



Sustainable Management of the West Bank and Gaza Aquifers

Outcomes and Follow-Up

The outcomes of the SUSMAQ project include: the first published hydrogeological map of Palestine; spatial databases related to aquifer use and protection; groundwater flow and pollution models of Palestinian aquifers; new data from a field programme on recharge assessment; spatial models of rainfall and groundwater recharge; a regional-scale climate model; new socio-economic field data on the links between water and livelihoods; a Decision Support Framework for sustainable water resources management, based on a Multi-Criteria Assessment methodology and stakeholder participation; provision of training courses in all of these areas; and assessments of the status of water resources in Palestine.

A follow-up project (2004-2005) has been funded by the Department for International Development to embed the SUSMAQ outcomes within the PWA. Further capacity-building activities in this phase will support operational implementation of the technical tools, socio-economic assessments, and sustainable management procedures developed in SUSMAQ. A newly-established NGO in Palestine, the House of Water and Environment (HWE), collaborating with the University of Newcastle upon Tyne and other international partners, will continue to provide support for Palestinian sustainable water resources management into the future.



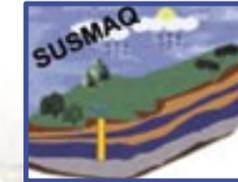
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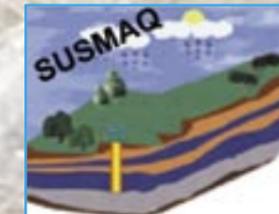
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Overview

The overall goal of the SUSMAQ project (1999-2004) was to support the sustainable management and use of scarce water resources in the West Bank and Gaza Strip. The project was led by the University of Newcastle upon Tyne, working with other UK partners, and with the Palestinian Water Authority (PWA) as the main project beneficiary. The comprehensive scope of the project ranged from regional climate change and aquifer modelling through to assessments of local water access, livelihoods and institutional arrangements. The project outcomes have provided the PWA with a highly responsive water resources planning and management capability that can react to changing political, socio-economic and environmental circumstances. SUSMAQ was funded by the UK Government Department for International Development (DfID).



Pollution Modelling



Construction of a spatial database of aquifer water quality and pollution sources has indicated key issues including the disposal of untreated sewage from

Palestinian villages and Israeli settlements in the West Bank. Numerical modelling has been used to simulate pollution hotspots and to inform the development of groundwater protection measures.



Rainfall and Climate Change



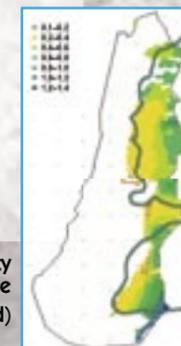
Detailed spatial and temporal rainfall data are essential for accurate predictions of future replenishment of groundwater resources. A stochastic space-time rainfall model has been calibrated against historical climate data and used to provide realistic rainfall input into recharge and groundwater models for predicting impacts of future climates. A meso-scale regional climate model has been used to assess the feedback mechanisms between land-use changes in Israel and climate in the Eastern Mediterranean.



Recharge Estimation and Wadi Natuf Study



New primary data on recharge into the West Bank aquifers have been collected from a field monitoring programme in the Wadi Natuf catchment, including detailed meteorological, groundwater, soil moisture and wadi flow data. These have provided new understanding of the spatial variability of recharge processes in semi-arid conditions, which have supported the development of a new object-oriented spatial recharge model.

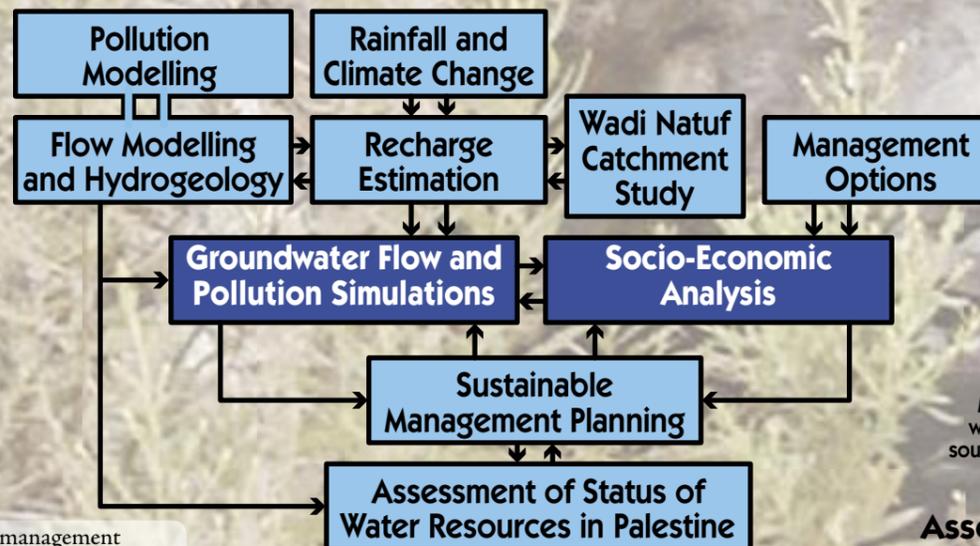


Spatial variability of recharge April 1987 (mm/d)

Flow Modelling and Hydrogeology



An extensive re-evaluation of geological data and new hydrostratigraphic descriptions of the regional aquifers have provided the basis for conceptual models of the transboundary groundwater flow systems and the publication of the first hydrogeological map of Palestine. Steady-state and transient numerical models have been calibrated against historical data, and are being used within a user-friendly *Integrated Management Tool* to provide predictions of the impacts of future climate inputs and Palestinian and Israeli groundwater abstractions.



Management Options and Socio-Economic Analysis

New micro-scale socio-economic data on the



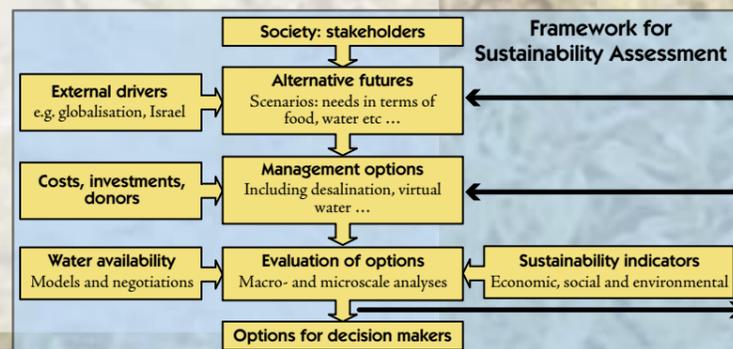
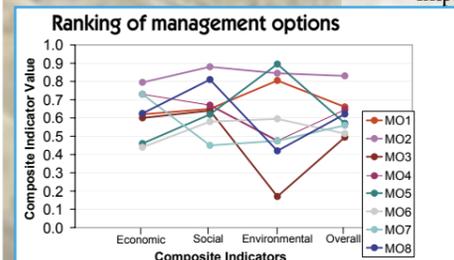
links between water and livelihoods in the West Bank and Gaza have been collected using a questionnaire survey of 2,300 households, village level case studies, and local stakeholder workshops. Together with macro-scale economic and institutional analyses, these provide the basis for assessment of the impact of water sector Management Options on the social and economic situation in Palestine.



Sustainable Management Planning

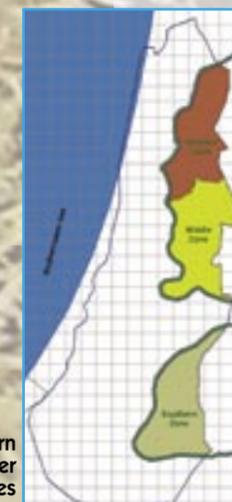


A holistic approach to sustainable water resources management has been developed based on the internationally accepted DPSIR (Driver-Pressure-State-Impact-Response) methodology. This is based on stakeholder participation and involves evaluation of a range of social, environmental and economic indicators to measure the impact of different water sector Management Options, under a set of scenarios describing possible hydropolitical/socio-economic and climatic futures. This approach has been implemented in user-friendly *Decision Support Toolkit* software to provide a means for helping to prioritise water sector investment planning.



Assessment of Status of Water Resources in Palestine

The methodologies and tools developed in the SUSMAQ project have been used to provide detailed understanding of water resources in Palestine, supported by new scientific interpretations based on original field data and new groundwater models. In particular, the maximum quantities that can be abstracted from Palestinian wells in different zones of the Western Aquifer Basin without adversely affecting Israeli abstraction have been determined using the groundwater models. The outcomes of this work can be used to assess the adverse impacts of activities affecting Palestinian water resources such as the building of the Separation Wall. Under this activity, Technical Files have been produced to support the Final Status Negotiations.



1986-1998 mean annual abstractions from Western Aquifer Basin (MCM)

