The impact and management of recent drought on the West Bank groundwater aquifer system

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The impact and management of recent drought on the West Bank groundwater aquifer system

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Abstract. Water is a vital element for the development of all sectors in Palestine. Currently, the estimated average per capita use is around 50 l per day, which is half of the minimum recommended by the World Health Organization (WHO). Water demand in the West Bank is expected to increase substantially in the future. This is due to improved standards of living and increased population growth rate. For example, the estimated domestic water demand for the West Bank in the year 2000 is around 98 million cubic meters (MCM) while it is currently in the range of 55 MCM/year. Projected water demand for the year 2020 for domestic purposes is around 278 MCM. To meet the demand for water, additional supply will be needed. Groundwater is the only source for water supply in the West Bank. Currently, most of the water from West Bank aquifers is utilized by the Israelis and only very limited amount is given to Palestinian for water supply in the Palestinian areas. The total amount currently extracted by the Palestinians and Israelis from the Eastern Basin is around 40 MCM/year. The West Bank has a Mediterranean climate. The annual average rainfall varies between 700-850 mm on the western slopes, 500 and 800 mm in the hilly areas and 100 to 150 mm in the Jordan Valley. Evaporation is particularly high in the summer due to a rise in temperature, intensive sunshine and low humidity. Rainfall is the only source for recharging aquifer systems in the West Bank. Recently, West Bank suffered severe droughts due to drop in the rainfall. As a result a significant drop in the water table in both the upper and lower aquifer systems which form the main source for water supply. This paper will investigate the impact of recent drought on the groundwater aquifer system in the West Bank and drought management procedures applied by Palestinian Water Authority in the light of continuous Israeli control of Palestinian aquifers.

Keywords. Drought management – Water demand – West Bank aquifer – Palestine water resources.

L'impact et la gestion de la récente sécheresse sur les systèmes aquifères souterrains de Cisjordanie

Résumé. *L'eau est un élément vital pour le développement de l'ensemble des secteurs en Palestine. Actuellement, l'utilisation moyenne estimée par habitant est d'environ 50 litres par jour, c.-à-d. la moitié du minimum recommandé par l'Organisation mondiale de la santé (WHO). La demande en eau en Cisjordanie augmentera certainement de manière substantielle dans le futur, ceci étant dû à un meilleur niveau de vie et un taux démographique croissant. Par exemple, la demande d'eau estimée pour les foyers en Cisjordanie pour l'année 2000 est d'environ 98 millions de mètres cubes (MMC) tandis qu'elle est actuellement de l'ordre de 55 MMC/an. La demande d'eau projetée pour l'année 2020 pour la consommation des foyers tourne autour de 278 MMC. Pour satisfaire cette demande en eau, un approvisionnement additionnel sera nécessaire. Les nappes souterraines sont la seule source d'eau en Cisjordanie. À l'heure actuelle la plupart de l'eau des aquifères de Cisjordanie est utilisée par les Israéliens et seulement une très petite partie est attribuée aux Palestiniens pour alimenter les zones de la Palestine. La quantité totale prélevée actuellement par les Palestiniens et les Israéliens dans le Bassin Oriental est d'environ 40 MMC/year. La Cisjordanie possède un climat méditerranéen. La moyenne annuelle de précipitations varie entre 700-850 millimètres (mm) sur les versants occidentaux, 500 et 800 mm dans les zones de collines et 100 à 150 mm dans la vallée du Jourdain. L'évaporation est particulièrement élevée en été dû aux hautes températures, l'ensoleillement intensif et la faible humidité. Les précipitations sont la seule source pour recharger les systèmes aquifères de Cisjordanie. Récemment, la Cisjordanie a subi des sécheresses sévères dû à une baisse des précipitations. Comme résultat il y a eu une baisse significative des masses d'eau à la fois dans les systèmes aquifères supérieurs et inférieurs qui forment la source majeure d'alimentation en eau. Cet article étudie l'impact de la sécheresse récente sur les systèmes aquifères souterrains en Cisjordanie et les procédures de gestion de l'eau appliquées par l'Autorité Palestinienne du Bassin à la lumière du contrôle israélien permanent sur les aquifères palestiniens.*

Mots-clés. *Gestion de la sécheresse – Demande en eau – Aquifère de Cisjordanie – Ressources en eau en Palestine.*

I – Introduction

One of the main impacts of climate change is the drought or drop in precipitation, and shifts in historic hydrological cycle events (mainly temperature and precipitation). These changes are of particular interest in areas where their water supply is dependent on direct recharge from rainfall.

Generally, there is uncertainty with respect to the prediction of drought cycle at the global level, regional, and national levels. Higher temperature and decreased precipitation would lead to decreased water supply and increased water demand (water demand increases during dry, warm periods and decreases during cool, wet periods). In addition, these changes might cause deterioration in the quality of freshwater bodies, putting strains on the already fragile balance between supply and demand in many countries. Even where precipitation might increase, there is no guarantee that it would occur at the time of year when it could be efficiently utilized.

In Palestine, groundwater is considered as the only source for water supply. The Palestinians have no access to Jordan River or any other surface water source. Due to the diversion of the water from Jordan River tributary upstream to Israel National carrier, the flow of Jordan River dropped significantly and the water quality in the river deteriorated to levels where it cannot be used for domestic or irrigation purposes.

Within the political boundaries of the West Bank there are three groundwater basins (Eastern Basin, Western Basin and North-Eastern Basin). The aquifer boundaries of both the Western and North-eastern Basins extend beyond the political boundaries of the West Bank (as shown Fig. 1). Along the western and northern West Bank aquifer boundaries, Israel has drilled hundreds of wells to tap West Bank Aquifers. In addition, they prevented the Palestinians from drilling wells upstream or inside West Bank so they can continue get the water from these aquifers.

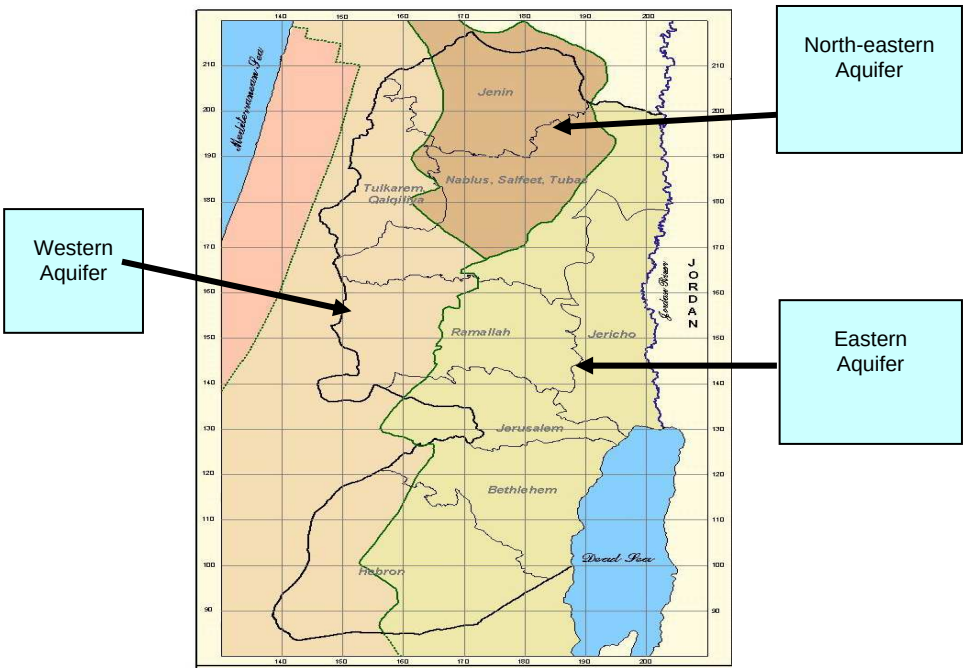

Fig. 1. West Bank aquifers.

The groundwater basins are almost overexploited and recent drought (2000 to 2009) has contributed to significant drop in water table. The most important source of natural replenishment of groundwater basins is recharge from rainfall. The natural replenishment zones of the mountain aquifer are the outcrops of Upper and Lower aquifers in the Ramallah and Hebron Anticline areas and outcrops in the area of Fari'a anticline axis and Gitit and Fasayil areas. The Upper and Lower aquifers outcrop at Ramallah, Jerusalem and Hebron hills where rainfall in these zones is quite high (500 to 700 mm/year). Further to the east, rainfall is less, lower recharge rates are expected. The latest recharge studies (Palestinian Water Authority, 1995; Millennium Engineering, 2001; CH2MHILL, 2003) have indicated that the average recharge from is around 20% of rainfall. Because the recharge from rainfall is the only viable source for groundwater replenishment, any drop in rainfall and recharge has significant impact on the groundwater storage, springs discharge and wells yield. On the other hand due to population growth and economic development especially after the peace process in 1993, the water demand has increased significantly (CH2MHILL, 2003). Currently, the water consumption in the West Bank is low (average per capita is between 50 to 70 l/person/day).

II – Drought elements

1. Drop in rainfall

In order to investigate the changes in rainfall, the historical records for the last 10 years at six rainfall stations in the West Bank were studied. The changes in rainfall in Jerusalem, Hebron and Jenin areas [these areas form the main recharge areas where the aquifer is exposed (outcrops) and high rainfall occurs]. It is found that the rainfall in the last 10 years is below average (average rainfall is around 450 mm/year) and continues to drop with time. The average drop in rainfall in this period is around 20%.

2. Change in temperature during rainfall

Another element contributing to drought is that, through this period, the historical records from the rainfall stations indicated that the number of rainfall events has increased together with an increase in temperature. This has resulted in an increase of water losses due to evaporation and a decrease in recharge amounts.

III – Drought assessment

The spatial and seasonal patterns of rainfall over the mountain aquifers of the West Bank are crucial to planning and operation of the use of groundwater resources. Recent studies of rainfall over West Bank have shown evidence of a trend in annual rainfall, broadly summarized by a decrease trend.

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 in some areas. The analysis results show that recharge rate dropped by 5 to 7% through this period.

As a result of drop in recharge and increase of pumping from wells, the water table in many wells of the West Bank, especially in southern Hebron area, have drop significantly (the recorded drop in Heriodian, and Bani Naim wells in Hebron area ranges from 30 to 60 m). If the current situation continues, it will lead to mining and deterioration in water quality in the lower aquifer.

IV – Drought impact

1. Municipal sector

The 2008 drought, the most serious drought in the West Bank in the past decade, aggravates the built-in, constant shortage of water in the West Bank. Rainfall this year in the northern West Bank was 64% of the average, while in the southern sections of the West Bank, it was 55%. As a result, the water stored from rainfall has already been used. The Palestinian Water Authority estimates this year's water shortage in the West Bank at 42 to 69 million cubic meters. The total water consumption in the West Bank is 79 MCM.

Due to the chronic water shortage, water consumption in the northern West Bank has dropped to one-third this amount. In Tubas, per capita consumption is 30 l; in Jenin, it is 38 l. In Nablus and the Southern Hebron Hills, the figure is slightly higher than 50 l a day. The average per capita consumption throughout the West Bank is 66 l, two-thirds of the minimal amount needed according to the WHO. These figures include water for livestock, meaning that the water consumed for personal use is even less.

2. Agricultural sector

The agricultural sector has been severely hit; indeed, rain-fed farming in the West Bank has totally collapsed. Irrigated agriculture has also been affected since spring flows have been reduced by decreased precipitation. An estimated $200 million loss has resulted from this year's drought. The Palestinian Authority, which has declared a state of emergency, is trying to prevent the total collapse of the agricultural sector.

Palestinians are being forced into the black market to purchase water, consuming up to 20% of their income on this item. The Palestinians are paying $4 per cubic meter (including delivery costs) for water costing Israelis $0.50-$1.00 per cubic meter.

V – Drought management counter actions

Various organizations including Palestinian Water Authority have implemented several measures or actions to minimize the impact of drought. These are as follows:

(i) Control groundwater abstraction from upper and lower aquifers to be within the sustainable yield limits.

(ii) Investigate the possibility of improving groundwater recharge through utilization of generated runoff.

(iii) Purchase extra amounts of water from the Israeli water company to provide villages with water supply.

(iv) Encourage farmers to use treated wastewater in agriculture which will reduce the pressure on groundwater.

(v) Enforce new legislation in new buildings to construct stormwater harvesting storage tanks.

(vi) Conduct public awareness to control water demand.

(vii) Study other potential sources such as desalination of sea water.

(viii) Continue to address international organizations to push for a water agreement that give Palestinian their water rights where they can access their surface water in the Jordan valley and stop Israel from stealing their groundwater aquifers.

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