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# Urban Water in Israel

**by**

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## Introduction

Israel is a small country in a semiarid region. Its economy is industrialized and modern, its income is comparatively high. The water economy of Israel is also modern. It is founded on a law that specifies central control of the resources, and in general, water provision and sewage removal are adequate. Urban consumers receive ample supply of water of reasonable quality. There are however more than a few weak points in the structure of the urban water sector and the water economy in the country at large; they will be highlighted together with reforms that are being introduced in an effort to amend shortcomings.

Israel shares water sources and watersheds with its neighbors, particularly with the Palestinians on the West Bank and the Kingdom of Jordan on the east. This survey deals only with Israel proper, although several Israeli urban settlements on the West Bank are included in the official municipal statistics quoted in the chapter.

## The People and the Economy

The State of Israel was established in 1948 following a United Nation resolution on the partition of Palestine. The war between the emerging nation and the Arab countries around it ended with Israel occupying a larger area than was allotted to it in the resolution but its borders were not finalized and have since been referred to as the "green lines," the color used on the ceasefire maps (the green lines and international borders are marked in Figure 1—depicting the northern two-thirds of the country—by segmented lines separated by dots). In another war, in 1967, Israel occupied all of the area of Palestine

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west of the River Jordan. More recently, some of the occupied areas were handed over to the Palestinian Authority in accordance with various stages of peace agreements signed since 1993.

It was estimated that 650,000 Arab refugees left the war regions in 1948 and moved to neighboring areas. The population of Israel, which numbered less than a million in 1948, doubled in size in its first decade, mostly due to large Jewish immigration from Europe and Middle Eastern countries—many of them refugees. Another large wave of immigration, again close to a million people, came in the 1990s in the wake of the collapse of the Soviet Union. The population's average growth rate for the last half-century was 4% per year and by now the total number of people residing in the country has reached 6.5 million.

Most of the people of Israel, more than 90%, live in urban areas. Agriculture employs less that 2.5% of the labor force and this share has been declining for a long while. Despite the decline, rural communities have been expanding as many who exited agricultural occupations stayed in their rural homes which, in a small country such as Israel, were never too far from urban centers of employment and commerce. As the population grew, municipalities were upgraded. A large number of today's towns and cities were regarded as villages 40 and 50 years ago.

In its early period, Israel was recognized as a developing country, with comparatively low levels of income. Since then, per capita Gross Domestic Product increased on average 3.3% per year, partly thanks to international aid. At present GDP is approximately 16,000 US dollars per person. The economy is modern and standard of living is close to European.

## The Water Sector[1]

Israel is a small and narrow country; half of its area is desert. Precipitation, only in the winter, averages more than 700 mm per year in the north and less than 35 mm in the southern tip of the country. Throughout the country's history its people relied on springs, rivers, and shallow wells for water provision. Intensive utilization of the resources started in the second half of the 19$^{th}$ century with the expansion of the citrus industry in the coastal plain. Up to the 1950s, water projects were local in nature. An integrated national

[1] A more detailed survey of the water sector of Israel can be found in Kislev (forthcoming).

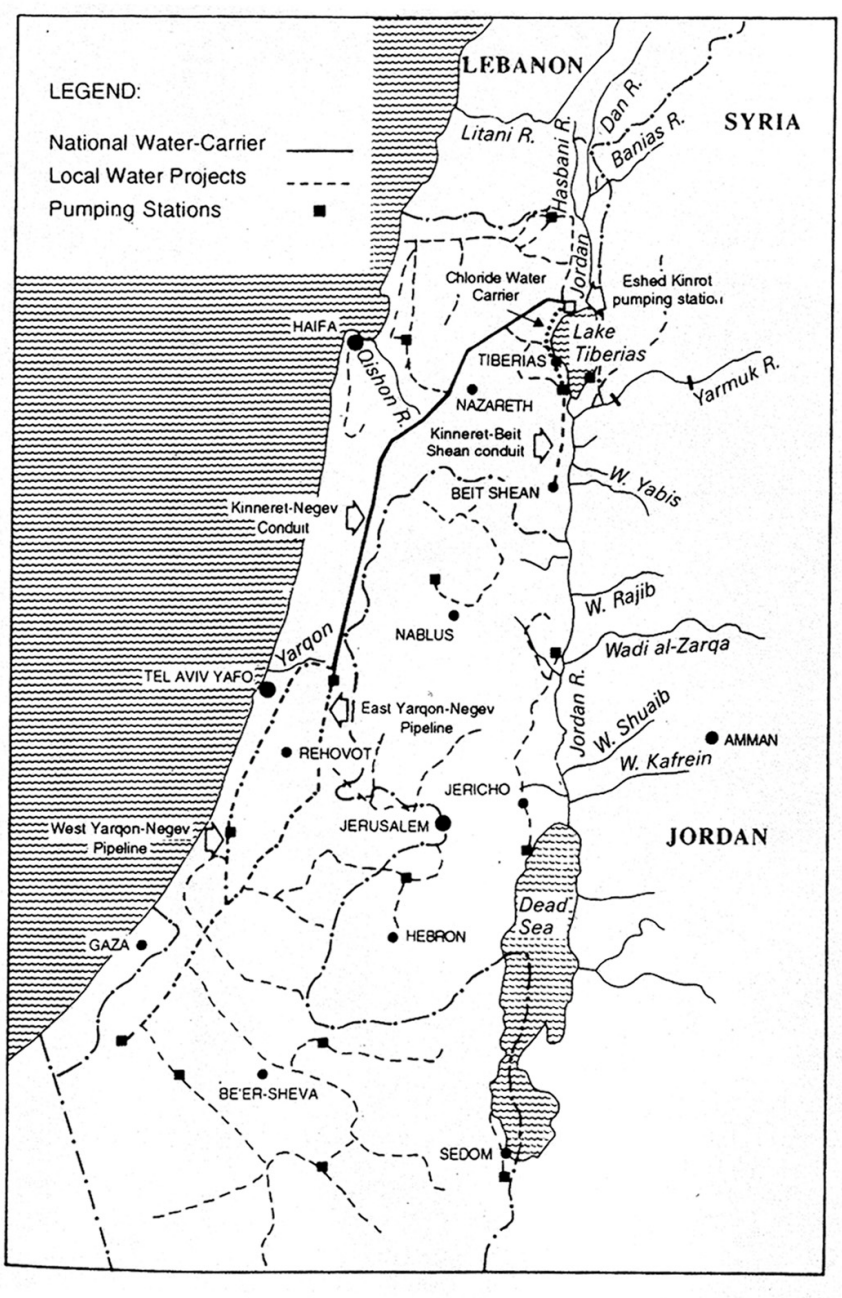


Figure 1: A Map of Israel and the National Project
Source: Kliot, Nurit, Water Resources and Conflicts in the Middle East, Routledge, 1994

system was established in the early 1960s with the completion of the National Water Carrier connecting the Sea of Galilee (Lake Tiberias) in the north with water sources and points of demand in the center and the south (the carrier is marked as Kinneret-Negev Conduit in Figure 1).

The largest utility, Mekorot Water Co., supplies two thirds of the water in Israel and the company also operates the National Carrier. Mekorot is a government company; the other suppliers are private well owners, municipalities, and regional cooperatives. Municipalities are required to collect and treat their sewage and several cities have cooperative projects with agricultural interests in their vicinity.

The "safe yield" water supply from natural sources is estimated as 1,550 million CM per year[2] (Water Commission, 2000). Two hundred and seventy MCM of recycled water are added to this quantity. The forecast is that by the year 2020, Israel will utilize 830 MCM of recycled water per year. The first comparatively large, 100 MCM per year, desalination plant is soon to be constructed on the coast of the Mediterranean south of Tel Aviv and preparations are under way for the installation of an additional capacity and for the import of 50-100 MCM a year from Turkey in converted oil tanks.[3] Consumption of fresh water is some 720 MCM in households and industry and the rest in agriculture. The government aims to supply agriculture with 1,130 MCM per year of water from all sources (including reclaimed and brackish water) but this may not be possible in the coming years.

In Israel's early days, in the 1950s, total water supply amounted to less than 600 MCM per year. Capacity was increased to irrigate dry lands and to expand and improve supply to the growing population. However, resources were limited and their development expensive; population growth has surpassed water supply over the last half-century, and the amount available per person (in the country's population) has declined. By the data depicted in Figure 2, per-capita consumption in industry has remained essentially constant for the last 40 years, while consumption in households increased at an average yearly rate of 0.66% (calculated in a regression of log consumption on time). Over the same period, per-person water available for agriculture was cut in half compared to the volume of the 1960s. Despite the reduction, agricultural production per-capita is, today, more than 150% of the quantity produced 40 years ago. By these numbers, water productivity in agriculture has increase threefold over the period. A similar increase was also recorded in industry.

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[2] The units of measurement are: CM = cubic meter, MCM = million cubic meters. One CM = 264 American gallons, 1 acre-foot = 1220 CM.

[3] Actually, Israel has always been importing large quantities of virtual water (a term due to Allen, 2000) in grain and beef purchased in water rich countries.

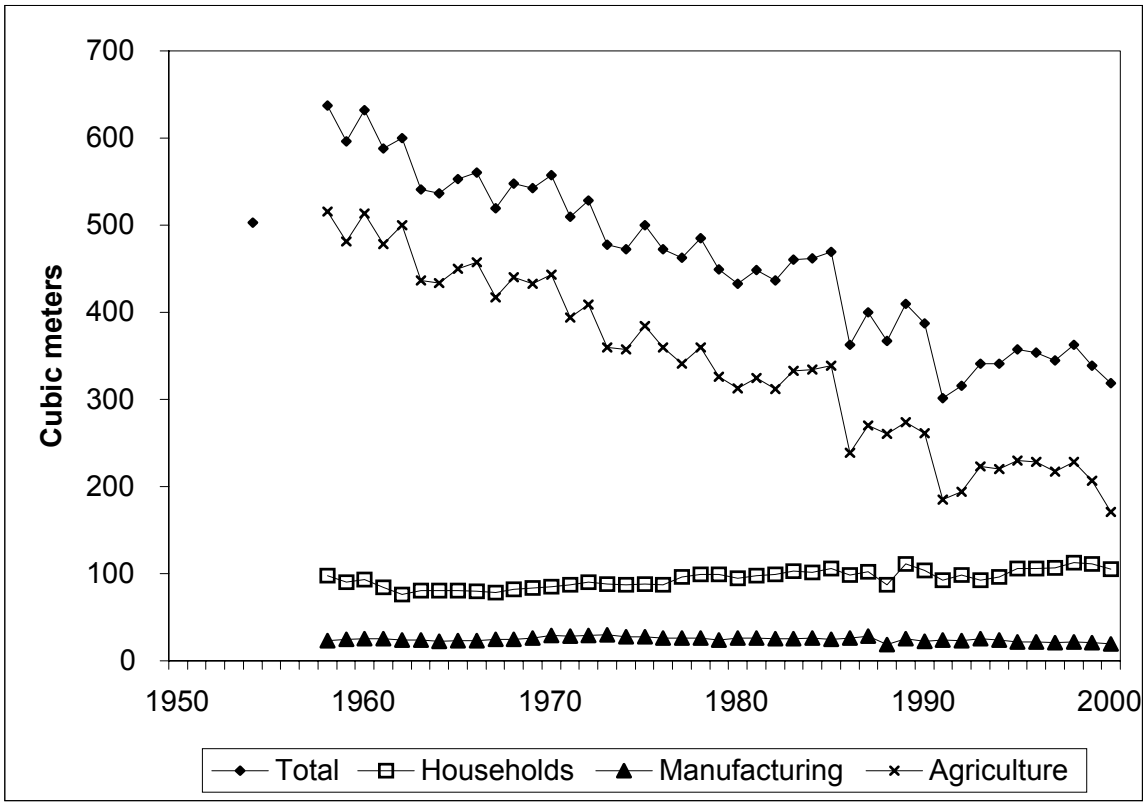


Figure 2: Per-capita Water Utilization
(Water use divided by the population in the country)
Source: Central Bureau of Statistics, Statistical Abstract of Israel.

Water potential and safe yields are generally stated in terms of average use. Precipitation varies from year to year and, with fluctuating rains, natural replenishment of the reservoirs is not stable. There is a tradeoff between average supply and its reliability. With a policy of regular extraction of large quantities of water, reservoirs are often low and a reliable supply cannot be maintained. This truism was brought home twice in the last 15 years, once in 1990-91 and again more recently. Israel is facing now, as it also faced more than 10 years ago, an acute water crisis into which the country slid when several dry years followed a period of over-utilization. The crisis caused a public outcry and even panic. And indeed, the water level in the Sea of Galilee is lower now than it has ever been in known history and the aquifers show clear signs of overdrafting. The recent crisis and the panic it caused hastened Israel's move to desalination and import.

Public Control

As natural resources, water reservoirs are common pools. Under open access, individuals will behave as free riders: they will extract water as long as it is beneficial for their own use disregarding the detrimental effect that their action may have on other users of the reservoirs (for example, by lowering water levels or drawing in salty ocean water). The common resource will be depleted (Hardin, 1968). In addition, suppliers are monopolies, particularly Mekorot. These features call for government intervention. Consequently, "The sources of water in the State are the property of the public, are given over to the control of the State …" (Israel Water Law—1959) there is no private ownership of water in Israel. The Water Commissioner is responsible for the utilization and the sustainability of the resources. The law requires metering of all uses of water. This means that wells and pumps are monitored and consumers—households, manufacturers, farmers, and others—pay by the quantity they use. But, as we shall see below, government intervention is not limited to the protection of the resources.

Allocation

There are two major water allocation problems: a. allocation of extraction; where, when, and how much to pump; b. allocation of water for utilization and consumption. The two problems are distinct, although the wording of the law obscures the distinction.

The criterion for extraction of water is sustainability of the resources. The role of the Water Commissioner is to guard the long run stability of the quantity and quality of water. Fulfilling this role may require decisions on each source and well separately, depending on local hydrological circumstances. The criterion for the allocation of water for consumption and utilization is efficiency; that is, maximization of economic welfare from the use of water. Two management instruments are in use: prices and quotas. Households and most manufacturers can purchase from Mekorot all their demand at the established prices. Water in agriculture is allocated by quota and, in addition, farmers who purchase water[4] pay Mekorot or the regional suppliers.

As water is the property the public and controlled by the state, suppliers or private well owners are issued extraction licenses together with allocation instructions, how much to provide each user. In principle, both the licenses and the quotas are reallocated

[4] Some farmers own private wells and others, around and above the Sea of Galilee, pump directly from the lake or the Jordan River (under license).

every year, in practice they seldom change. Possession creates rights. As a result, the water sector operates under a mixed, sometimes fuzzy, regime of public ownership and private rights. Examples: although the law does not prohibit explicitly trading in water, it does not permit it either. Officially the Water Commissioner was against trading in quotas, but in many cases he allowed the exchange. However, an official water market has not been established yet.

The multitude of possibilities was also reflected in the courts. A milestone decision was handed down in 1964 when a farming community in the coastal plain refused to contribute its high quality water to the National Carrier in exchange for more salty Lake of Galilee water. The Supreme Court ruled then that, by the law, the water commissioner may force a water allocation program, including the mixing of water of different qualities. In another case, in 2001, a court did not accept the doctrine of the omnipotent commissioner and rejected his decision that, since the water—all of it—is public property, cities cannot sell recycled water to farmers and the water they treated must be handed over for irrigation free of charge. (Indeed, in practice most cities do not charge for water leaving their recycling plants.)

Hydropolitics

Government intervention in the management of water is a necessary consequence of the common pool features of the resources and the monopoly position of the suppliers. Once the government is involved, in any issue, interest groups rise in an attempt to change public policies in their favor (Zusman, 1997). The two strongest groups in the water sector, the farmers and the workers of Mekorot, have different interests and attempt to affect different aspects of policy. The "greens" form the third group. They are growing in strength but their overall effect is still marginal (the green assessment of the water sector of Israel is summarized in Auerbach and Karassin, 2002).

The farmers push for larger water provision at the lowest possible price. Indeed, the development of agriculture was uppermost on the minds of the builders of the National Carrier and its extensions. It seems, however, that in more recent years, lower world food prices, the declining share of agriculture in the national economy, and the increased demand for water in the urban sector—reduced the power of the agricultural lobby. Compared to farmers in other countries, farmers in Israel pay high prices for irrigation water, Mekorot charges now 0.20-0.25 US dollars per CM; independent

suppliers and regional cooperatives pay an extraction levy (the levy will be explained below). Consequently, in recent years, prices, not the quotas, determined water utilization in agriculture. Still the farm lobby was strong enough to guard the policy of overdrafting that resulted in the acute crises of the last 15 years.

Mekorot workers are interested, naturally, in their positions and income. And, to protect their interests, they defend the monopolistic position of the utility. The government has been attempting for years to reform the structure of the company and to reduce its market and political power. Any achievement in this endeavor was despite a strong opposition of the workers and their union. We shall encounter traces of this struggle in the discussion of the urban water sector below. The ongoing conflict between Mekorot and the government, its official owner, uncovers the real governance structure of the company—it is run by its workers much more than by its owners. It should however be added that the workers are a dedicated lot. Water is not cheap but Mekorot's provision is reliable and of good quality.

Contrary to the farmers and Mekorot's workers, the public at large is not organized and its voice is not heard when decisions on the utilization of the resources are made. But it is not completely overlooked. Two examples: The recent decision to move to desalination despite the heavy investment the new technology entails—is to a large extent reaction to public pressure that the government "does something" in face of water shortage. And, despite the shortages and curtailed provision to agriculture in the recent crises, there were no cuts in supply to urban consumers. The only way urban dwellers felt the shortage, besides being exposed to alarming stories in media, was through the promotion of a water saving campaign. The government did not approve the suggestion of the Water Commissioner to prohibit irrigation of parks and to raise marginal price of water to heavy residential consumers. It probably figured that it would rather risk the health of the aquifers than face discontent among noisy urban voters.

The government, although taken generally as a unified entity, does not always speak in a single voice. In particular, the Treasury is concerned with conservation of the fisc and with economic efficiency. Other offices are often striving to promote the interests of the sectors they are responsible for (sometimes seem to represent) and projects dear to their hearts.

Early Urban Supply

The first human settlers kept close to sources of water. Natural supply was supplemented by rainwater artificially collected in cisterns dug in the ground and sealed to reduce leakage. In towns, water was diverted to the cisterns from rooftops and courtyards; in the desert, occasional floods were stored in nearby cistern and sometimes carried later to storage facilities close to home. Biblical Jerusalem, King David's city, was built on a slope reaching down to a spring in the valley underneath. In the 8th century B.C., to prepare for emergencies, King Hezekiah "constructed the pool and the conduit to bring water into the city" (2 Kings, 20, 20). The spring and the tunnel are still drawing admiring tourists. Water collected from springs, wells and cisterns was augmented by water carried from distances. Ancient Roman aqueducts, built some 2000 years ago, can still be seen in several places in Israel. A few of the aqueducts were maintained and rebuilt but many were neglected and fell into ruin.

Gravitational water conveyance and distribution systems were the hi-tech projects of the ancient world. Technology did not change much for generations. As late as in the early 19th century, when the need arose to expand supply of water for the city of Akko (Acre, north of Haifa), the solution was a new aqueduct. This one may however have been the last.

Where groundwater was available, wells were dug by hand and the water was lifted by human or animal power. These wells could not be deep and they did not support large flows. Engines and lift pumps replaced animals at the end of the 19th century and the beginning of the 20th. The first reports of mechanical well drilling in Israel are from the 1920s (Karlinsky, 2000).

The Municipal Sector

There are 263 municipalities in Israel classified by their governing bodies

| | |
|---|---|
| Cities (city councils) | 64 |
| Towns (local councils) | 146 |
| Regional councils | 53 |

Cities are generally larger than towns.[5] Regional councils are comprised of villages and other small places of dwelling and do not include communities of urban character. Water supply to residential users in the regional councils is, in many cases, part and parcel of the water supplied to agriculture and is not measured separately. I shall therefore deal in the survey only with cities and towns.

The municipalities are responsible for local services; among them, education, welfare, roads, parks, water, sewerage, and garbage collection. In education and welfare they act as agents of the national government that covers most of the cost of services specified in the law of the land. In other lines of activity the municipalities are expected to operate independently and to finance their services from local taxes, mostly on property, and specific charges (such as for water). However, the national government is nevertheless deeply involved in local affairs—on average, a third of the outlays of the municipal governments comes from the national budget. The involvement is motivated by the desire to assist weaker communities and to enhance the development of the country, and also, evidently, by the conviction that big brother knows best. Also, assistance to local authorities, delivered at the grass roots, is deemed to have high political payoffs; parties in coalition governments vie for control of the Ministry of the Interior, the supervisor and supporter of the local authorities. Whatever the motivation behind it, government interference in local affairs creates a situation of "soft budget constraints"—mayors can spend beyond their means and plead with the government to cover deficits.

The municipalities differ significantly by income of their residents. The 1999 average for the 10 poorest communities (out of 186 cities and towns for which data were available) was less than 3000 US dollars per person per year. The richest ten registered more than $14,000.[6] As usual, the poorest communities have the largest number of children. In most, the share of children of 0-17 years old exceeds 45% of the population. In the rich communities the corresponding shares are 30% and lower. The meaning of these numbers is that the weaker municipalities are torn between the need to provide vital services, particularly schooling, on a comparatively large scale and the poorer ability of

[5] The terms city and town are mine, the official terminology refers to the governing body of the locality.

[6] The difference is exaggerated somewhat as welfare payments are included in income but income taxes are not deducted.

their populations to support them. Naturally, however, municipalities in higher income communities are also short of funds for project they would like to promote, a fact that often has (particularly had in the past) a significant bearing on their water economies.

Special problems are posed by minority municipalities. Of the population of Israel, close to 5 million are Jews and the rest, 1.5 million, are minorities, mostly Arabs. The history of war and the continuing tension between Israel and its neighbors has naturally reflected on the relations of the state with its Arab citizens. Seven cities in Israel have both Jewish and Arab communities—among them the largest three: Jerusalem, Tel Aviv, and Haifa—but most of the localities are separated, either Jewish or Arab (77 municipalities are Arab). As a rule, the Arab communities are poorer than most Jewish municipalities and they also have less developed water and, particularly, sewage and recycling systems. This gap is due to neglect on part of the government, to the fact that Arab towns and cities are traditional villages that grew by leaps and bounds without adequate town plans, and to lags in the collection of charges for water and sewage removal in Arab communities—they lack therefore the ability to participate in government supported program based on matching of local and national funds.

However, governments in democracy cannot keep neglecting more than a fifth of the population and its voters. The water and sewage sector of the Arab municipalities has been improving, even if slowly, and can be expected to reach the standards of the country at large in the future.

Urban Water

Several municipalities rely to a large extent on their own water sources; some even supply themselves more than 50% of their needs. Most others have to get all their water from the national utility. For the country as a whole, Mekorot supplies more than 80% of the urban water. In a few exceptional cases urban communities buy water from regional agricultural cooperatives.

The total quantity of water the town and cities received and extracted in 2000 was 614 MCM. Table 1 reports the distribution of uses by sector. Most of the municipal water goes to urban uses, small amounts are provided to agriculture and industry located within the municipal areas. The urban water is also divided into sub-sectors, with the largest quantities consumed in households. Overall, the residential sub-sector's share of the municipal water is 56.7%.

Table 1: Municipal Water Use, 2000

| Sector | Per-capita (CM) | Share (%) | Share (%) |
|---|---|---|---|
| Total Municipal | 106.6 | 100 | |
| Urban | 86.1 | 80.8 | 100 |
| Residential | 60.5 | | 70.2 |
| Schools | 3.4 | | 4.0 |
| Sport | 1.1 | | 1.2 |
| Parks | 7.2 | | 8.4 |
| Institutions | 3.2 | | 3.7 |
| Hospitals | 0.9 | | 1.1 |
| Hotels | 2.1 | | 2.4 |
| Commerce | 5.7 | | 6.6 |
| Police and transportation | 0.6 | | 0.7 |
| Construction | 1.5 | | 1.7 |
| Industry | 5.4 | 5.0 | |
| Agriculture | 3.1 | 2.9 | |
| Other | 1.4 | 1.3 | |
| Losses | 10.7 | 10.0 | |

Source: Dauber, Joseph, 2001, Annual Report 2000, Water Consumption in the Municipalities, The Water Commission, Tel Aviv (Hebrew).

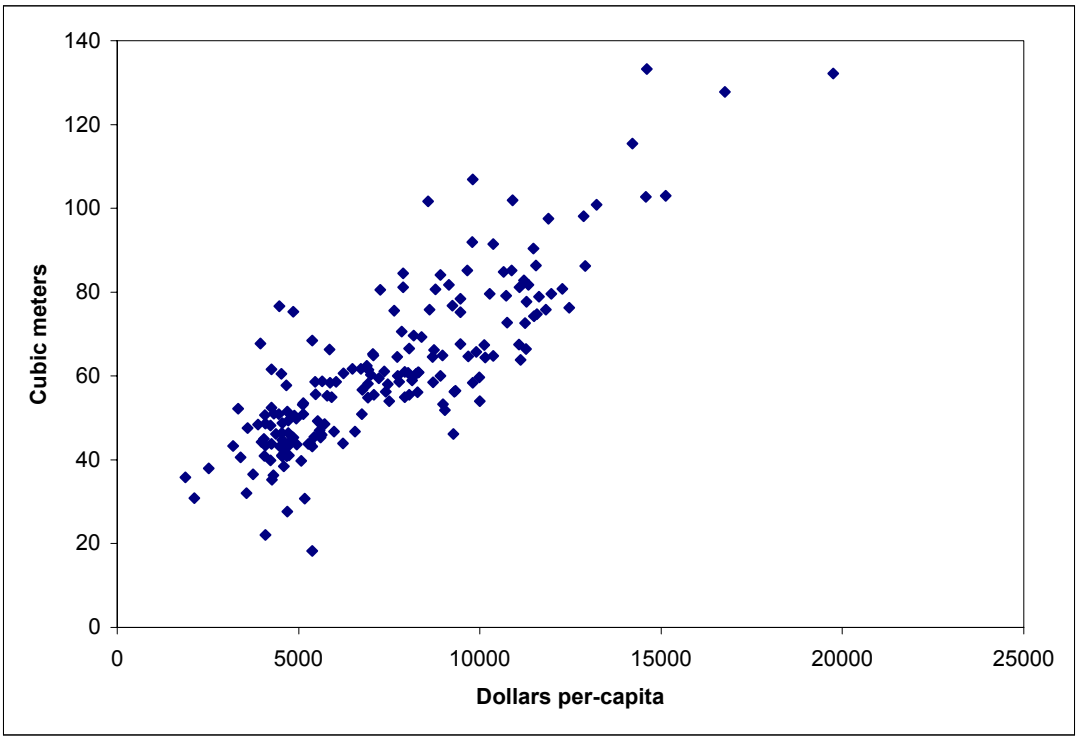


Figure 3: Per-capita Income and Residential Water Consumption for 2000
Source: Cohen, Nir, M. Sc. Thesis (in preparation) The Hebrew University.

On average, residential water consumption in the municipalities was, in the year 2000, 60.5 CM per-person; urban water consumption was 86.1 CM per-person. There are however marked differences between the municipalities in water use (Dar, 1996). In general, high-income communities consume more water per-person than localities where the average income is low (Figure 3). Income may affect consumption in at least three different ways: (a) high-income families have larger houses and gardens (and cars to wash and some even have swimming pools to fill-up); (b) lower-income families are larger and enjoy economies of scale in water use; (c) low income communities have poor distribution systems and more frequent interruptions in supply. The last factor was important in the past but is less significant now that most municipal systems have been modernized.

The income elasticity of demand for residential water, estimated from the data depicted in Figure 3, is 0.60. The meaning of this parameter is that, on average, if income in community A is 10% higher than in B, residential water consumption in A will be 6% higher than in B (the urban water elasticity is 0.68).

Figure 3 depicts data for a one-year cross section. Long period development is presented in Figure 2. In terms of Table 1, the Household series in Figure 2 is Urban Water plus Other and Losses[7], and it covers not only urban, but also assessments of residential consumption in the rural areas. Recall that the Household series increased 0.66% a year. To what extent was the long-term growth in consumption determined by changes in income? At this stage, the question can be answered only in rough terms. Per-capita GDP rose over the last 40 years at an average yearly rate of 2.64%. Accepting GDP as a proxy for income and applying the elasticity estimated from the data of Figure 3, one may calculate a predicted growth in per-capita household water use of 1.58% per-year—much higher than the actual rate of 0.66% per year. Over forty years, an annual growth of 1.58% is an increase for the period of more than 85%; the actual increase was less than 30%. Evidently, income has not been the only determinant of water utilization in the urban sector in recent times. Better understanding of the economics of urban consumption will require further analysis.

[7] Unaccounted for, the difference between water metered at the city gate and water sold to users.

Prices and Cost

The government sets the prices for Mekorot's water, the charges users pay for water they receive from municipalities, and the extraction levies. Regional cooperatives charge their members cost-recovery fees, and wherever trade occurs prices are market determined.

Prices should reflect cost. Two major factors have affected in the past cost of water as conventionally defined (capital and operating cost); the first was the shift from relatively inexpensive to higher cost systems and the other was the rise in the world price of energy since 1974. In rough terms, and with the present prices of energy, water cost is $0.12 per CM for local provision and the average cost is $0.35 for countrywide supply through the National Carrier. Most Mekorot's customers pay the same prices whatever the source of water (details below) and the prices they pay have risen over time, particularly when energy cost increased. The company is recovering approximately 80% of its cost. Israel is now entering the epoch of desalination with marginal water cost reaching $0.60 per CM[8] and perhaps even more.

Another cost component, often not recognized explicitly, is the scarcity cost of water in its sources. When the quantity of water is limited, the supply to one person reduces the amount available to another. As an example, consider farming, the reduction in production on the farm where water is missing is the scarcity or opportunity cost of water supplied. This economic insight is the basis for the recently imposed extraction levy. The revenue of the levy goes to the general government budget on the presumption that just as the water is the property of the public at large so also payment for its use belongs to all the citizens of the country. Abstraction charges, or pump fees, are imposed in many countries and sometimes for dedicated funds (OECD, 1999), but I have not found that the charges are connected, as attempted in Israel, to the scarcity cost of the water.

In the urban sector there are currently four different government-set prices and price groups for water:[9]

a. The wholesale price the city pays Mekorot for water delivered at the head of the system (the city gate) is $0.38 per CM.

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[8] The implicit price of the agreement signed recently with the builders and operators of the new desalination plant is $0.53 per CM, but to this will be added the cost of treatment and connection to the National Carrier.

[9] New users are also charged connection fees to the water and the sewage networks.

b. An extraction levy (paid to the government) of $0.13 per CM on water the city draws from its own wells (the levy on water for urban use drawn from surface sources is $0.11 per CM and this rate applies only to the city of Tiberias that gets its water from the Sea of Galilee).

c. The prices users pay the city for water. Residential consumers pay block rate charges in two-months billing periods:

$0.61 per CM for the first 16 CM per period

$0.89 for the next 14 CM per period

$1.27 per CM for any addition.

Large families have discounts; a certain quota of garden water is also charged the lower rate ($0.61 per CM).[10] In addition, households and other users pay $0.03 per CM to a restoration fund managed by the Ministry of the Interior. We shall see its operation below.

d. The fourth is the group of charges on other sectors in the urban economy. They pay different prices; for example, manufacturing charges are $0.36 and hotels $0.42 per CM, both prices are flat rates.

While water charges are identical in all towns and cities, municipalities may, with the approval of the Ministry, impose a sewage charge to finance investment in collection and treatment systems. These charges are not identical; they range from $0.20 to $0.60 per CM. Garden water is excluded.

Cities and towns, paying at the gates a wholesale price of $0.38 per CM, cover a little more than the cost of water of the National Carrier. Since agriculture pays less—approximately $0.25 per CM as average charge of a block rate schedule—it is generally claimed in Israel that water consumers in town subsidize the farmers. This is not the complete picture. Cost of water Mekorot supplies to farmers in remote and hilly areas is higher than the price they pay. Likewise, the cost of delivering water to Jerusalem in the hills is twice as high as the cost of supplying water to Tel Aviv on the coast. With identical prices, some farmers and many town dwellers subsidize water used by other farmers and other city people. (In addition to this cross subsidization, the government

[10] The quota—applicable in the summer months of April to November—varies with the size of the garden, up to a limit of 30 CM per two-month billing period, provided the household's water consumption was higher than 16 CM per period. Residents in a condominiums share the quota.

finances from the national budget the share of cost Mekorot does not recover with the administratively dictated prices.)

Municipal Cost and Surplus

The municipality pays for water purchased from Mekorot and it incurs cost of pumping its own water (if it has any), distribution to users, and collecting and treating the sewage. The prices and levies set or approved by the government are supposed to cover cost of service and maintenance of the system. It has often been claimed that local politicians—not unlike their colleagues at higher levels of government—are short run maximizers; the municipalities enjoy money surpluses in their water operations and they neglect maintenance and use the funds saved to finance visible, aboveground projects. The outcome is obsolete networks, water losses, and local authorities whose interest lies not in saving, but in increasing water use. Here are the words of a parliamentary committee (The Knesset, 2002): "The committee finds fault with water pricing in the urban sector. The gap between the price that the municipality pays for water and the price it charges the local consumer is not reasonable. … The current situation can be defined as extortion." Nowhere in its 300-page report did the committee back its accusations with data or analysis.

Reality is a little more complicated. True, on average, cities and local councils have a financial surplus of 25% in their water and sewage service,[11] but there are significant differences between the municipalities (CBS, 1998). As we have seen above, the government dictates identical prices in all municipalities. Some municipalities are more efficient than others, both in service provision and in collecting water charges, and are making, with these identical prices, handsome "profits" on the water they supply, while some face difficult conditions—old networks, hilly terrain, large families—and are incurring losses. The significance of the surplus should also not be exaggerated; it amounts to less than 7% of the property taxes the municipalities collect and 2.5% of income they have from all sources (again on average). Moreover, as we shall see shortly, the municipalities invest regularly in development and restoration of water and sewage systems and their financial surplus may go to cover these outlays.

[11] As common in government budgets, the reported information is on current outlays, depreciation is not included. Cost of capital is included only as much as the municipalities pay interest on loans taken for the water and sewage sector.

My critical remarks on the popular misconceptions notwithstanding, local government is not necessarily the best manager of local utilities. And indeed, the urban water sector is now undergoing a reform, "incorporation" for short; we shall come to it below.

The Restoration Fund

Although a great share of the water system in Israel is relatively new, many municipalities also have older networks. Old pipelines tend to leak and to have calcified deposits on their walls. The deposits separate and pollute the water with abrupt changes of pressure or interruption and resumption of flows. To reduce leakage a fine has been imposed on cities and towns where water losses exceed 12% of supply. Twenty years ago, a Water Administration was established in the Ministry of the Interior. The Administration collects the contributions to the restoration fund and assists cities and towns in investments and renewal of water networks. The participating municipalities receive assistance from the restoration fund and from other sources the administration raises. They have to match the external assistance with local funds. Participating municipalities also receive engineering and planning advice. Water losses have been reduced markedly since the establishment of the administration and the commencement of its activity; on averages the share of losses in supply is now 10% (Table 1).

Quality and Health

Utilization of the resources alters the quality of water in its storage. When irrigating with aquifer water, salts percolate and their concentration in the aquifer gradually increases. Even if the accumulation of salt is slow—water sources are tolerant—eventually the aquifer will have to be cleaned, perhaps by desalination. The authorities and the public will have to recognize that maintaining sustainable resources and sustainable salt regimes is expensive but unavoidable. Sodium chloride (table salt) is the most common agent contaminating the aquifers, but it is not the only one. Among the other factors are nitrates from fertilizers and sewage, industrial chemicals, and fuel from gas station. Encountering contaminated water, the Water Commissioner ordered wells to be closed, but this is not a solution as the contamination remains in the aquifer or even accumulates and spreads.

Recently cities and towns in the coastal area have installed water-purifying devices and returned inactive wells to operation. The Commissioner encourages the increased supply of water thus created and the government subsidizes the investments.

In a small country, where population density is high, water quality is always at risk. Diseases, particularly intestinal diseases, are a constant threat. By law, the responsibility for the hygienic standard of the water lies with the Ministry of Health. By the ministry's regulations, all water in Israel is chlorinated and large communities (45% of the population) receive fluoridated water. Suppliers, cities, and towns follow directives handed down from the ministry and the ministry also monitors water quality and takes action when and where its interference is needed. By a recent regulation, municipalities must publish their water quality tests. And indeed, tap water quality is generally good in Israel. The credit goes to the stringent application of the law by health authorities and to the concentration of large parts of the supply in one hand, Mekorot. With economies of scale and cost-plus pricing, the company incorporated in its network sophisticated quality monitoring, testing, and treatment facilities. Still, water quality assurance needs constant vigilance and effort.

Growth of urban population and its water consumption has entailed reductions in the supply of fresh water to agriculture and increased prices. At the same time, urban centers have increased the quantities of treated sewage that is mostly used for irrigation. Irrigation with recycled water is regulated to assure that contamination does not reach aquifers or wells and that the treated water does not come in direct contact with food. Modern practices allow farmers to mix chemical fertilizers with water in high-pressure drip irrigation systems (fertigation). The Health Ministry insists on separate networks and the fitting of check valves as an additional line of defense against unwanted chemicals in water supplied for human consumption. Similar check valves are also required in hospitals and manufacturing facilities. The ministry has been halting the development of residential areas unless adequate sewage removal was assured.

Surface water poses special health hazards. Small localities in the north, drawing water from the River Jordan or the Sea of Galilee, are required to filter the water they supply to households. Sea of Galilee water supplied by the National Carrier is not up to most stringent standards; particularly, turbidity cannot be avoided. The technical solution is to filter the water in the National Carrier. The Treasury deemed the solution too expensive and farmers opposed it, fearing that they, who are also using the carrier's

water, will be required to pay the cost of filtering that they actually do not need. An alternative solution is to filter the water at the gates of the cities. Economically a single filter is more efficient and it secures quality to all users, including inhabitants of small communities that may find local filters too expensive or technically too complicated to operate. The filter has not been installed as yet but preparations are underway after the government promised the construction of the filtering plant when a green group has brought recently the issue before the Supreme Court.

Indeed, while green lobbies have not been effective in changing overall water policies and reducing overdrafting, they are heard and are often effective on issues of water quality. They bring the authorities to court whenever they find that water is not up to the standards specified in health regulation, in Israel or in other countries. They also increase the awareness of the public to water quality issues. They may thus be partly responsible for the fashionable spread of bottled "mineral water" in Israel. Evidently consumers in a high-income country are willing to pay for drinking water 500 times the price of the water supplied in the national network. (I drink tap water.)

Sewage Collection and Treatment

Sewage amounts to 60-70% of the water supplied to urban communities. This ratio serves to indicate that most of the water households and others in towns and cities receive is not consumed but is used as a carrier of dirt and refuse. Once treated, the sewage—now as recycled or reclaimed water—can be reused. At present, close to a third of the water provided to agriculture is recycled sewage. This share is expected to exceed 70% in twenty-years time.

Originally, houses in Israel had individual septic tanks and cesspools in which the sewage was collected and from where it slowly drained away, often into aquifers. When collection systems were built, the first some 50 years ago, the raw sewage was dumped directly into the Mediterranean Sea or the nearest streambeds going to the sea. This practice created environmental nuisance and health hazards. Most visible was the pollution in Tel Aviv where waves washed parts of the sewage back on the beach. In the mid 1970s, the city, together with a few surrendering towns and with the help of the

World Bank[12], built a central treatment plant (the Shafdan, named after the biblical term, Dan, for the region in which Tel Aviv is located).

Table 2: Sewage and its Treatment

| Year | Raw sewage | Centrally collected | | Treated | |
|---|---|---|---|---|---|
| | MCM | MCM | % | MCM | % |
| 1971 | 183 | 145 | 78 | 69 | 38 |
| 1982 | 251 | 210 | 84 | 137 | 55 |
| 1989 | 293 | 273 | 93 | 232 | 79 |
| 2000 | 451 | 438 | 97 | 418 | 93 |

Source: State Comptroller, Annual Report 41 and data received from the Water Commission.
Remark: Percents are of raw sewage.

Regulations on sewage removal were on the books for a long time. A comprehensive law requiring modern treatment was enacted in 1962. The requirement was only partly satisfied. As Table 2 indicates, 30 years ago less than 40% of the sewage was treated. But the situation has gradually improved. The sharp increase in the treated sewage reported in Table 2 between 1971 and 1982 is due to the construction of the Shafdan, the Tel Aviv treatment plant. However, it and another plant built in Haifa by Mekorot were essentially the only high standard treatment plants. Most other municipalities, if they treated their sewage, treated it superficially and did not bring up to the required standards. Evidently, like with the water systems, city fathers preferred to invest the money they had in visible projects and let partially recycled sewage flow away down the nearest creek. The government, as much as it attempted, did not manage to force compliance with the law and with health regulations.

The policy was modified dramatically in 1992 when a new government came into office; the stick was replaced by the carrot.[13] The national government started to support enthusiastically local sewage and treatment plants, budgets set for assistance to municipalities for sewage collection and treatment increased fivefold between 1991 and 1995, and the money has since continued to flow in similar rates. This change of face came in the wake of the realization that the sewage problem and the extreme negative

[12] This was the last project the Bank undertook in Israel. The country has since matured to the status of a developed economy.
[13] On the question of fines or subsidies as policy instruments, see Finkelshtain and Kislev (1995).

externalities it created would not be solved unless the local authorities are assisted. But two other considerations also added to the move to the new policy. One was a wave of immigration increasing significantly the demand for housing and employment and the second was a shift away of the new government (in 1992) from investment in settlements in the West Bank and Gaza Strip to infrastructure inside Israel.

Some of the newly constructed plants treat sewage that was disposed raw in the past, but most replace or modernize old and primitive facilities. The recycled water is of secondary treatment (removal of organic material), except for the Tel Aviv plant where the treatment includes filtering in sandy dunes and the recycled water is considered "fit for occasional drinking." To reduce the financial burden of the municipalities and assure professional management, the cities and towns are encouraged to contract with business enterprises to Build Operate and Transfer the plants (BOT, transfer to the municipality after a period, typically of 20 or 25 years). The introduction of private interests into the provision of local public goods, in swage treatment plants and in the future perhaps also through the incorporated water units, raises issues of finance and control that municipalities in Israel are now experiencing for the first time.

By and large, the recycled water is utilized in agriculture where farmers have accepted it, as the provision of fresh water has been curtailed and its price increased. At present, recycled water form 30% of the water provided to agriculture. This share is expected to grow as the supply of fresh water is curtailed when demand in the urban sector increases and as the sector produces larger and larger quantities of sewage for treatment and disposal. The government supports investment in the adaptation of irrigation to reclaimed water. The cost of the adaptation is not negligible: storage is prepared to keep treated water from winter to summer and new networks are constructed to separate recycled sewage from drinking water. I do not know of assessments of the value of the subsidies involved in the support to sewage and recycling activities but, essentially, most of the initial capital outlays are covered by public funds. Farmers and their regional coops cannot raise on their own the amounts needed for these projects on the capital market.

Up to now, most experts in the water economy have regarded regard secondary treatment and utilization in agriculture as an appropriate solution to the sewage problem. There is however, a growing understanding that the treatment will have to be more thorough to reduce health hazards and damage to the soil. Some specialists (in particular

Zaslavsky, 2002) have recently been calling for desalination of the reclaimed water, all of it. The arguments brought in support of desalination is that it will reduce the amount of salt irrigation adds to the aquifers (households and industry add salt to the water they use and dump as sewage); recycled water will be upgraded to tap-water quality and there will thus be no need to have separate networks for the reclaimed water; the desalinated sewage could be used for artificial recharging of the aquifers, saving in this way water that is evaporated when reclaimed sewage is stored in open-air reservoirs. The sewage desalination idea, which may increase significantly the cost of treatment that city dwellers will have to cover, has not been accepted thus far by the authorities but it may be considered seriously when actions to maintain sustainable salt regime in the aquifers become real.

Incorporation

Local governments are not necessarily efficient suppliers of services. A newly enacted law empowers the municipalities—individually or in town associations—to establish business entities, corporations that will function as public utilities supplying water and taking care of the sewage. But the law does not only empower, it permits the Minister of the Interior to establish such a utility for a hesitant municipality.

The envisioned institutional structure is made of four layers:

- The municipality will set-up the utility and transfer the city's water department to the new business enterprise.
- An Officer in Charge in the Ministry of the Interior will approve the utility or close it down if it fails to provide the expected services.
- A national Water Public Utility Authority will set standards and prices for the utilities and monitor their operation.
- The utility will receive from the municipality all assets and facilities of the water department together with its obligations, bank accounts, etc. It will be responsible for the provision of services in the water and sewage area.

The water utility may be owned by the municipality; alternatively, it may be an investor-owned utility or its ownership may be shared by the municipality and private interests. The law explicitly specifies that the major supplier of water to a community

cannot operate the local water utility. In simple language, Mekorot cannot operate as a local utility.

The law is recent, it was enacted in 2001, and the new structure is still in its teething stage. There will be learning by doing. A pioneering experiment in the incorporation direction is conducted in the capital city of Jerusalem.

Jerusalem is straddled on a mountain range, the largest part of the city is drained to the west toward the Mediterranean and a smaller area is drained to the east, to the Jordan and the Dead Sea. For decades, the city dumped its raw sewage into creeks on both sides. This was an exceptionally irresponsible behavior as the sewage was disposed above the mountain aquifer that supplies the best quality water in Israel. Several years ago the city, with the encouragement and financial support of the government, established a water and sewage utility and the utility constructed a treatment plant on the western outskirts of the capital. Instead of raw sewage, recycled water flows now down the creek. (The farmers downhill are complaining that the treatment has reduced nitrogen concentration in the water.)

All workers of Jerusalem's water department moved to the new utility when it was established while maintaining their previous pay and working conditions. Gradually, as workers retire, the utility reduces its work force and trims its operation. A reduction in water charges is envisioned. As of now the utility is wholly owned by the city, but privatization is planned. Jerusalem's experience is being watched closely by other municipalities that have to weigh the loss of freedom to run their water economies, sometimes profitably, against efficiency and quality of service.

Water Policy

Municipalities are responsible, in many places, for the water they supply to users in their jurisdictions. Not so in Israel. The country's Water Law made all water the property of the public, managed by the state. Mekorot's main lines reach every locality and, even municipalities that own and operate wells may purchase unlimited amounts of water from the national company. Consequently, the management of the natural resources and questions of sustainability have not been relevant at the municipal level in modern times. Similarly, municipalities readily dumped sewage in streambeds, particularly if it could then flow quickly away. Jerusalem was a blatant example.

As we have seen, the national government supports now the local water and sewage sector handsomely. Money cures many deficiencies. The urban water and sewage systems have been and are being upgraded, and it can safely be asserted that toward the end of the decade, by 2010, almost all communities in Israel will have modern water and sewage facilities and the recycled water will be utilized in agriculture according to health and water safety regulations. Needless to say, quality will still have to be guarded, criticism will continue to be heard, and not all professional debates will be settled.

The government, encouraging and supporting the modernization of local water and sewage systems, may be seen as a benevolent sovereign, concerned for the welfare of its citizens. However, the financial support of the water economy is but one aspect of the involvement of the central government in the affairs of local authorities. Such intensive interference suppresses local participatory democracy and reduces the willingness of the public to try and influence in democratic ways the society they are part of. It need not be, the urban water sector can be a lever raising local democracy. I shall consider two examples.

Recall the charge that municipalities are making profits on their water service. In principle, the financial surplus in the water sector, wherever it exists, can be viewed as a tax levied by the local authority on a service it provides (a subsidy where losses occur). As the law does not specify any such tax, its implicit imposition can be and should be criticized. But what should an efficient municipality do? Dump the surplus money down the drain? Moreover, water service is a convenient tax base; collection is easy and effectively costless. To my mind, municipalities should be allowed to levy a water tax (and perhaps also other similar taxes). If allowed, it will be imposed explicitly by a decision of the city council or a referendum, and where the public does not like it, they will vote the mayor and the council out, come next election. The possibility of imposing taxes and using the revenues for community projects will strengthen local democracy and improve its functioning.

The second example also relates to prices. As we have seen, wholesale water prices, at the city gate, reflect actual cost of water supplied from natural sources. In two or three years, the country will be entering the desalination epoch. The declared policy is that future wholesale prices will be equal to average actual cost and will not be much affected by the desalination of relatively small quantities of water. Average cost pricing, and small increases as desalination expands, will probably be accepted by the public.

Such prices seem just and do not affect much the small budgets households spend on water. Economically, however, they are not necessarily the right prices.

By the assessment of the water commissioner, founded on government's decision on allocation to agriculture, the supply from the natural resources does not cover anymore the water needs of Israel. If this shortage justifies desalination, the monetary value of the water (its scarcity cost) is equal at least to the cost of the new source of supply—approximately $0.60 per CM, more than 50% higher than the current price the cities pay. I would suggest that wholesale water prices are raised now to $0.60 per CM (that is, that we move to marginal cost pricing). User prices in the municipalities will also go up in accordance with this change. A sudden increase in prices will intensify awareness of water shortage and reduce consumption when supply is tight. In the long run, such marginal cost pricing will encourage the authorities to seek local solutions to water supply. Tel Aviv or Haifa may contract privately with desalination companies, reducing in this way their reliance on the national system and the monopoly that operates it.

Naturally, I do not expect my suggestion to be joyfully accepted by city dwellers. Somewhat to my surprise, the Treasury experts have also rejected the idea of marginal cost pricing. They want to see identical farm and urban wholesale prices and they realize that a price of $0.60 per CM for fresh water supplied to agriculture will reduce the quantity demanded, and therefore irrigated areas and farming activities, to a level far below the intention of the government. In my judgment, if the decision to maintain a certain level of irrigated farming is maintained, water supplied to agriculture will have to be subsidized and prices in town will anyhow be higher than for irrigation. They may as well be based on marginal cost.

Structural Reforms

Several government ministries and agencies are responsible for water issues, the Water Commissioner being only one of them. The recent water crisis has intensified the calls often heard in Israel for reorganization and that all responsibility be concentrated in one hand. The general issue is outside the scope of the chapter but multiple authority can also be seen in the government bodies dealing with urban water: The Water Administration in the Ministry of the Interior is responsible for restoration of water networks, a Sewerage Administration in the Ministry of Infrastructure deals with sewage lines and treatment plants, and a separate office under the Water Commissioner assists the farmers in the

utilization of recycled water. This situation may create inefficiencies; for example, when treatment plants are not coordinated with irrigation possibilities. Concentration of government functions in the urban water and sewage sector in one hand could streamline the administration and increase its efficacy.

The "incorporation" is aimed at creating business-like enterprises in the urban water sector. An effort of similar nature is going on with respect to Mekorot, the government has been trying for years to divide the company to several sub-units and to increase its capacity to operate independently in the capital market, away from the government's purse. To reduce Mekorot's monopolistic position, the government also decided that the company cannot build desalination plants and a "willing" clause has been added to the Water Law by which Mekorot (or any supplier) is required to move water through its network for "third parties," from another supplier to its customers. We have also noted that Mekorot is prevented from becoming a local water utility under the incorporation law.

Among the government agencies, the Treasury has been at the forefront of the incorporation, the attempts to restructure Mekorot, and to introduce business enterprises into the area of sewage treatment; but its efforts have not always been appreciated. The parliamentary commission (The Knesset, 2002), as one example, depicted the Treasury as arbitrarily halting the development new projects to the detriment of water supply. It can be expected that structural changes, experimentation, and public debates will continue for a long time to come.

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