Impact of rapid urban growth on sustainability of soil and water resources in Jordan

Higgitt D.L.

in

Camarda D. (ed.), Grassini L. (ed.).
Interdependency between agriculture and urbanization: Conflicts on sustainable use of soil and water

Bari : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 44

2001
pages 223-231

IMPACT OF RAPID URBAN GROWTH ON SUSTAINABILITY OF SOIL AND WATER RESOURCES IN JORDAN

David Higgitt
Department of Geography, University of Durham, UK.

Abstract

The Hashemite Kingdom of Jordan provides an example of a nation state in the eastern Mediterranean, which has undergone profound changes in population-environment dynamics during the twentieth century. The structure of interdependency between urbanisation and agriculture is distinctively shaped by the political history of the region. Created as an entity in 1922 through colonial demarcation of the former Ottoman Empire, the development of nationhood imposed both restrictions to the traditional mobility of pastoralists and the need for national identity. Environmental change driven by political and economic context has been rapid and varied. The growing demand for the use of water resources, in particular, from rapidly expanding urban centres is problematic for sustainable development. The structure between urbanisation and agricultural production is encroached by issues of population growth, migration, concepts of territory and boundaries, land tenure and factors driving mobility and settlement. An on-going Research and Development Programme in a sector of the Badia, the desert margin in the north east of the country, seeks to provide information about environmental resources and options for their sustainable use. Well beyond the limits of the capital, Amman, economic decision making in urban areas and global technological developments impact acutely on the physical environment and the nature of resource exploitation.

Amman has grown rapidly through a combination of natural population increase, rural-urban migration, influx of migrant labour and Palestinian settlement. Following Israeli occupation of the West Bank, many Palestinians settled east of the River Jordan and were further bolstered by 300,000 leaving Kuwait after the Gulf War. Combining very high rates of natural population growth with in-migration the population of Jordan as a whole has risen from 0.7 to 4.2 million between 1952 and 1994. About half of the population live within the urban areas of Amman and its satellite towns Zarqa and Suweilah. Two thirds of this urban population is Palestinian. The rapid growth of a low density city has not only changed the balance of urban-rural population but has consumed land which is capable of sustaining rain-fed agriculture, which is a rare commodity in Jordan. Water demand has increased

with population and has required groundwater to be exploited and pumped to Amman. Some of this is derived from areas to the east where local agriculture competes for irrigation water. Abstraction rates are well in excess of recharge. An internationally important oasis for migrating birds, the Azraq Basin, dried up in the late 1980s. The impact of the emerging state and its urban bias on the land areas to the east of the country extends beyond exploitation of water resources. International boundaries cutting across traditional concepts of Bedouin territory have affected lifestyles. Similarly notions of tribal ownership were replaced by government declaration that all uncultivated land belonged to the state. Settlement has also been encouraged as a means of delivering services and obtaining loyalty. Consequently the basis for traditional pastoralist agriculture in the area has been modified and there has been a transition towards village growth, rain and groundwater-fed agriculture and herds maintained by subsidised concentrates. Agriculture and rural development in Jordan has therefore changed profoundly in recent years in response to multiple stimuli, many of which relate to the control of political power in urban centres. The basis for the sustainable use of soil and water is constrained by these relationships. The paper will attempt to illustrate how the Badia R&D Programme has considered strategies to quantify developmental potential of rural areas in relation to urban pressures and requirements of resource conservation.

Introduction

The interaction between population and environment is highly sensitive in the arid lands surrounding the Mediterranean. Jordan is an example of a nation state where the population-environment dynamics have undergone profound changes in the twentieth century. In exploring the rapid urbanisation of Amman and its consequences for the sustainable use of soil and water in its hinterland, the increasing marginalisation of rural areas from political and economic decision making is marked. The traditional relationship between local population and the local environment (as a source of accessible natural resources) has been replaced by new (and frequently external) demands for soil and water resources in these areas and by the dilution of direct responsibility for the maintenance of the environment. As the rural populations become less dependent on land resources and their influence on decision making is reduced, it is not surprising that land degradation has become an important issue in recent years.

In this case study the historical and cultural context for recent environmental change in Jordan is explored. The changing relationship between people and the environment and its implications for sustainable use of soil and water is considered. Starting in 1991, the Jordan Badia Research and Development Programme (BRDP) has attempted to evaluate the natural resource base and its evolving use in a large area some 100 km east of the capital. Initial findings from the BRDP indicate the

extent to which the use of soil and water is constrained by decisions made outside the area, and in particular is influenced by the urban population of Amman. This prompts a series of questions about the ways in which urban growth is impacting upon the surrounding rural environments, but also about the information, data and techniques needed to evaluate these impacts and to deliver sustainable development in the rural areas. The paper is organised by first considering the recent history of Jordan and the cultural context for considering sustainable development. Second, population growth and trends are briefly considered. Third, the impacts of urbanisation and population growth on water demand is examined and its implications for agricultural development. Finally, these themes are amalgamated in considering the view from the rural hinterland through the initial results of BRDP.

Historical and cultural context

The structure and interdependency between urbanisation and agriculture is distinctively shaped by the political history of the region. The British Mandate of Transjordan was demarcated in 1922 following the partitioning of the Ottoman Empire. The interests of the colonial powers were central to the positioning of international boundaries, with Britain securing a corridor of Jordanian territory linking it with Iraq. This served as a route for crude oil to be piped to the Mediterranean coast at Haifa and also provided air space linking to India (Bocco and Tell, 1995). The

-

to the east of Amman and the throughout the south of the country were historically occupied by Bedouin tribes operating as pastoralsts and traders. Total numbers were limited, dependence upon, and responsibility for, the environment high. Traditionally,

in concept of territory - an area over which tribal groups migrated (Dutton, 1998). The creation of international boundaries cut across some dirah inhibiting transhumance and promoting settlement. However, it should be noted that the divergence of economic and political systems on different sides of borders has, in turn, encouraged enterprise that takes advantage of cross-border differentials (Dutton, 1998). In particular, the production costs of raising sheep in Jordan have been low because of feed subsidies while high market prices can be obtained to the south in Saudi Arabia. Consequently, sheep numbers have tended to increase in the Badia. Some cross-border trade is illicit but the local economy has also

ling, extract tariffs and police the international boundaries. Government declarations that all uncultivated land belongs to the state also undermines the traditional concept of dirah, such that responsibility for the resources within the local environment is weakened without replacement by an effective environmental management system.

Population growth and urbanisation

From a national perspective, the conflicts in environmental management in the outer margins of the nation state have been insignificant compared to the high rate of population growth and rapid urbanisation. Amman has grown rapidly through a combination of natural population increase, rural-urban migration, influx of migrant labour and Palestinian settlement. Fertility levels are very high though rates are markedly lower in urban areas (Findlay and Maani, 1998). Population growth in rural areas resulting from high fertility rates are somewhat moderated by rural-urban migration. Political upheaval has also influenced the population dynamics of Jordan. Following Israeli annexation of the West Bank, many Palestinians settled east of the River Jordan, following earlier flows of refugees. These were further bolstered by 300,000 leaving Kuwait after the Gulf War. Remittance income from citizens working overseas had been a feature of the Jordanian economy but in recent years there has been net-return migration from the Gulf states.

The population of Jordan has risen from about 0.7 to 4.2 million between the census dates of 1952 and 1994, an annual growth rate of 4.4%. About half the population live within the urban areas of Amman and its satellite towns of Zarqa and Suweilah. Two thirds of this urban population is Palestinian. Amman is generally a low density city and its rapid growth has not only changed the balance of urban-rural population, but has consumed land capable of sustaining rain-fed agriculture, which is a rare commodity in Jordan. The growth of Amman is even more astonishing considering that it was a small town of only 5000 inhabitants at the time it was chosen to become the capital of the new state in 1922. Significant growth has been related to refugee flows stimulated by the creation of the State of Israel (1948) and Israeli occupation of the West Bank (1967). By 1990 the conurbation covered 50 km^2 (Findlay, 1994). Recent growth, aside form the continued rural to urban migration has been largely derived by speculative building of villas and apartment blocks financed by remittances, which consume large areas of land. Speculative investment in land around the margins of the city has also proved profitable for some groups or individuals as urban sprawl raises the value of the urban fringe.

Water demand has risen both from increased domestic use and the need for irrigation for agricultural production. The availability of water resources and the demand for its use, as a component of the interaction between urbanisation and agriculture, is examined in the next sections as an international, national and local issue.

Water Resources

In examining the interdependency of agriculture and urbanisation in the eastern Mediterranean and its implications on the sustainable use of soils and water, it is first necessary to pay some attention to the international perspective on water use.

Hydropolitics have played an important role throughout the brief history of Jordan and its neighbouring states. National policies for water demand have tended to look first to the international arena and latterly to the effective management of resources and demand. This section will briefly summarise national perspectives on water resources before considering the local implications from the BRDP area.

Water is a scarce resource in Jordan which is unevenly distributed. The highest annual precipitation levels occur in the north west of Jordan and fall away rapidly in both an easterly and southerly direction. Surface water flows are similarly concentrated in the Jordan Valley and its principal tributary, the Yarmuk River. The Jordan Valley is the most productive agricultural area in the country but its

of political conflict, that has existed between Israel, Palestine, Syria and Jordan since 1948, is fundamentally related to scarce water resources. Each of these territories is estimated to use between 95% and over 100% of its annual renewable freshwater supply (Wolf, 1995) with exploitation of fossil groundwater sources making up the shortfall. In a context of growing population, agricultural extension and increased domestic and industrial water demand, the overpumping of fragile groundwater systems may appear to be imminent. Other observers (e.g. Allan, 1996) are sceptical about the way in which water and conflict has been accentuated by the political process and the media. There is some confidence that the improved scientific understanding of hydrological and hydrogeological controls in the Jordan basin, coupled with a firm commitment to negotiation through the peace process and a transition in approaches to water allocation and management, will overcome present difficulties. Environmental security rather than national security is seen as a prelude to enhanced co-operation by the parties (Dolatyar and Gray, 2000).

The relationship between politics and water in the Jordan River basin has been extensively studied and it is the most frequently cited case of potential water-induced conflict (Bulloch and Darwish, 1993; Gleick, 1994). Scientific assessment of the surface water and groundwater systems and their patterns of usage has also been abundant. Nevertheless, some of the tension surrounding proposed development surrounds suspicion of data validity. For example, an assessment of the impact of Dead Sea Canal project on Jordanian groundwater resources (Salameh, 1985) begins with rhetoric on the inscrutability of the science. By global systems, the Jordan River is relatively small, with a catchment area of about 18000 km^2 and a channel length of about 320 km^2, flowing south along the Syrio-African Rift into the Dead Sea. The northern headwaters are fed by three major springs the Hasbani (Lebanon), Banias (Golan Heights) and Dan (Israel). The Yarmuk River is the major tributary forming the border between Jordan and Syria with further springs on each side. South of the Yarmuk confluence the Jordan River receives further flow from springs and ephemeral tributaries on the West Bank and East Bank, which are also recharge areas for extensive aquifers. Annual flow in the

Jordan River is ab
freshwater supply is about 700 MCM, of which half is surface water derived from the Yarmuk (Wolf, 1995). An annual total water budget of 870 MCM includes 170 MCM supplied from non-renewable groundwater sources and it is estimated that 85% of consumption is agricultural, 10% domestic and 5% industrial (Wolf, 1995). The Jordan-Israel Peace Treaty of 26 October 1994 contained articles on water, environment and agriculture that are directly related to co-operative development of water resources. Annex II covers water-related matters of allocation of surface waters, storage, quality, data exchange and the establishment of a Joint Water Committee. Dolatyar and Gray (2000) suggest that the experience of an international water-scarce basin requires equitable sharing and efficient utilisation between parties that makes co-operation more likely than conflict.

Managing water demand

Having established the effective national limits on water resources, the rapid population growth and demands of an increasingly urban population impose severe implications for water management in Jordan. While diplomatic priorities lie with the Jordan Valley, the political strength of Amman dominates the transfer of water towards the capital. There are eleven principal groundwater basins in Jordan and these have become important sources in addition to transfer schemes form the Jordan Valley. In the mid 1970s, transfer began from the Azraq Basin (Haddadin, 1996) which partly underlies the BRDP area. Since 1980, abstraction rates have increased rapidly to an estimated 43 MCM (Dutton, 1998), with 15-20 MCM supplied to Amman as drinking water from the well field at Azraq. The ecologically important Azraq oasis dried up in 1992 as a consequence of continued abstraction exceeding recharge. Options for improving water supply nationally include further transfer schemes, re-use of urban waste water for irrigation, use of brackish water and desalinisation (Haddadin, 1996). Possible international water transfers from the Euphrates or southern Turkey have not proceeded because of the cost. Management of water demand can be approached through efficiency gains, legislation and pricing policies.

Efficiency gain in water delivery systems is a key to improving water demand

systems is lost to leakage. Technical improvements to irrigation methods can also reduce distribution losses. Legislative and regulatory measures are necessary to assign water rights such as permits for borehole drilling. The Jordanian experience is generally that the administrative control on the number of private water exploitation facilities has succeeded but the regulation and surveillance of abstraction rates is insufficient. Regulation might also seek to control cropping patterns or even the areas where irrigation is permitted. As noted above, agricultural activity consumes 85% of

ght be considered. Such regulatory forcing has not been applied with any fervour because of the expense of creating industrial jobs relative to agricultural employment. This contrasts with the Israeli experience where the estimated water demand for self-su
imports (Allen, 1996). Water demand reduction can also be approached through pricing policies. Prices in the Middle East have traditionally been well below the levels necessary to cover the financial costs of supply and in Jordan are about half of the operational and maintenance costs (Haddadin, 1996). As with regulatory approaches, market-led approaches to reduce water demand in the agricultural sector have conflicting impacts on the structure of the economy. In the meantime groundwater exploitation continues well above the sustainable yield, with some projection forecasting total demand increasing to double the safe yield by 2020 (Allison et al., 1998).

Moving to the east of Amman, the experience of water supply and demand in the BRDP is in many ways a microcosm of the national picture. The relationship between water availability and agricultural activity, the traditional imperative of Bedouin existence has been adjusted by economic alternatives, subsidies and national water redistribution. Most of the programme area lies with the Azraq groundwater basin, where an upper aquifer, formed in Late Tertiary basalts and Early Tertiary marls and limestones, is recharged by runoff from the Jabal al-Arab, which rise north of the Syrian border. In addition to the extraction and export of groundwater from the Azraq well field to Amman, the Syrian authorities have constructed numerous small dams of headwater wadis of the Jabal al-Arab which reduce recharge. The availability of water in the region for the local population has therefore been compromised by interference to both input and output. On the other hand, the network of tracks and transport links enable pastoralists to move water to flocks by tanker and to supplement natural grazing with subsidised feed concentrates. As a consequence, flocks can be maintained or moved into areas of relatively poor grazing, further contributing to its degradation.

Increased settlement in villages leads to increased water demand for both domestic and agricultural purposes. More than twenty farms using drip irrigation have been established around the villages on the lower slopes of the Jabal al-Arab, extracting water from private boreholes. The rapid growth of the villages through settlement and population growth increases water demand and more than 80% of houses are now connected to a mains supply (Dutton, 1998). Here leakage rates are even higher than in Amman and may account for 60% of the supply (Waddingham, 1998). Investment is needed to curtail leakage and enforce regulated abstraction rates for private boreholes.

Interdependency between agriculture and urbanisation. A view for the desert margin.

Rapid cultural transition and population growth have transformed the traditional dependency between people and the environment in Jordan during the twentieth century. International tension regarding the Jordan River Basin and the refugee flow and consequent urbanisation of Amman has tended to focus national attention towards the west of the country. The desertified Badia is marginalised politically as well as climatically and, arguably, is an environment far removed from the national consciousness. Yet, activity in the desert margins is increasingly controlled by urban-led policies and by external technologies.

The historical dependence between human activity and environmental resources has been supplanted by the involvement of decision making and stake-holders far removed from the immediate environment. Nationally, the primary concerns of political decision making has been the urban population and the hinterland has been regarded as a source of potential resources, most notably groundwater. Technologies have allowed the development of irrigated farms in the area but many of the boreholes have been financed by speculators from Amman and have not delivered economically (or environmentally) viable enterprises (Dutton, 1998). There is a tendency towards short-term economic gains at the expense of soil conservation and biodiversity targets. In short, the responsibility and control of the local population over the local environment has been reduced by outside events.

In the face of these circumstances what can an externally funded R&D programme achieve? As it is a contention that the local population have effectively been passive in reaction to externally induced change, a clear developmental and environmental potentials of the area, mindful of the existing over-exploitation of groundwater and grazing lands, and of the biodiversity objectives. Interdisciplinary approaches to integrating environmental considerations with development policy through complex system modelling offers some potential (Perez-Trejo and Clark, 1996). Identification of the information which is possible to obtain and necessary for context-sensitive and environmentally sustainable policy development remains the key challenge.

References

Water, peace and the Middle East: Negotiating resources in the Jordan basin, Tauris Academic Stuides, London, pp. 75-119.

Allison R.J., Higgitt D.L., Kirk A.J., Warburton J., Al-Homoud A.S., Sunna B.F. and

n R.W., Clarke J.I. and Battikhi A.M. (eds.), *Arid land resources and their management. Jordan's desert margin*, Kegan Paul International, London, pp. 21-44.

Tribus, tribalismes et états en Moyen-Orient, pp. 26-47.

Bulloch J. and Darwish A. (1993), *Water wars: Coming conflicts in the Middle East*, Victor Gollanz, London.

Dolatyar M. and Gray T.S. (2000), *Water politics in the Middle east: A context for conflict or co-operation?,* Macmillan, London.

Clarke J.I. and Battikhi A.M. (eds.), *Arid land resources and their management. Jordan's desert margin*, Kegan Paul International, London, pp. 3-20.

Findlay A.M. (1994), *The Arab world*, Routledge, London.

Clarke J.I. and Battikhi A.M. (eds.), *Arid land resources and their management. Jordan's desert margin*, Kegan Paul International, London, pp. 197-213.

Environment, 36(3), pp. 6-15.

(ed.), *Water, peace and the Middle East: Negotiating resources in the Jordan basin*, Tauris Academic Stuides, London, pp. 59-73.

Perez-

Brandt C.J. and Thornes J.B. (eds.*), Mediterranean desrtification and land use*, Wiley, Chichester, pp. 431-446.

-Dead Sea Canal project on *Israel and Arab water*, Arab Research Centre, London, pp. 33-44.

A.M. (eds.), *Arid land resources and their management. Jordan's desert margin*, Kegan Paul International, London, pp. 119-125.

Wolf A.T. (1995), *Hydropolitics along the Jordan River*, United Nations University Press, Tokyo.