure transparency, interactivity and, therefore, participatory decision making on a multilateral level. The Information and Expert System (IES) developed during this project displays relevant geodata and gathers several DS Tools.

THE COMPONENTS OF THE SALAM IES

The SALAM IES stores geodata, hosts various web applications for water planners, and provides interfaces for data visualization. The ArcGIS Experience Builder was used to develop the web applications as it provides useful basic functionalities to build an Expert System. An information platform and five DS Tools are hosted in the SALAM IES. The system is accessible with an ArcGis Online license (https://salam2-dss.uni-goettingen.de/).

INFORMATION PLATFORM

Geodata is structured in thematic groups in the information platform (Figure 1). Data on the water and wastewater infrastructure and on the freshwater resources was gathered from the partner institutions in Israel, Palestine and Jordan. Project results, such as the freshwater deficits at cluster level, the water transfer pathways of the different transboundary water strategies, the suggested additional wastewater infrastructure or the wastewater reuse options in the Lower Jordan Valley are also displayed on the information platform. Clicking on a specific element allows the user to access technical information such as for example the freshwater deficits in a demand cluster or the capacity of a seawater desalination plant.

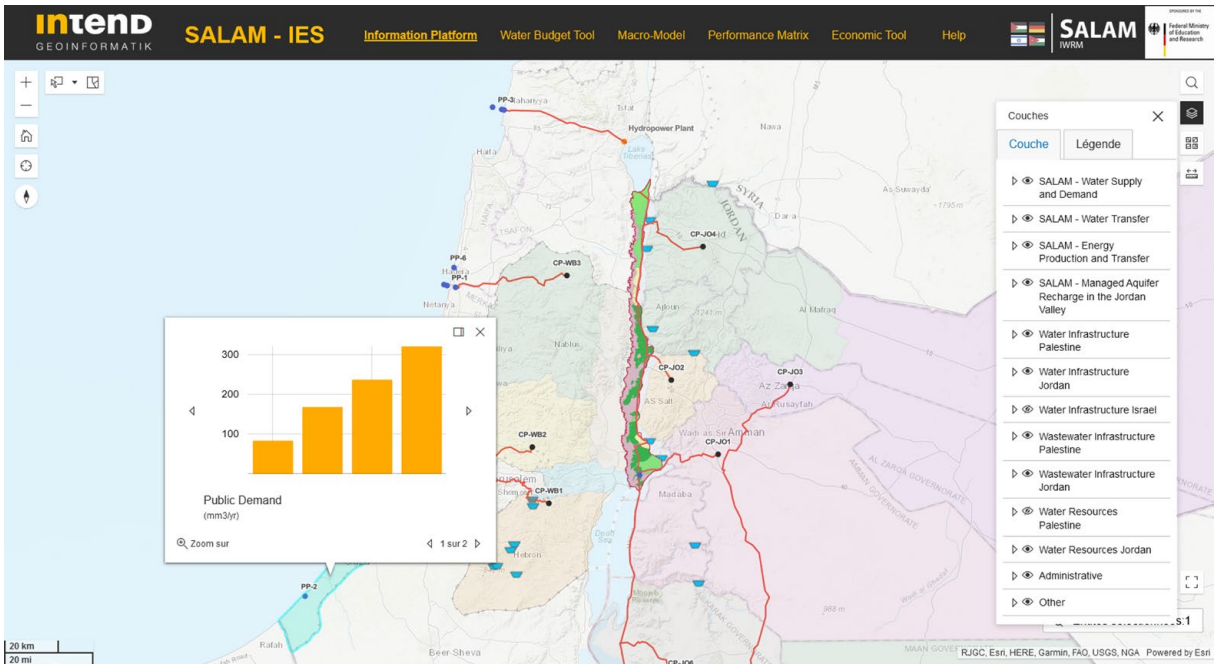

Figure 1: Information Platform

WATER BUDGET TOOL

The tool computes the projected freshwater budget from 2020 to 2050 in several economic sectors in Jordan and Palestine at the cluster or national level. A baseline scenario is defined in both countries. The computation mode of the freshwater budget and the underlying assumptions for the baseline scenarios are explained in [Future Freshwater Deficits in Palestine and Jordan, p. 18]. The user can choose to compute water supply and demand using the assumptions defined in the baseline scenarios or change these assumptions and define his own development scenario. Water demand, supply and budget are displayed in graphs (Figure 2). Inputs and outputs of the newly defined scenario can be saved and exported in a table.

SALAM ECONOMIC TOOL

The costs of a seawater desalination plant can be computed easily in the SALAM Economic Tool. Costs include capital expenditures (CAPEX) and operating expenditures (OPEX), divided between annual fixed and variable

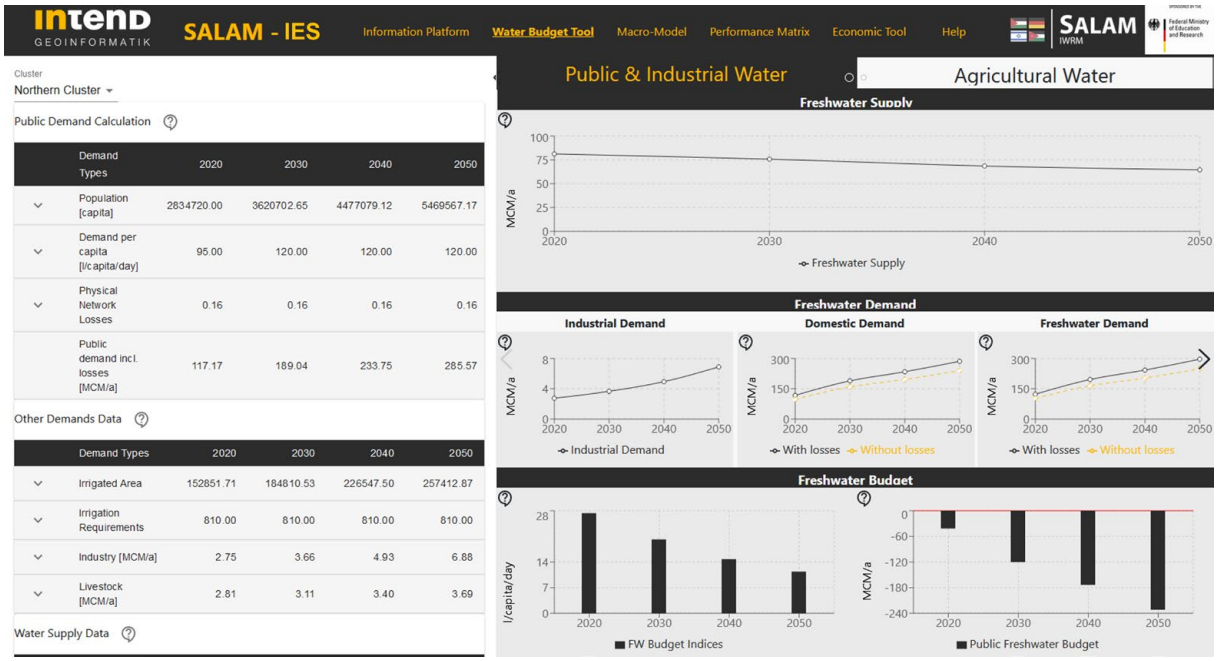

Figure 2: Water Budget Tool

costs. More details on the cost computation are provided in [Techno-Economic Assessment of Water Infrastructure Projects, p. 72]. The tool features a user-friendly Graphical User Interface. Outputs include the total investment and the specific desalination costs in €/m³. A cost breakdown allows the water planner to identify the main cost drivers, which is a prerequisite for developing effective cost-saving strategies.

MACRO-MODEL

TThe Macro-Model Tool is an optimization tool designed to identify the cost-minimal option to supply water from desalination plants at the Mediterranean and Red Sea to all demand clusters in Palestine and Jordan. The potential locations of the desalination plants and the potential water transfer network are defined. Details on the objective function and the optimization can be found in [Regional

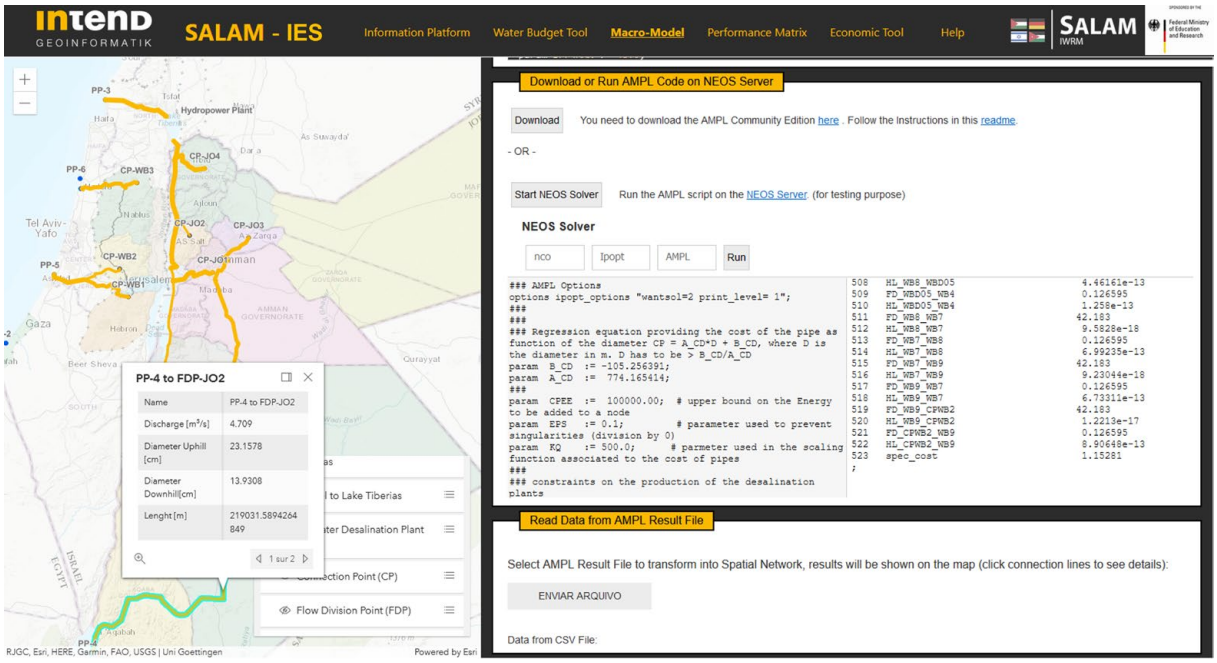

Figure 3: Macro-Model Tool

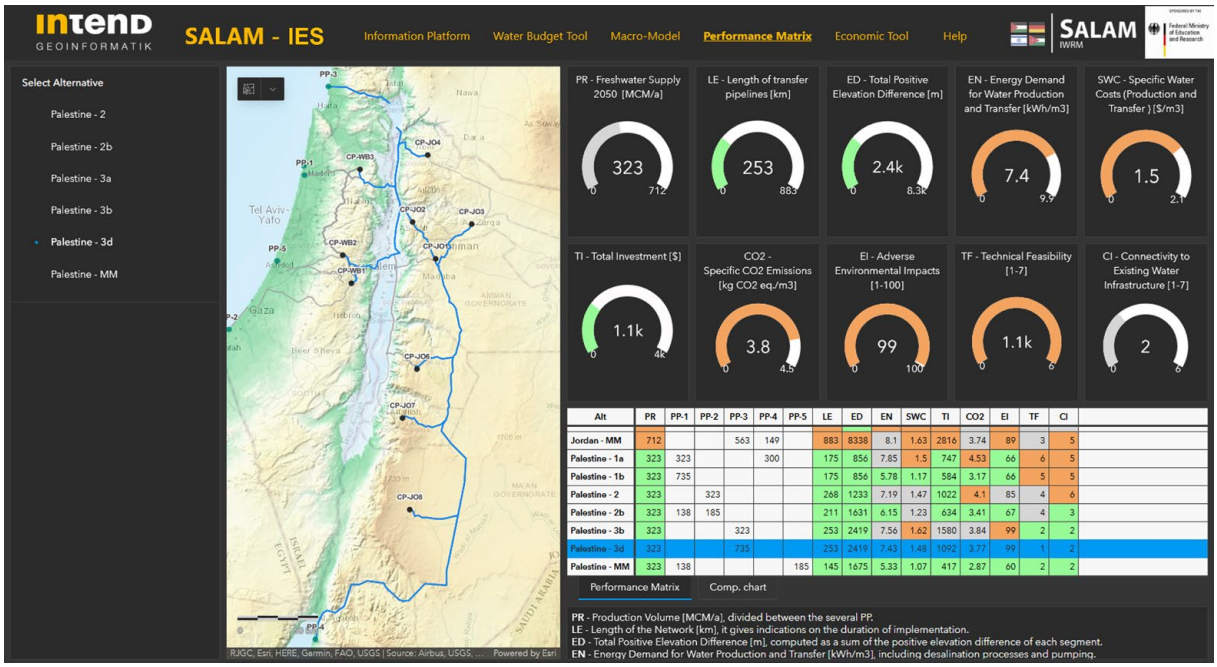

Figure 4: Performance Matrix

Macro-Model for Transboundary Water Resources Planning, p. 76]. The water-planner has the option to modify constraints regarding the capacity of the seawater desalination plants or even the possibility of not considering certain locations, to modify the planning horizon and, accordingly, the freshwater deficits of the demand clusters, and to compare the cost-minimal solutions obtained. The specific water production and transfer costs and the ideal transfer paths are determined and displayed by the system (Figure 3). Technical information regarding the discharge and diameter in each segment of the optimized network is given.

PERFORMANCE MATRIX

The water production and transfer strategies developed in the SALAM project are compared based on specific criteria, which are displayed in the Performance Matrix. Technical, economic and environmental criteria were evaluated for all strategies by the SALAM project partners. Their values are discussed in [Assessment of Freshwater Strategies and Recommendations for Implementation, p. 92]. The visualization tool allows the mapping of all strategies on the GIS platform and includes gauges with the performance of the strategy on all criteria and the whole performance matrix (Figure 4). Gauges and colours allow the user to assess the relative performance of a strategy against the others.

PROMETHEE-CLOUD

The tool aims at helping decision-makers to choose between various planning alternatives by means of Multi-Criteria Analysis (MCA). The planning alternatives should first be defined and evaluated on various decision-relevant criteria. The weight of a criterion illustrates its relative importance. The process and aim of the MCA are explained in detail in [Multi-Criteria Analysis of Water Resources Planning Options, p. 80]. The PROMETHEE-Cloud provides the user with graphs and tables and contains elements of interactive guidance which makes it user-friendly.

KNOWLEDGE TRANSFER AND NEXT STEPS

Decision-Support tools are successful if they are relevant to the user, reliable and intuitive. A user guide was elaborated for each tool and is accessible from the Help tab of the SALAM IES. A series of tutorials should be organized with decision-makers from Palestine and Jordan for technology transfer, ensuring that the potential of all tools can be fully exploited. The Water Budget Tool and Macro Model Tool could serve as basis for still more advanced and flexible water resources system planning tools in the context of SALAM follow-up projects. Desktop DS tools developed by other project partners during the project (e.g. UFZ and UK) could be adapted and integrated as online tools in the SALAM IES. The geodata gathered in the project is open-access and beneficial for any future research in the region.

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