INTRODUCTION

Water and society in Jordan and Israel today: an introductory overview

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Increasing population levels and demand for water have led to a global water shortage, with more than one billion people unable to access safe drinking water. The Middle East is particularly vulnerable to water stress because of its dense population, variable climate and vulnerable groundwater resources. In Jordan, for example, if current trends in population continue, the water per capita will halve—putting the country in the category of having an absolute water shortage. This opening paper summarizes the climate and hydrology of Jordan and Israel, describes how water is managed at a national level in Jordan and reflects briefly on the broader international context.

Keywords: Jordan; Israel; hydrology; precipitation; water management

1. Introduction

This introductory overview sets the scene for the rest of the Issue by describing the geography of the Middle East today, the way water is managed at a national level and the political and international context. To this end, §2 describes the climate and hydrology of the region, and §3 outlines how scarce water resources are managed in Jordan. Finally, §4 reflects on the broader political significance of water.

2. Geographical setting: climate and hydrology

(a) Climate

Precipitation in the Middle East is affected by both mid-latitude and tropical processes. In the boreal winter, most precipitation arises from storms crossing the Mediterranean (e.g. Enzel et al. 2003), while the summer is dry as a result of descent related to the Indian monsoon and Hadley circulation (Rodwell & Hoskins 1996; Ziv et al. 2004). During the transition seasons most precipitation results from the northward extension of the Red Sea troughs that arise from the Sudanese low (Tsvieli & Zangvil 2005). Although they are not the main driver of boreal winter precipitation, when they occur in this season, Red Sea troughs can

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cause particularly intense events. For example, during November 1994, the effect of a Mediterranean cyclone was magnified in the eastern Mediterranean by the presence of a Red Sea trough (Krichak et al. 2000), and during December 1993 a Red Sea trough caused severe storms in the normally dry Negev Desert (Ziv et al. 2005).

The intensity of precipitation during winter cyclones is modified by local geographical features such as the proximity of the Mediterranean, the trajectory of air masses entering the region, orography and urban development (Goldreich 1994; Evans et al. 2004; Freiwan & Kadioglu 2008). In the north, the amount of annual precipitation is primarily related to orography, with precipitation in Galilee and Jerusalem (elevations approx. 800 m) exceeding 600 mm yr\(^{-1}\) and precipitation in the Jordan valley (elevations of \(-400\) to 0 m) less than 200 mm yr\(^{-1}\) (see figure 1 for locations). In contrast, the south is very dry and
precipitation is not influenced by orography. Ma’an, for example, has an elevation of 1069 m and annual total rainfall of less than 100 mm (Diskin 1970; Goldreich 1994). This north–south contrast arises from differences in the trajectories of the depressions that bring most of the winter precipitation to the Middle East. In the north, these systems bring moist Mediterranean air and hence cause precipitation; in the south, the same large-scale depressions bring dry Sinai desert air.

Israel and Jordan experience large interannual variability in precipitation, with the standard deviation in annual total being approximately 30 per cent of the mean. At the peak of the rainy season, most interannual variability is caused by perturbations in the path followed by cyclones as they cross the Mediterranean (the Mediterranean storm track). These perturbations are associated with variability in the larger scale circulation over the North Atlantic and Europe (see Black et al. (2010) for further discussion). On a longer time scale, by the end of the twenty-first century changes in the global storm tracks are projected to lead to significant reductions in precipitation at the peak of the rainy season throughout the Middle East and eastern Mediterranean (Black et al. 2010; Hemming et al. 2010; Jin et al. 2010).

(b) Hydrology

The dominant water source for Jordan and Israel is the Jordan River system and associated aquifers. The Upper Jordan is fed by three sources—the Dan, the Hasbani and the Banias—before flowing through northern Israel into the Sea of Galilee, and is known thereafter as the Lower Jordan. The river is joined 10 km south of this by the Yarmuk and, before it reaches the Dead Sea, by several tributaries—the most important of which is the Zarqua River.

The Jordan River is small compared with other major rivers. The entire system drains an area of approximately 18 300 km², compared with 145 000 km² for the Rhine. Furthermore, the total natural discharge of the basin averages around 1500 million cubic metres (mcm)—65 times less than the Nile’s discharge and 400 times less than the Mississippi’s. There is a large interannual variability in River Jordan discharge, with drops of up to 40 per cent in drought periods, such as occurred in 1987–1991 (Libiszewski 1995 and references therein).

Although they are the most visible water resources in the region, the rivers and lakes described above do not provide the majority of water to Israel and Jordan. Rather, most renewable water in the region comes from a groundwater aquifer known as the Mountain Aquifer, which can be divided into western, eastern and northeastern sections. The potential of the Mountain Aquifer is difficult to assess, with estimates ranging from 600 to 900 mcm yr⁻¹. More than half of the total yield comes from the western aquifer, with the other aquifers contributing approximately quarter each. Brackish water underlies fresh water in many parts of the aquifers, and overpumping has resulted in an increase in the salinity and lower water quality (Libiszewski 1995; US Geological Survey 2006 and references therein).

The aquifer system consists mainly of karsitic limestone/dolomite formations, with recharge areas concentrated along the upper mountain slopes and ridges of the West Bank. The natural outlets of the Western Basin are two large springs: the
Yarqon, near Tel Aviv, and the Taninim, in the Qesarya (Caesaria) area. There is also a small seepage into the Mediterranean Sea. Exploitation of the western aquifer has considerably diminished the flow from these springs. The natural outlets of the northeastern aquifer at the foot of the Gilboa Mountain have also been depleted by pumping from numerous shallow boreholes sited near towns and villages. The eastern aquifer has small natural outlets in various wadis in the region as well as larger outlets on the shores of the Dead Sea. It is mainly exploited by boreholes in the mountain ridge area (most intensively in the Herodian area), and around Jericho.

3. Water management in Jordan

The generally small precipitation–evaporation (P–E), dry summers and large year-to-year variations in precipitation place great strain on water resources throughout the Middle East. The vulnerability of the aquifers in the region to overpumping and the large variability in river discharge necessitate careful management of water resources. As an example of water management at a national level, this section outlines how water has been managed in Jordan over the past 25 years. The impact of these government-level decisions on individual households is described in subsequent papers in this Issue (Carr et al. 2010; Potter et al. 2010).

The pressure on water resources in Jordan has led the government to develop stringent methods of water management. In 1987 water rationing was introduced, guaranteeing water for only 1 day per week. Between 2000 and 2003, the urban water supply was prioritized, irrigation in the Jordan valley was restricted and summer cultivation in the Jordan Valley forbidden. In 2000, the World Bank and other donors financed a rehabilitation of the Amman water system on the condition that it would be operated by a private company. The private operator chosen was LEMA, which managed Amman’s water supply until its contract expired in 2006. As a result, Amman’s water supply had three tiers of management: a private company, the national government and international financing organizations.

Recognizing that the pressures on Jordan’s water supply are likely to worsen as demand for water increases, the Government of Jordan, in 1997, under the guidance of the World Bank, committed the Ministry of Water and Irrigation (MWI) to the development of an integrated policy of water resource management, the Water Strategy for Jordan (MWI 1997). This strategy had a number of aims: to protect water resources; to improve efficiency of water management; to develop government and private structures for managing water resources; and to introduce a socially acceptable tariff system. A key element was the publication in 2004 of the National Water Master Plan of Jordan (NWMP) by the MWI with institutional support from the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ and MWI 2004). The plan addresses the provision of water under three broad strategies: water resources, water allocation and the control of water quality. Both the NWMP and the Water Strategy for Jordan consider the management of water only up to 2020 and therefore do not take into account the potential longer term impact of climate change.
4. The international and political dimensions of water

The previous section described the difficult decisions about water management made by the Jordanian government. Here we reflect more broadly on the international context in which these decisions were made, and the political importance of water in the Middle East and elsewhere.

Mutual dependence on shared aquifers, technologies and infrastructure can exacerbate pre-existing political tensions. The 1967 Six Day War in the Middle East, for example, was partly prompted by a dispute over the diversion of the River Jordan and the sabotage of water pipelines. On the other hand, water can serve as a focus of cooperation. For example, the Israel–Palestine water commission, which was set up as part of the Oslo Agreement, is the only joint committee still functioning today. Furthermore, Israel and Jordan have cooperated for many years about the management of the Sea of Galilee, which is situated in Israel, but near to the Yarmuk River, the border between Israel and Jordan. Under the terms of the 1994 Israel–Jordan Treaty of Peace, it was agreed that the Sea of Galilee would serve as an operational storage reservoir both for the Israel National Water System and for the Jordan Valley Water Project. This allows Jordan to store a water surplus from winter floods in the Yarmuk River in order to maintain a water supply during the summer. In return, Jordan allows Israel to pump more than 12 mcm yr$^{-1}$ from 14 wells, drilled into a groundwater reservoir located in the Jordan territory, in the central Arava Valley, between the Dead and Red Seas (E. Adar May 2010, personal communication).

Taking a wider perspective, 145 countries have international river basins. Managing the water supply from these rivers is politically sensitive, and longstanding agreements can become victims of international politics and environmental and demographic change. The 1960 Indus Waters Treaty between India and Pakistan, for example, which has survived Indo-Pakistani wars in 1965, 1971 and 1999, is now threatened by disputes between the two countries over the infrastructure developments needed to support their growing populations and increasing industrialization (Grimond 2010). On a more encouraging note, the success of river basin organizations, like the Nile and Mekong groups, demonstrates that joint management of water resources is possible, even in politically complex regions. Another notable example is the Senegal River group, which has chosen to focus on distributing infrastructure projects to each of the constituent countries (Mali, Senegal, Guinea and Mauritania), rather than on intractable disputes about water allocations. An unintended but welcome consequence of this is that the president of the group has been able to use the influence he has gained from these negotiations to resolve unrelated disputes in the region (Grimond 2010).

It is clear even from this brief discussion that the role water plays in international politics is complex and volatile. Depending on the circumstances, water can be a bargaining tool, a weapon or a focus of cooperation. It is therefore simplistic to assume that climate change and population growth will lead to ‘water wars’. It is also overly optimistic to predict that in the face of increasing water scarcity nations will put aside their political differences to manage shared water resources fairly. As scientists and social scientists, we would argue that policy-makers tasked with making tough decisions on the management
of water need accurate information on how water is managed, how climate will change and the impact of both management decisions and the climate on water resources. Nowhere is this more true than in the Middle East.

References


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