CHAPTER 13

Water Crisis in Israel

Michael Beyth[1]

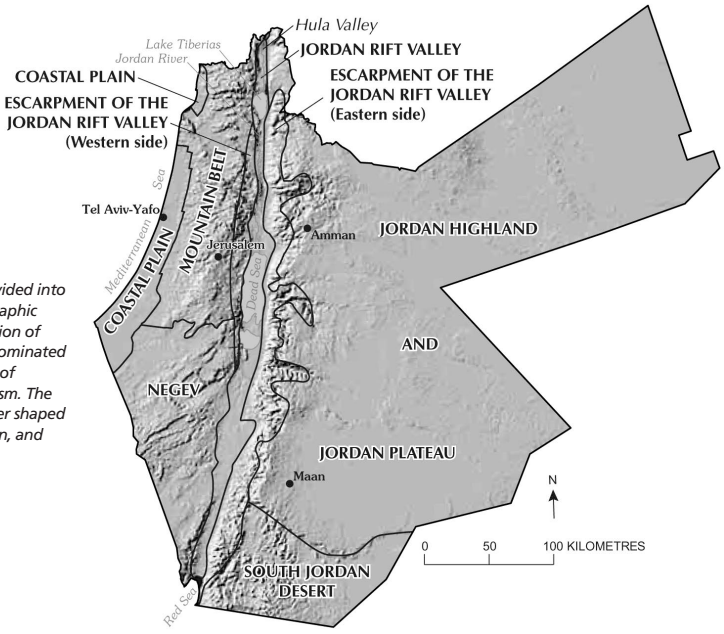
INTRODUCTION

Water crisis in the Middle East is an ancient and a regional problem. More than 3000 years ago, the Old Testament highlights quarrels between Isaac and the Philistine shepherds about well rights. All ancient cultures were developed along the three major river systems—the Nile, the Euphrates, and the Tigris—and along the small rivers like the Jordan. The Center for Strategic and International Studies predicts that water, and not oil, will become a dominant subject of conflict in this region. Rapidly growing populations, ambitious development programs, and prolonged droughts have accelerated this transformation.[2] There are rich water sources in Turkey, and a number of other countries, in particular Syria and Iraq, are dependent on this water. That is the reason that large, regional-scale projects have been suggested, such as the 'Peace Pipe' that would aim to carry water from east Turkey to the western area of Saudi Arabia. That is also the reason that Israel is considering importing water from Turkey through the Mediterranean Sea. The Helsinki Rules (1966) may play an important role in such areas.

Physical geography and average annual rainfall are certainly the major factors controlling the water resources of Israel, Jordan, and

the Palestinian Authority (figures 13.1 and 13.2). The three major water bodies are the Dead Sea and the Lake of Galilee (Tiberias) in the Dead Sea Rift at the eastern boundary of Israel, and the Mediterranean Sea at the western boundary. The coastal area adjacent to the Mediterranean Sea and the mountains of central Israel, which are the major groundwater aquifers, are also shown, as well as both the desert areas and the rainy zones in Israel, Jordan, and the Palestinian Authority.

The low average precipitation indicates that a water crisis is almost inevitable, and the climatic zones indicate that the only way to live in the desert is to transfer water from north to south in Israel



The region may be divided into seven major physio-graphic provinces. The formation of these provinces was dominated by geologic processes of tectonism and vulcanism. The landforms were further shaped by weathering, erosion, and deposition.

FIGURE 13.1: Physical geography of Israel, Jordan and the Palestinian Authority (source: Executive Action Team (EXACT), Multilateral Working Group on Water Resources http://exact-me.org/)

and Jordan. The Central Water Carrier was constructed by Israel in the 1950s, and was operating by the beginning of the 1960s. The major goal of this project was to carry water from the rainy region at the north, from the Lake of Galilee, to the arid areas in the south, and balance demand with supply. A similar project on a smaller scale was constructed in Jordan carrying the water from the Yarmuk River in the north (King Abdullah Canal). The Dead Sea is the terminal lake,

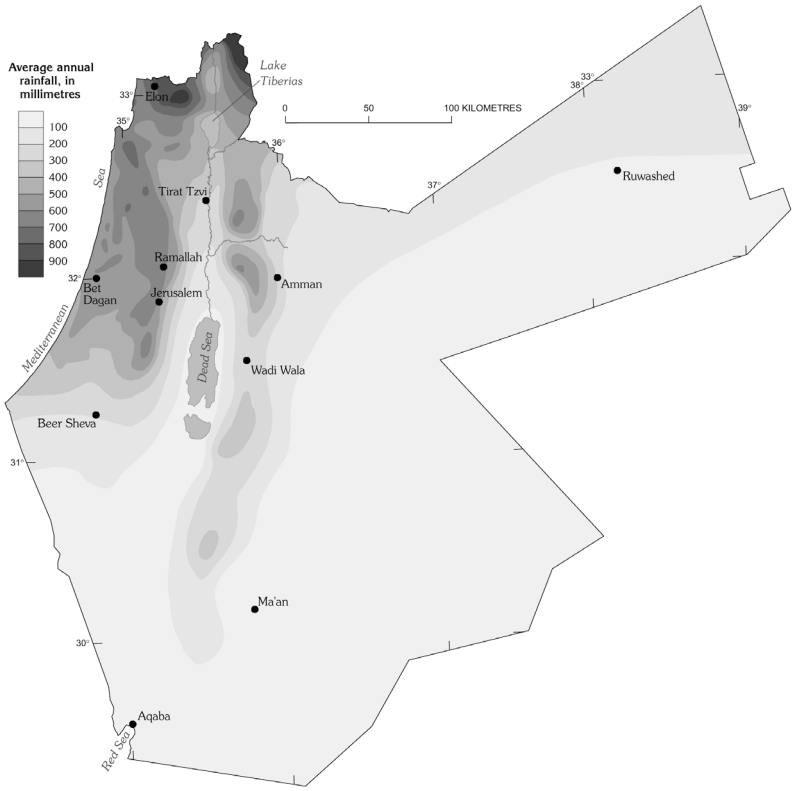


FIGURE 13.2: Average annual rainfall: Israel, Jordan, and the Palestinian Authority (source: Executive Action Team (EXACT), Multilateral Working Group on Water Resources http://exact-me.org/)

with a catchment area that spreads over five nations (Egypt, Israel, Lebanon, Syria, and Jordan) and the Palestinian Authority. In some ways, the Dead Sea is the water seismograph of the region. The rapid decrease in the Dead Sea water level (annual average approximately 1 metre) expresses the nonsustainable use of fresh water by carrying it from the Lake of Galilee and the Yarmuk River. In the past, until the early 1960s, approximately 1300 million cubic metres (m^3) of water flowed along the Jordan River down to the Dead Sea, but today only around 200 million cubic metres now flows through. This decline in water levels in the Dead Sea causes environmental hazards such as the development of hundreds of sinkholes along the Dead Sea shores (figure 13.3). In fact, the whole infrastructure of the region is suffering, and there is much concern by government and non-governmental organisations.

The scarcity of water in the Jordan River (annual discharge approximately 600 million cubic metres) and in the Yarmuk River (annual discharge approximately 500 million cubic metres) systems has made water supply a strategic issue, which led to the development

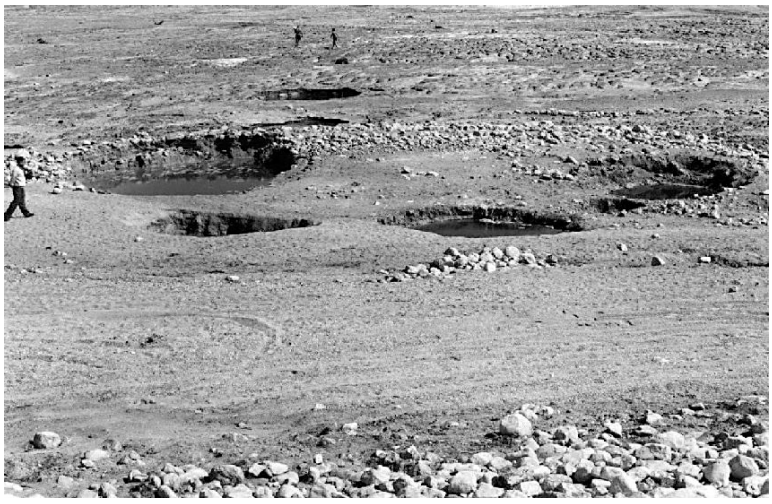


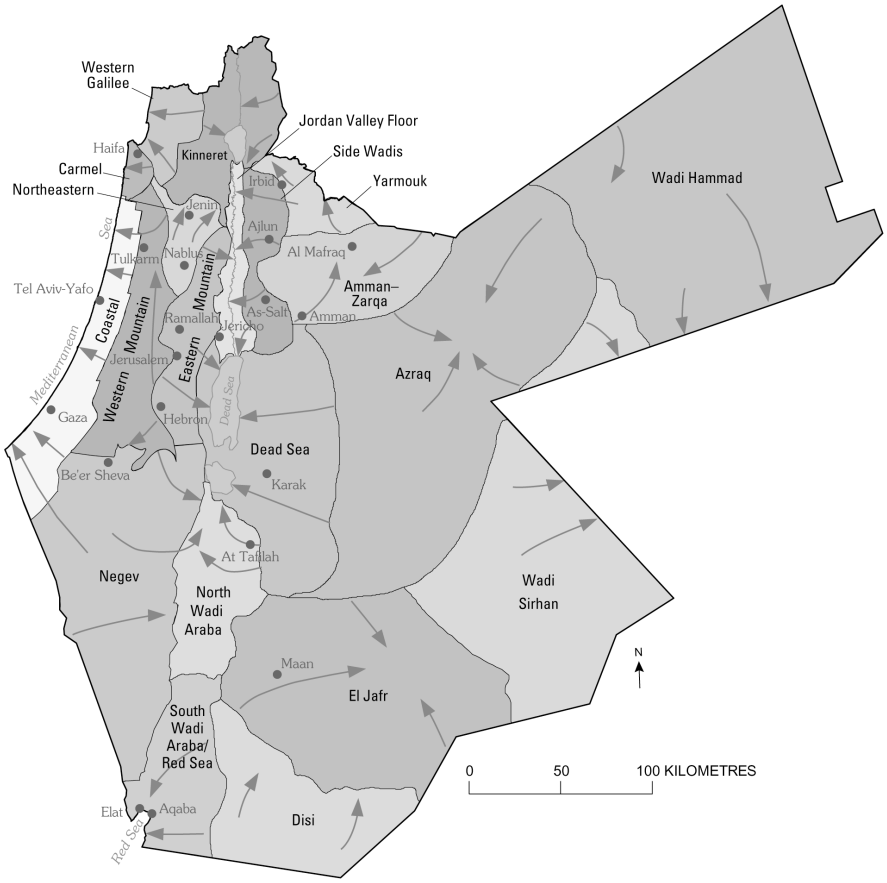
FIGURE 13.3: Sinkholes along the Dead Sea shores

of the Johnson Plan (1956), which followed the 'Water War' between Israel and Syria in the 1950s.[3]

THE FRESHWATER RESERVOIRS AND THE 'RED LINES'

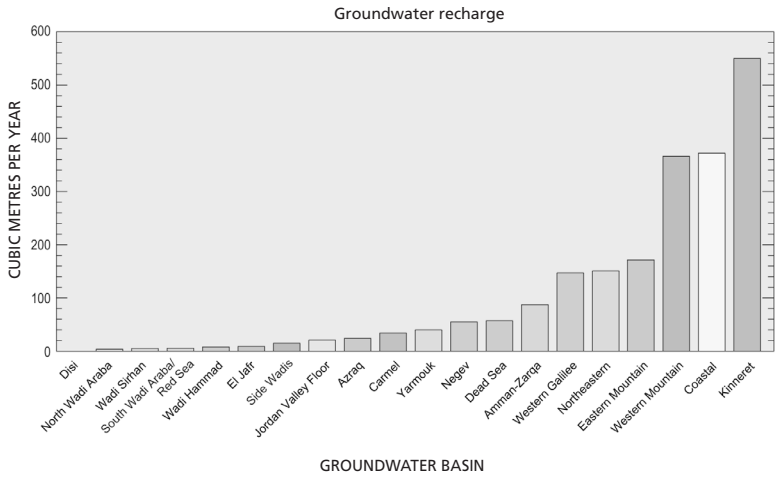
There are three major water reservoirs: a surface one, the Lake Kinneret, or Lake of Galilee; and two groundwater ones, the coastal and the mountain basins or aquifers (western, eastern, and north-eastern; see figure 13.4). The Lake of Galilee stood at very low water levels, approximately 215 metres below sea level, below the red lines, from 2001 until November–December 2002. The red lines are the lowest water levels permitted by law, levels mainly decided according to ecological considerations. During the rainy winter of 2003, there was a 4.5-metre increase in the lake level, approximately an additional 800 million cubic metres of water. However, this was a year of extremely high rainfall. At the same time, there was a salinity increase from 200 to almost 300 milligrams of salt per litre.

A map of groundwater basins and groundwater recharge (see figure 13.4) indicates that the important aquifers are Kinneret, and the coastal and mountain aquifers. The Disi is a major fossil aquifer that supplies water to Jordan. Fossil water is also common for most of the southern aquifers in Jordan, and a few minor ones in southern Israel. Since the rainy winter of 1992, the water level in the aquifers has dropped down even below the red lines, a fact that endangers water quality. In Figure 13.5, we can see the recovery of 10 metres of water during the wet winter of 1991–92, and also the fact that during the dry winter of 1998–99 there was no increase in the water level in the mountain aquifer. Here the red lines are between 9 and 12 metres above sea level, and an annual deterioration by salination of the coastal aquifer by 2 parts per million was observed. Also, contamination of the coastal aquifer by industrial waste adjacent to the industry was observed (vaporised organic compounds).[4] In order to manage the water in the aquifers, modern high-resolution seismic and time domain electromagnetic (TDEM) techniques are used. One of the most important tools to manage the aquifers is applying hydrological/geological numerical models.



Groundwater basins and direction of groundwater movement (indicated by arrows)

FIGURE 13.4 (a): Groundwater basins: Israel, Jordan, and the Palestinian Authority (source: Executive Action Team (EXACT), Multilateral Working Group on Water Resources http://exact-me.org/)



Estimated recharge rates are highest in the coastal and mountain basins, and least in the southern and eastern basins. These patterns generally correspond to the distribution of precipitation in the region.

FIGURE 13.4 (b)

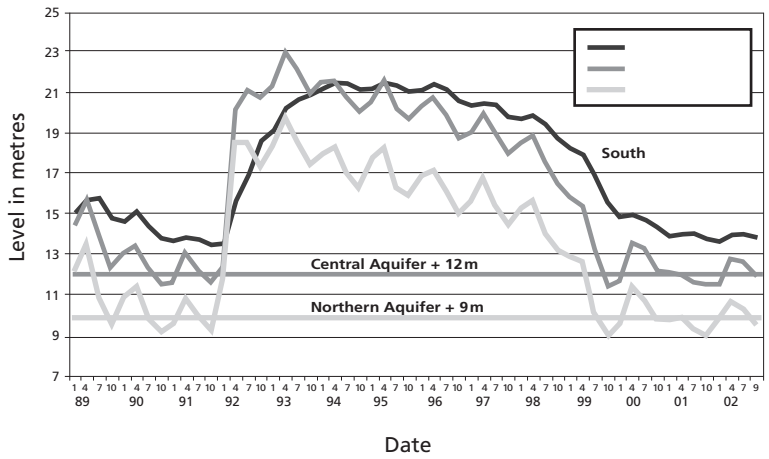


FIGURE 13.5: Mountain aquifer level changes, January 1989–September 2002 (source: Israel Water Commissioner)

THE WATER CRISIS

The water crisis is being caused by a depletion of water reservoirs, associated with water-quality deterioration, which is endangering the water supply. According to an Israeli parliamentary investigation committee, the water crisis in Israel is a result of over 30 years of overpumping, and the management of the water resources without a clear, sustainable policy.[5] Data on freshwater consumption and the population in Israel are presented in table 13.1. The forecast for 2002–10 indicates that the population in Israel will increase from 6.5 million to 7.3 million, and water consumption from 1.5 to 1.7 million cubic metres. In 2000, the average total water potential was 2050 million cubic metres, out of which 1600 million cubic metres was fresh, and 450 million cubic metres brackish and treated. The problem is that, with moderate or even extreme droughts, which are quite common in this region, or with an increase in regional conflict, the demand will be much higher than the potential presented (see figures 13.6a and b).[6] Because of this situation, the Water Commissioner has adopted a new policy, whereby a sustainable approach, the manufacturing of water, is a major component.

TABLE 13.1: Total fresh water consumption (million cubic metres) and population forecast (2002–2010)

Year	**2002**	**2004**	**2006**	**2008**	**2010**
Population (k)	6509	6705	6902	7098	7300
Urban	700	763	800	839	878
Industry	99	102	105	108	110
Agriculture	582	544	538	533	530
Nature	25	31	38	44	50
Jordan	35	35	35	35	35
Palestinian Authority	35	38	40	42	45
Palestinian Authority	27	29	32	33	36
Total	**1503**	**1542**	**1587**	**1634**	**1683**

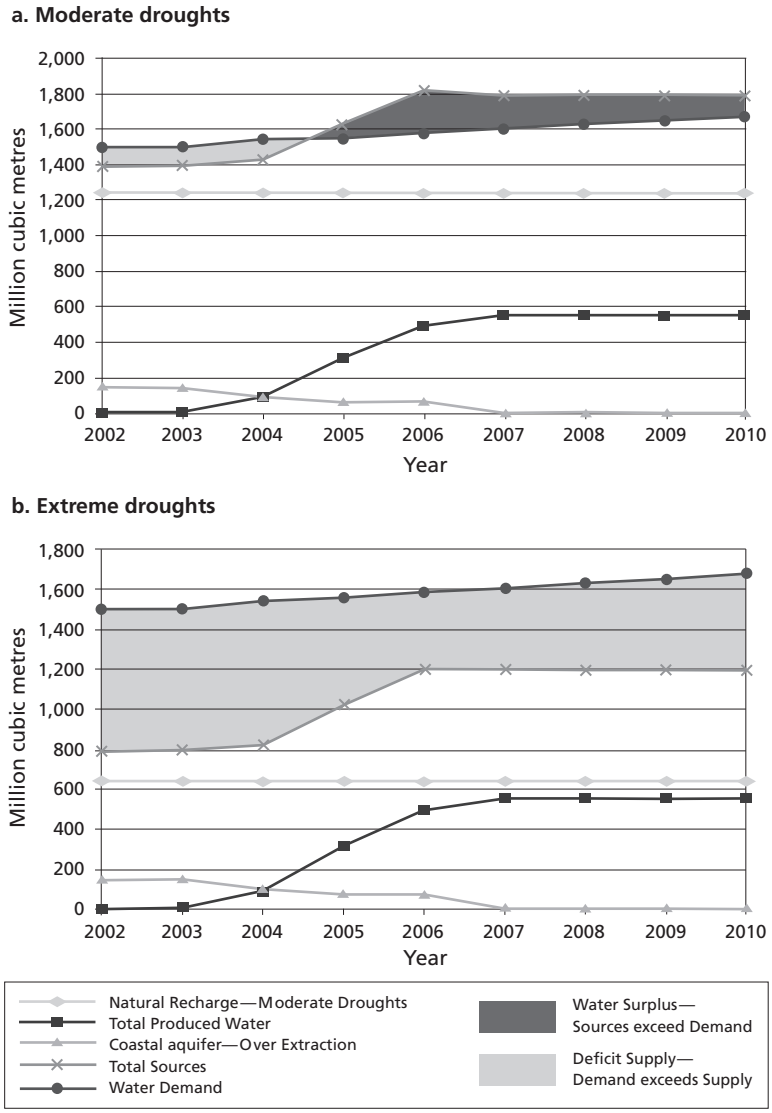


FIGURE 13.6: Water balance in Israel (source: Israel Water Commissioner)
a Moderate droughts
b Extreme droughts

NEW POLICY: SUSTAINABLE APPROACH

The major goal of the new sustainable policy is to balance water demand and water resources, and to prevent ecological deterioration. This will be done through a significant increase in manufactured water, up to 40 per cent of the natural water resources (see table 13.2); improving desalination technology and reducing costs (estimated as US$0.55 per cubic metre); and replenishment of natural water resources by 2000 million cubic metres. The reclamation of the water levels will contribute to the environment.

Extensive legislative, economic, and educational measures must lead to water preservation. Because of the water problem of Israel, Israel's irrigation industry is one of the most modern and rapidly developing, taking up water-saving approaches, such as drip irrigation, which was invented in Israel.

Agricultural consumption of water will be reduced by 50 per cent in the short term. Today water cost for irrigation is approximately US$0.20 per cubic metre, compared to US$1.0 per cubic metre for urban water use. However, the domestic sector must also save water.

Tertiary-treated effluents are cheaper than manufactured fresh water. These treated high-quality effluents will be the main source for agriculture (55 per cent by 2010), and will prevent pollution or soil

TABLE 13.2: Manufactured water (million cubic metres), 2002–2010 (source: Israel Water Commissioner)

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sea water desalination	—	—	65	275	365	365	365	365	365
Recycle system	—	—	—	—	—	20	35	35	35
Brackish water desalination	1	8	15	20	30	55	55	55	55
Water import	—	—	—	20	50	50	50	50	50
Additional amounts of potable water	1	8	80	315	445	490	505	505	505
Treated waste water	295	332	359	390	441	461	471	491	509
Manufactured water (%)	16	18	22	31	36	38	39	39	40

damage to groundwater and crops. These effluents will also be used for municipal and industry consumption.

In order to achieve these goals, and to overcome the water crisis in Israel, the Water Commissioner is leading the implementation of a master plan (2002–2010) for the sustainable development of the national water supply system.[7]

There are a few indirectly related solutions with political aspects, such as the Mediterranean–Dead Sea Canal or the Red Sea–Dead Sea Canal, which were presented by Jordan and Israel in the Johannesburg Summit in 2002 and the Amman Summit in 2003. This project may restore the Dead Sea water levels, by bringing water over 100 kilometres from the Red Sea to the Mediterranean, and may produce up to 800 million cubic metres of desalinised water by applying the technology of reverse osmosis.

Another promising approach is mariculture, which is agriculture where food is produced from sea water, growing sea fishes either in sea cages or in land-based ponds. This was described in a cover paper of the *Economist* as the 'Blue Revolution'. In southern Israel, in the Gulf of Aqaba, this agriculture, which is the fruit of local research and development, is very well developed.