Israel – a case study of water-demand management

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How has Israel managed to increase its living standards over 50 years, but still maintain the same low level of per capita water consumption? This article explains the principles of water-demand management and how Israel has managed to apply them in practice.

Israel was established in 1948, a semi-arid country, having a population of 650 000, a GDP of $300 per capita and using approximately 300 cubic metres of water per person per year for all uses. By 2002 Israel had reached a population of 6.5 million, a GDP of $15 000 per capita, was supplying much of its agricultural needs (except grains) and exporting agricultural products, and had maintained water use at 300 m^3 of water per capita per year (see Figure 1).

It is often asked: how does a semi-arid country like Israel prosper with less than 300 m^3 of water (per capita per year) for all its uses, while international organizations define countries with less than 1000 m^3 as highly stressed, where water becomes a severe constraint to socio-economic growth?

This section will try to clarify some of the economics that form the basis of water-demand management (WDM).

Some water economics issues

When water is scarce it is costly to develop and to use. However, when a person (e.g. a farmer or an industry) uses water in an area in which water is limited, that quantity is not available to another farmer, city or industry. The productive value of the water on the farm or the site where it is missing is known as the *shadow cost of water*.

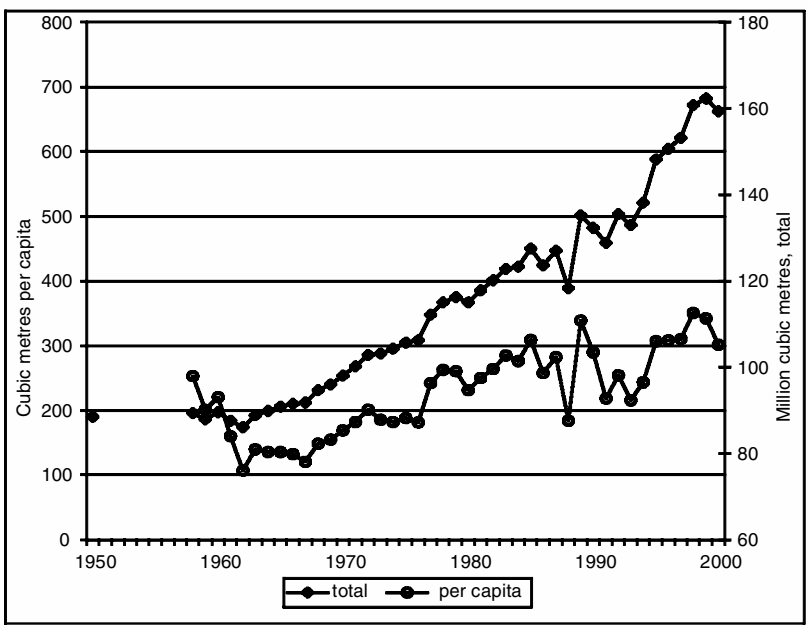

Figure 1 Urban water use (total and per capita)

The efficient use of water means that the contribution of water to human welfare is the maximum that may be achieved. Where people are poor and where food supply is not always assured, the contribution to agricultural production is a contribution to welfare. Where water is used for human consumption, in urban or rural areas, it should be allocated to satisfy equally the needs of all.

Scarcity requires a careful allocation of water, which can only be achieved with a hands-on policy. Efficient utilization means that water contributes equally wherever it is used, within a defined project, river or area. Experience in Israel has also taught us that wherever successfully applied, markets and prices are efficient instruments of allocation.

How water prices function

We learned in Israel that the first role of prices, to provide information, is the least understood. The right price will reflect the cost of water to society; that cost materializes only under scarcity. The product not produced where the water is missing is its cost. The right or shadow prices will reflect the cost of the resource; this was the basis for the abstraction fees imposed in Israel since 2000.

When prices are right, reflecting water's real economic value, farmers, industries and households will utilize it efficiently. Prices are not necessarily intended to encourage people to use less water; their aim is to promote the use of the right quantity of water.

Prices also transfer income, however, and failing to understand the information and allocation role of the

prices, farmers and urban dwellers oppose the adequate price system. They see it only as a means of income transfer. But prices will encourage efficient use of water; they will increase, not reduce, income in rural and urban communities alike, and will reduce the reliance of water users on the whims of the political powers-that-be and their servants.

It is important to emphasize, however, that water is intended to satisfy the needs of all members of society and thus must be under public control, especially in water-scarce regions and during droughts, when prices by themselves cannot maintain the necessary distribution.

The WDM supply strategy

A nationwide development of water resources (surface and ground) has been completed, involving the construction of regional projects connecting all resources into a network, and then a national carrier which transfers surpluses of water from the relatively water-abundant north to the water-scarce centre and south. The aquifers and the groundwater reserves act as the most effective storage of water between seasons, dry and wet years and weather fluctuations. The National Water Carrier (NWC) intersects all regional projects, thus completing the National Water System. This has been achievable because Israel is a small country, 500 km long, having an area of only 20 000 km^2.

The demand management strategy

Pricing and economic policies. These involve progressive block rates (the price per cubic metre increases in blocks) coupled with a metering system for everyone: for each well or water producer and consumer in the rural, urban and industrial sectors. These meters are calibrated by certified laboratories, read routinely and reported to the water authorities. Prices are updated automatically with a cost-of-living formula and subsidies are minimized. Recently water abstraction fees have been approved by parliament.

Reuse of sewage effluents. Legislation has been enacted to increase the quality levels of sewage treatment plants and effluents. The aim of the allocation policy has been to reduce fresh water allocations to the farming community and replace them with treated wastewater effluents. The total sewerage costs are borne by the city, while the reuse component costs are borne by the water sector. For the industrial sub-sector, the price mechanism as well as effluent charges are gradually being enforced and are contributing their share to urban and industrial water-demand management. As a result, industrial production per unit of water (in real terms) has increased by 250 per cent over the 20 years of a demand management campaign (see Figure 2). The reuse of secondary effluents in Israel is restricted to industrial field crops (cotton, maize, etc.) and the tertiary-treated effluents are used for unlimited irrigation with sub-surface drip irrigation in horticulture.

Water conservation/improved efficiency of water use. Policies concentrate on mixed tools including: (1) allocations, norms and progressive block rates for each sector, and (2) research, development and implementation of agronomic techniques (the most well-known being the large-scale implementation of drip irrigation techniques and the automation of irrigation) as well as the wide-scale use of technologies to improve water-use efficiency and reduce water consumption in the domestic, commercial and industrial sectors.

Agricultural water allocations. The irrigation water allocations are based on norms developed by the agricultural research community together with the farming community, reflecting the potential economic gains of introducing new irrigation technologies, changing cropping patterns and moving away from crops where the product value per unit of water is relatively low, e.g. grains. (See Figure 3, which shows how the value of crops per unit of water has changed over the years.)

'*Virtual water policy*'. The authorities took the difficult decision in the 1960s to import the great majority of grains instead of growing them in Israel. In today's figures it means the 'virtual import' of almost 3 billion m^3 of water annually, almost twice the total availability of fresh water resources in Israel. This decision has meant, of course, that the most strategic products like bread, beef, poultry, eggs and dairy products are all dependent on the world grain markets and at risk of potential political disruption.

Water markets (internal and possibly external). Parliament has recently approved a change enabling the holders of water allocations to sell their permanent or temporary allocations to others, while making the actual transaction via the national water carrier, thus opening the sector for a market-like operation. The water commissioner has already been doing this for years by trading fresh water with treated sewage effluents.

The market concept could well serve or even promote peaceful exchanges of

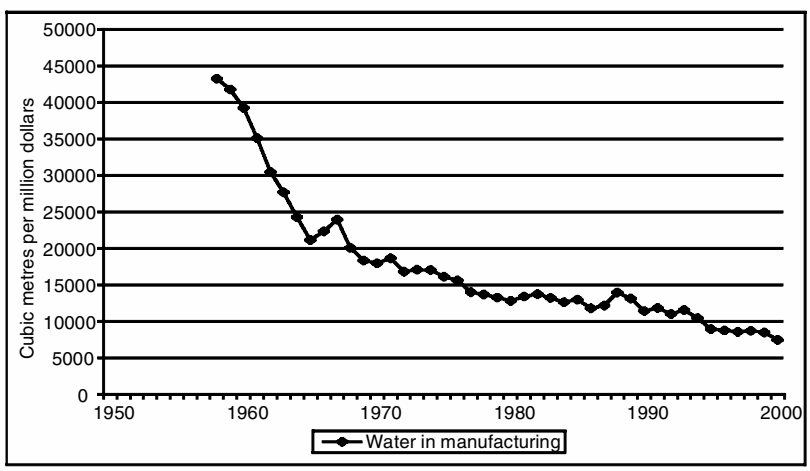

Figure 2 The National Industrial Water use per real term value of industrial production (Source: Prof. Yoav Kislev, Faculty of Agriculture, Department of Economics, Hebrew University)

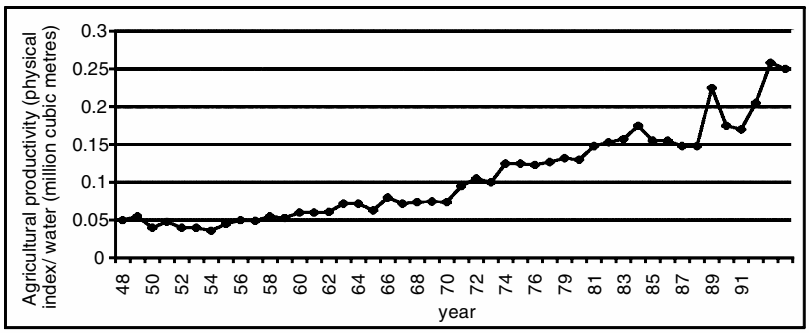

Figure 3 Real agricultural production in terms of fixed prices per unit of water (Source: Israel statistical abstract, Central Bureau of Statistics, Israel)

water between the countries of the Middle East.

The national water strategy model

There are a number of cornerstones to the national water strategy:

- *The water code* is based on the declaration of all water resources as public property, and the promotion of water conservation and of water use efficiency, in order to meet future demands, following gradual and economic development of the water resources. The code includes all the relevant and specific laws like the water drilling law, the water metering law, the water pollution prevention laws and others.
- *The Water Commissioner's Office* has complete responsibility for all water affairs and their management.
- *Integration* of the great majority of the water resources in the national water carrier.
- *Total water metering* was started and completed within ten years and is the basis for the demand management strategy.
- *The water annual licensing and allocation system* was initiated in 1959, based on water production and consumption norms mainly used in the agricultural and industrial sectors. The norms were developed, and are being changed over time, through an intensive research and development programme, which establishes the optimum water use by crops, regions, industrial products and others.
- *Water pricing.* Prices for over 70 per cent of the total water supply (mainly for water produced and distributed by the National Water Corporation operating the national water carrier) are based on the progressive block rates principles, set by a parliamentary commission. The water rates for the rest of the producers and consumers are based on costs in addition to abstraction levies, which reflect the average economic shadow values of water.

A number of other important issues like the prevention of water pollution, water-quality control, water drainage regulations and others will not be detailed here.

However, it is worthwhile to stress that, as a result of the recent dry spells and water demand beyond natural recharges, the government has decided to initiate and accelerate the construction of Reverse Osmosis Sea Water Desalination Plants (ROSWDP), which by 2005/6 should add about 25 per cent to the total freshwater available to Israel, following significant cost reductions for this technique.

Water shortage will also be eased by the completion of a nationwide treatment system in which all its tertiary or secondary treated wastewater will be reused by farmers in exchange for their fresh water allocations. This policy and investments will allow the country to continue its socio-economic growth indefinitely despite the increase in population and standard of living, as well as opening the door for the potential solutions of water conflicts between Israel and its neighbours.

Urban water conservation

'Unaccounted for water' (UFW) causes significant water and financial losses to urban utilities and municipalities. Unaccounted for water has been substantially reduced in Israel (down to 11–12 per cent on average from 25 per cent 15 years ago), but remains a serious problem in other Middle Eastern countries where, for example, UFW rates in some cities are over 50 per cent and represent critical water and financial losses.

The water market – a temporary or permanent solution?

In Israel, water is used within a system of allocations (annual or multi-annual), while in most other countries in the region user rights determine the demand. In many countries, a person who owns land (or cultivates it) has the right to the water flowing beside or under the plot. Elsewhere, various quota systems allocate the amounts of water on an annual, monthly, weekly, daily, or even hourly basis. Veteran users usually have the rights to continue to use the resource, when shortages prevail.

In Israel it has been shown that the efficiency of water resource allocation and use can be substantially improved through the increased use of price and trading mechanisms. Trading water on the margin, or using a system in which urban or industrial demand is met by supply from farmers selling their quotas, reduces the inefficiency of administrative allocations.

Irrigation water in Israel is partially subsidized when supplied by the National Water Corporation, 'Mekorot'. The annual water allocation is done by the Water Commission Office, and it is an administrative allocation system. The water rates do not match the marginal water price (sea-water desalination costs). Because of the subsidy for irrigation water, for many years pressure groups pursued the development of new water resources. The higher level of water demand led to a partial level of water-use inefficiency. This inefficiency will be improved as water trading is established. It will enable the trading of allocations between consumers using the national water system as a conduit, or using the aquifers as common pools, allowing one to pump more and others

less and to be compensated financially, according to the regulations. However, the recent legal establishment of water abstraction fees has minimized the potential rent between water producers, thus limiting the effectiveness of the water market as an instrument for improved efficiency of water use in the country.

The Middle East region

Many of the Middle East and North African countries face an environmental crisis, much of it as a result of water scarcity and the existing and potential pollution of their water resources. It is estimated that the investment needed to deal with and solve the problem could reach US$70–80 000 million in the period 1995–2005 (World Bank).

The hydro-geological conditions are constantly deteriorating. As extraction from ground- and surface-water resources increases, so do the problems associated with low water levels and falling quality. Inadequate human and industrial waste discharges as well as inappropriate wastewater reuse programmes lead to higher concentrations of chemicals and organic contaminants.

Adopting intensive WDM strategies will require political courage, but unless this happens the region will face serious water crises.

About the author

Saul Arlosoroff is the Chairman of Israel Water Engineers' Association.

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The following websites are good sources for finding out more about water and sanitation in the Middle East.

- **IES Water Database Bibliography**
  MEWIN (Middle East Water Information Network) is a free web-accessible bibliography of 10 000 catalogued entries, encompassing hydrology, geography, science and technology, economics, population, politics, law, management and strategic affairs.
  http://water1.geol.upenn.edu/index.html
- **Columbia University's Middle East Studies Internet Resources**
  An on-going compilation of electronic bibliographic resources and research materials on the Middle East and North Africa, organized by region, country and subject. The scope of the collection is research-oriented, although it provides access to broader online resources.
  www.columbia.edu/cu/lweb/indiv/mideast/cuvlm/water.html
- **Water and conflict in the Middle East**
  The focus of the Middle Eastern page of the Waternet site is on the Israeli–Palestinian conflict and the issue of water resources in the Jordan River basin. Updates are published regularly in the form of articles, policy documents, links to web sites related to the peace process and background information about the water conflict.
  http://waternet.rug.ac.be/ME.htm
- **Arab Water World (AWW) Magazine**
  AWW is targeted at the public and private sectors, governmental institutions, engineering consultants, contractors and organizations whose interest lies in developing and maintaining safe and healthy water supplies to the Gulf area, the Middle East and Africa. An online sample version (May/June 2003) can be downloaded.
  www.cph.com.lb/aww.htm
- **Sanitation Connection – Middle East**
  This is the Middle East regional section of Sanitation Connection, an information portal on water and sanitation issues.
  www.sanicon.net/titles/topicintro.php3?topicId=30
- **The Inter-Islamic Network on Water Resources Development and Management (INWRDAM)**
  INWRDAM is an inter-governmental, autonomous organization operating under the Organization of the Islamic Conference. Services include newsletters, publications lists, training activities and conference papers.
  www.nic.gov.jo/inwrdam/index.html
- **The World Bank Group Urban Water Supply and Sanitation**
  Part of the Middle East and North Africa (MENA) World Bank site, this includes project listings, water data, publications in English and Arabic available as downloadable documents, policies and strategies and related links.
  http://lnweb18.worldbank.org/mna/mena.nsf/f34b224d37365b3f852567ee0068bd93/c9e83517ae931faf8525694400051ddc?OpenDocument
- **'Urban water and sanitation in the Middle East and North Africa: The way forward' (2000) Saghir, J., M.Schiffler and M.Woldu**
  This study considers the critical issues for managing urban water supply and sanitation in countries in the Middle East and North Africa.
  Available in Arabic
  http://wbln0018.worldbank.org/mna/mena.nsf/f34b224d37365b3f852567ee0068bd93/2421f467c2c0262685256951006660e9/$FILE/way-arabic.pdf
  and in English
  http://wbln0018.worldbank.org/mna/mena.nsf/f34b224d37365b3f852567ee0068bd93/2421f467c2c0262685256951006660e9/$FILE/way-english.pdf
- **Interwater: Your gateway to water and sanitation organisations**
  Descriptions of relevant organizations in the Middle East and North Africa, including their aims and contact details.
  www.irc.nl/interwater/list.php?action=region&text=MEA

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