Palestinian National Authority
Palestinian Water Authority

السلطة الوطنية الفلسطينية
سلطة المياه الفلسطينية

Sustainable Management of the West Bank and Gaza Aquifers

Rainfall Variability and Change in the West Bank

UNIVERSITY OF NEWCASTLE

BGS 1815

Department for International Development

DFID

SUSMAQ- RAIN # 13 V 1.0

Feb 2003

Rainfall Variability and Change in the West Bank

Report of Phase A

SUSMAQ Project

University of Newcastle upon Tyne
Water Resource Systems Research Laboratory
School of Civil Engineering and Geosciences

February 2003

TABLE OF CONTENTS

1. Overview

1.1. The rainfall component of SUSMAQ

The spatial and seasonal variability of rainfall over the mountain aquifers of the West Bank has a crucial influence on the planning and operation of the groundwater resources. The Rainfall Component of the project has been devised to provide two main sets of deliverables for the project:

1. Suitable rainfall scenarios for input to the recharge model, accounting for both the spatial and temporal variability of the rainfall regime, and incorporating possible future changes for use in sensitivity analyses;
2. Predictions of changes in rainfall due to natural and anthropogenic climatic variability.

The work is programmed in three phases, with a review of each phase before commencing the next:

A. Preliminary assessment of rainfall variability, trends and potential climate change impacts, to provide immediate guidance for management and planning;
B. Stochastic space-time rainfall modelling to provide inputs to the recharge model, and to enable risk-based sensitivity analyses of the possible impacts of future changes in rainfall ;
C. Regional climate modelling to provide predictions of climate change impacts on rainfall, and of potential interactions between future land use and climate change.

Phase A has now been completed, and is reported here. Mindful of the need for rapid availability of guidance, the preliminary assessment of rainfall properties and climate impacts has been made using observed data and immediately available output from climate models (General Circulation Models: GCMs). The second phase will develop a model to produce daily spatial-temporal rainfall scenarios for application to the recharge model. The third phase will make an advanced climate change impact assessment using GCM downscaling methods to produce more detailed future rainfall scenarios. This will include the use of a Regional Climate Model to produce finer resolution future scenarios than are available from GCMs. This will allow topographic influences to be taken into account directly, as well as assessing the possible effects of land use and irrigation changes on climate and rainfall. This work would be in collaboration with the Hadley Centre, and there will be additional important benefits from such a programme to neighbouring countries in the region.

1.2. Background of Phase A of rainfall component

Two concerns have recently been raised regarding changes in rainfall threatening the water resources of the West Bank.

- The first concern is the threat from the effects of global warming. Current predictions from General Circulation Models (GCMs) are for significant decreases in annual rainfall over the region by the 2050s. This is combined with an increase in temperatures, causing higher losses from evaporation and changes in snow

accumulation and melt over the mountain regions of the West Bank. These combined effects pose a serious threat to groundwater resources, which need to be accounted for in planning the sustainable management of resources in the future. A further issue, little understood at present, is that of the effect of variations in rainfall intensity on groundwater recharge. It is likely that, even if annual rainfall remains the same under climate change, there will be changes in the number of wet days and in rainfall intensity, which will have significant impacts on the efficiency of recharge.

- The second concern was raised by recent studies of rainfall over Israel, which have shown evidence of trends in regional annual rainfall. These trends are characterized by a decrease in rainfall over northern Israel, and an increase in the more arid south. It is not known how these trends affect the West Bank itself, as insufficient observational data from the West Bank have been used in the studies to date and the region lies between the zones of most marked increase and decrease. These trends may reflect the influence of climate change and/or the effects of land use changes on local climate and rainfall.

1.3. Consequences for sustainable management of the West Bank aquifers

Recharge of the mountain aquifers of the West Bank is sensitive to the spatial and temporal variability of rainfall. If rainfall over a period of 3-4 years is above or below average, the effect can be seen relatively quickly through increased or decreased groundwater levels. The effect of below average rainfall over the past few years provides evidence of this. Moreover, groundwater levels in the Southern West Bank have decreased very significantly in recent years, with groundwater mining taking place in some areas.

It is crucial that the available long-term records for rainfall over the West Bank are analysed for evidence of trends, and that the consequences of the recent spatial and temporal variability of rainfall over Israel and the West Bank for the sustainable management of the West Bank aquifers are fully understood. Moreover, if, as has already been speculated by Israeli scientists, man-made interventions in the natural hydrological cycle have altered the natural rainfall regime in the region, this needs to be investigated and the consequences for sustainable management of the West Bank aquifers also understood.

If, as expected, climate change leads to decreased rainfall in the region, then it is important that sustainable management plans (and the negotiations over water with the Israelis) take into account possible future variations in rainfall associated with climate change. Moreover, the influences of any local man-made interventions on the rainfall regime must also be taken into account.

1.4. Objectives of Phase A of rainfall component

The overall aim of the rainfall component of SUSMAQ research is to enable the assessment of the impacts of possible changes in rainfall regime on groundwater

resources, in order to supply guidance for the sustainable management of the groundwater resources of the West Bank. Phase A of this research has been achieved by executing the following tasks:

- Collection and analysis of West Bank rainfall records
- Characterisation of the spatial and temporal statistics of the rainfall regime relevant to aquifer recharge i.e. intensity, seasonality, spatial correlation;
- Identification of spatial patterns;
- Identification of temporal trends;
- Relation of spatial patterns and trends to the regional climate and topography;
- Preliminary assessment of the likely impacts of climate change on rainfall using output from GCMs

Full report/document is not available online