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WATER POLICY IN ISRAEL

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"The beasts of the field cry also unto thee; for the streams of water are dried up…."
Joel 1: 20

I. Introduction

It seems to be fairly commonly understood in Israel that governmental water policy is harmful and produces waste and misallocation.[1] Existing water policy was the target of an extremely critical report by Israel's state comptroller, published in December, 1990. Among the conclusions of that report were: "Irresponsible management of the water supply for 25 years has caused the destruction of the water reserves of Israel and serious damage to water quality. Excess pumping from water reserves over many years has caused a hydrological deficit of the most severe proportions."[2] It has also been recognized, including overseas, that Israel's water policy also threatens severe ecological damages.[3] This past year's State Comptroller's Report (2000) spent considerable time criticizing the failure of the government to prevent pollution of the country's water resources with contaminants.[4] In May 2000 the Israeli Ministry of Health and the Water Commissioner released information on infiltration of types of contaminants that had not been previously documented in the coastal aquifer.[5] These included carcinogenic substances and poisonous materials unsafe for fetuses. In the year ending October 1999 eight wells in the coastal aquifer were closed by the Ministry of Health and others were declared hazardous. Before the press in Israel broke the news, the Ministry of Health and the Water Commissioner had issued orders to keep the findings regarding the contaminants secret. In typical Israeli fashion, the government bureaucracy seeks to prevent access to information of any sort, especially if it is embarrassing. [6]

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As we shall see, the main guidelines of Israeli water policy have consisted of underpricing, distorted and discriminatory pricing, and gross misallocation among water users. All of this particularly affects farm production and agricultural exports, as the limited water supplies could be used much better to generate farm value and export earnings. In a sense, a large portion of Israel's water resources are "exported," as embodied in farm exports. When water allocation is distorted, Israel ends up exporting its water for too few dollars.

The role of water policy and its damages have become of enhanced concern, given the role of water in the Israeli-Arab conflict and in all peace accords signed or that might be signed in the future. All such agreements are likely to *increase* the pressures and demands upon Israel's limited water resources. Israel is *already* obligated to share its water sources with Jordan and the Palestinian Authority, and would no doubt have similar obligations in any accord with Syria. Already, a new specter has been raised: ecological damages from overpumping and infiltration of contaminants into the mountain aquifer, from the territories of the Palestinian Authority.

The main immediate dangers to Israel's water supply are the contamination of the aquifers and the continued lowering of the surface level of the Sea of Galilee (Kinneret). In May 1988, the Sea's level was still at minus 209 meters (below sea level), whereas by the past winter (2000) the minimal level ("Red Line") of the Sea of Galilee was officially lowered to 213 meters. In fact it fell below that for much of the winter. These four meters represented an enormous fall in water reserves for the country.[7]

Economically, the damages from water policy remain largely unresolved and unaddressed. Despite major changes in economic policy in almost every other aspect of Israeli domestic policy, water policy continues to embody all of the muddled socialist thinking that has dominated it since Israel's inception, with grave damages to the economy, the farm sector, and the environment.

II. Institutional Background to the Current Crisis

The total natural water supply capacity in Israel is officially estimated (by the Israeli government) to be about 1800 million cubic meters per year. Obviously in drought years the supply is smaller. The supply in the current year (1999-2000) is estimated to be 1350 million cubic meters. About 400 million of these are from the coastal aquifer, 300 million each from the mountain aquifer and from the Sea of Galilee, 300 million from other sources, and the remainder is recycled water. The Sea of Galilee and the aquifers are also the main available forms of water storage in Israel; the Kinneret basin is estimated to be able to hold enough water to supply the country's current needs for 1.5 years, while the mountain aquifer has the capacity to store three year's worth. The coastal aquifer has a hypothetical storage capacity that is much larger, but for hydrological reasons only a small portion of this can be tapped without creating serious qualitative damage to the water therein. Other than these three main sources of water, there are smaller sources in Israel, including wells, runoff from Mount Carmel, and sewage water that may be used for commercial purposes.[8]

Recently there has been public debate over the option of developing new alternative sources of water, although it is not clear how commercially viable these are. In April 2000 the Israeli government announced its intentions to construct the first desalinization plant to operate in Israel, to be built near Ashkelon.[9] There has been ongoing discussion of importing water from Turkey or from other sources, although this appears to be uneconomical. There continues to be periodic discussion of building a canal from the Mediterranean to the Dead Sea, a plan originally envisaged by Herzl, which would then permit the complete diversion of the Jordan River for commercial uses and use of the canal flow to generate hydroelectricity. However, many believe this plan is also of dubious economic value and could cause severe environmental damage.

If measured by its role in GDP and in export earnings, water and water policy *seem* to be matters of minor importance. The role of agriculture in Israeli GDP has fallen continuously from 1950, when it was about 11 percent, to below 2 percent today.[10] Agriculture exports only produce about 4 percent of export earnings today.[11] This is in spite of the fact that irrigated farmland rose by a factor of nine and the total area under cultivation nearly tripled in the same period. This, however, is a misleading indication of the seriousness of the water problem and the magnitude of the damages posed by water policy.

Water is defined in Israel under the 1959 Water Law as a nationalized public good; all water is the property of the state, including waste, sewer and runoff water that can be used commercially.[12] An owner of land does not own the water under his land. The 1959 Water Law also created a permanent body known as the Water Commissioner to oversee and allocate water rights. The Water Commissioner is legally empowered to plan the water infrastructure, set water prices, license drilling of wells, set water quotas, make determinations regarding water quality and prevent ecological damages to the country's water resources. The Water Commission supervises the National Water Carrier and other water development projects. Originally appointed by the minister of agriculture, the commissioner and the commission are today under the joint ministerial supervision of the ministers of infrastructure and agriculture. After the commissioner retired early in 2000, the country was without a commissioner for several months. On June 2, 2000, the government approved the appointment of Shimon Tal, associate director for engineering at Mekorot, as the new water commissioner.

According to the 1959 Law, the Water Commission was supposed to be composed two-thirds of representatives from the "public" (out of 39 commissioners). These "public" representatives are supposed to represent water "consumers," primarily farmers.[13] In fact the "Agriculture Center," the main lobbyist for the farm sector, is guaranteed 13 representatives on the commission. A water planning commission consisting of 11 professionals and representatives of the "public" was also created to oversee new water projects.

The most important power of the Water Commission under the 1959 Water Law is no doubt its control over water quotas.[14] Supposedly on the basis of serious research, the commission decides the norm of how much water is "needed" for any crop produced by farmers. Water quotas are in fact more a reflection of "entrenchment," essentially perpetuating the existing water allocation pattern, with small amounts set aside for planned future settlements and activities.[15]

Actual supply and pumping of water in Israel is performed by Mekorot, Ltd., a public corporation that pumps and supplies about 66 percent of the nation's water, including that drawn from the Sea of Galilee. The rest (the remaining 34 percent) is from small independent suppliers. Mekorot is also the official governmental body empowered to undertake development and planning of water sources. Much of the distribution of the supply takes place through the "National Carrier" system of aqueducts and pipelines opened in 1964. Mekorot is one of the larger enterprises in the Israeli economy and employs over 2,300 employees, which is huge in relation to most other Israeli companies.[16]

The ownership structure of Mekorot was changed in 1995. Until then, the central Israeli government owned 70 percent of the equity shares of the company, the Jewish Agency held 13 percent and local authorities held 9.5 percent, with the remainder divided among others, mainly agricultural water consumers who received the shares as a "bonus" when they were allotted water rights.[17] Actual control of Mekorot was exercised through a smaller set of "ownership shares" giving two-thirds control to the central government and one-third to the Jewish Agency.[18] In September 1995 the central government bought out the entire position of the Jewish Agency in the corporation and now exercises complete control.

Mekorot is a poorly regulated governmental monopoly, which faces no competitive pressures at all and has no serious incentives to improve efficiency, cut costs or downsize its huge manpower. Mekorot's costs of production were about NIS 1.5 billion ($395 million) in 1998, of which energy and variable costs amounted to about 28 percent (Mekorot actually consumes 6 percent of Israel's total electricity production),[19] manpower, maintenance and other fixed expenses were 30 percent, and capital costs were the rest.[20]

Mekorot has traditionally priced water under a "cost-plus" formula, or what might more properly be termed a "cost-minus" formula. Water prices have been traditionally set so low that they do not cover the actual costs of operation of Mekorot. The company then builds up debts (in large part by borrowing from the government itself at subsidized interest rates) and is periodically bailed out by the government. The company is also deeply subsidized by the government as part of the annual budget, once again – because water prices do not even cover the costs of pumping and transport for Mekorot.[21]

At the moment the government has plans (the decision was actually made in October 1996) to restructure Mekorot by creating three subsidiaries or affiliates of the "mother" company.[22] These will be: a corporation operating the National Water Carrier; an asset holding company; and a company for development and "entrepreneurship." Ownership shares in these three plus the "mother" Mekorot company is to be transferred to a "Mekorot Holding Company." But this last parent holding company is to remain completely nationalized, and is not slated for privatization. It is therefore unclear why anyone believes this restructuring will have any real effect on the efficiency and operations of the water system. The officially declared motivation for the restructuring is to allow some segments of the water system to introduce competition, such as in water treatment and urban water supply.

The minister of agriculture was until recently the supreme statutory authority charged with formulation of water policy in Israel, subject to oversight by the Knesset Finance Committee. The minister traditionally appointed the Water Commissioner and the advisory Water Commission, and also the directors of other public sector agencies who play a role in water development, pricing and supply, such as TAHAL (an agency for developing new water resources).[23] The subordination of water policy to the Ministry of Agriculture has always been problematic, because of the natural tendency of the ministry to act as advocate on behalf of farm interests, who consume around three quarters of all water. Similarly, the Knesset Finance Committee's Subcommittee on Water Affairs is now chaired by MK Shalom Simchon, who is also the leader of the Knesset's "farm lobby," Knesset members representing farm sectors. Hence there is an automatic conflict of interest at the heart of water policy.[24]

III. The Damages to the Country from Water Policy

1. Overpumping and Overutilization

Water policy in Israel has for decades been disastrous. Total water consumption has been much larger than the natural water production capabilities of the country. The result has been a steady drop in the level of the Sea of Galilee, the country's main fresh water reserve. Its "Red Line," thought to constitute the minimal level consistent with preventing environmental damages to the lake, has been lowered to allow continual pumping, and this past winter saw the actual level fall below even this lowered minimum.

In addition to the Sea of Galilee, there are two large underground aquifers providing Israeli water: the Coastal and the Yarkon-Taneenim aquifers. For many years overpumping of water has threatened to create ecological damages to these as well. A past commissioner of water, Professor Dan Zaslovsky (of the Technion), claims that serious overpumping has been occurring since about 1965 and that 20 percent of the coastal aquifer is no longer fit for normal use (with water that is not drinking quality). For hydrological reasons, overpumping allows sea water to seep in and raise chloride levels, especially in the coastal aquifer;[25] it is estimated that for every meter by which the water table of the aquifer is lowered, the level at which salt water infiltrates rises by 32 meters.[26] Historically, much of the overproduction can be linked to the granting of control over water-pumping decisions to policy bodies that have been dominated by narrow special interests, namely, the Ministry of Agriculture. This might have been partially mitigated recently when some of the discretionary control over water was transferred away from the Ministry of Agriculture and to the Ministry of Infrastructure, which is less beholden to farm interests.

The very fact of overconsumption is equivalent to stating that water in Israel is grossly *underpriced.* The overconsumption stems from the permanent excess demand by farm interests for water at current prices.[27] Their demand is always above and beyond the natural production capacities of the country. Farm interests use their political clout to lobby for excess pumping, even in severe drought years, and the political leadership tends to meet their demands.

2. Misallocation of the Water that is Allocated

Overconsumption is only part of the Israeli water problem. Of the water that is allocated and consumed, the allotment is wasteful and distorted. Water allocation is to a large extent based upon the political influence of users and not on commercial considerations.[28] Water rights in Israel are allocated "administratively," meaning they are allotted in a non-economic manner; they are not auctioned. The government has always been resistant even to considering the possibility of "price rationing" as a tool for efficiency.[29] There are also arrangements for excess consumption above and beyond water allotments; these are *also* politicized, with influential farm interests able to consume above their allotment with little fear of punishment, fines or reprisals. But it should be emphasized that even with a penalty surcharge added to the price of this excess water consumption, the water prices are *still* far below social costs or the true resource value of water in Israel.

The administrative mechanism that governs the allocation of agricultural water is essentially a state secret. The government does not publish the user-by-user allotments of water it awards, nor does it even feel compelled to describe the rules of its decision making. It is satisfied to assert that water allocation is based on "fair" and "objective" criteria. One of the best possible uses of Israel's new law on freedom of access to information would be to demand the revelation of water allocation quotas.[30] For now, there is no way the public can learn why kibbutz A received a lot of water while moshav B received little. Similarly, there appears to be no explicit objective criterion used for allocating water among competing farm crop sectors, such as cotton, citrus, and others.

In any case, Israeli water policy has never even pretended that efficiency is its goal in allocating quotas. Its main concern has always been "fairness" among users or at least the appearance of fairness. One of the more bizarre consequences of "fairness" has been that water allotments have come to be regarded as entitlements for farmers. When they are cut back in years of drought, farmers are granted "compensation" for the water they do *not* purchase.[31]

For all intents and purposes, "fairness" seems to consist of maintaining the status quo, perpetuating agricultural allotments more or less in line with their historic levels on a user-by-user basis. A producer who received allotment X in the past will generally continue to receive at least the same allotment, again with no regard to alternative uses or commercial considerations.

These historic allotments, however, were no doubt based on the political clout of the different farm sectors, users and producing organizations in the past. Those farm interests with larger historic allotments seem happy with the system, whereas less powerful farmers lose out. This "dynamic inertia" in allocation causes its own problems. One reason for the overconsumption of water is the inability or reluctance of the authorities ever to scale back water allotments to farmers below historic levels.

An Israeli farmer is not even permitted to change his own use of his own water allotment, such as applying it to crop A instead of crop B or to field X instead of field Y, without prior approval by the water authorities. This of course perpetuates misuse of water, since farmers face impediments to transference of water rights from less productive to more productive uses.

Moreover, farmers who temporarily consume less than their full water allotment find their allotments cut in subsequent years.

All this creates an incentive system to waste water. Just like a government minister will seldom voluntarily spend less than his budget allotment for fear that next year this budget will be cut, so farmers have motivation always to use all water allotted, even if it means just dumping it down the drains. This way they preserve their option of using more water in the future. Finally, a farmer who sells his land cannot sell his water allotment together with the land, and must include a clause in the contract where the buyer attests to having been forewarned of this. Hence water and land productivity are further distorted.

3. Growing Pollution of Water Sources

This problem is largely a consequence not only of overpumping and overutilization, but also of a host of other policies encompassing everything from use of fertilizers to use of recycled water in Israel. The added salt in the country's water supplies causes other environmental damages; when used for irrigation it raises the salt levels of the soil. Underground water has also been polluted due to seepage of fertilizers and from the use in irrigation of recycled sewage water. Recycling of waste water retains all pollutants, which enter the soil instead of being washed out to sea. Even treated water generally retains many pollutants, "treatment" mainly eliminating organic substances.

The coastal aquifer has been seriously damaged due to seepage of sewage water and other pollutants. The mountain aquifer has also suffered some contamination. Chloride concentrations in the coastal aquifer have risen from 95 mg/liter in 1970 to about 190 today.[32] In many areas they are in fact above 250 mg. The official maximum standard is 600 mg., far higher than in many other countries, and many wells in the coastal aquifer have been closed because they surpass even that. The reason for this increase is seepage of sea water as well as the use of saline water from the Sea of Galilee basin and elsewhere for irrigation, which "recycles" the chloride.

Nitrate concentration levels are also a growing problem in the coastal aquifer. Their levels have increased sharply over the past two decades and are expected to rise further. They are raised by use of fertilizers in agriculture as well as treated effluents. The State Comptroller's Report of 2000 expressed harsh criticism of this continued contamination of water and warned of the dangers from ongoing ecological destruction of the country's water resources.[33]

4. Excessive Water Quality for Non-drinking Water

This is perhaps an ironic problem to note, given the concern over contamination of the water resources in the previous section. But water policy in Israel has traditionally sought to supply as much water as possible at drinking-tap levels of quality. This is even though only a fifth of water is consumed by households. This has resulted in what can only be regarded as excessively high total water quality. The government has resisted developing parallel high-quality and low-quality water networks, where the latter would be used for farming and industry. Such a proposal was recently made by Dan Zaslovsky.[34] The exception is the use by farming of recycled sewage water, but even

this is often purified to near drinking-quality levels. Of the water consumed by farming, 71 percent is drinking quality.[35]

IV. The Harmful Components of Israeli Water Policy

1. Water Pricing

The most obvious defect of Israeli water pricing is that the price of water is much too low. Hence there is permanent motivation for overconsumption, especially by farm interests. The officially pronounced policy of pricing water has always been that water prices are supposed to reflect pumping and transportation costs *only*.[36] It cannot be emphasized strongly enough that these are the *wrong* criteria for efficient water pricing from an economic point of view. Water should be based on social opportunity costs, that is, on the alternative value that other potential users could and would assign to the water. Pricing water on the basis of pumping costs makes no more sense than pricing oil on the basis of its pumping costs. In both cases the social value of the resource itself is being ignored.

Beginning in 1999, the so-called philosophical doctrine behind Israeli water pricing was amended somewhat. Instead of declaring that water prices should be based on pumping and transport costs alone, the Israeli government added that the prices should also include a component reflecting "the cost of the water at origin reflecting the conditions of regional or national shortages."[37]

The government may have in mind a charge that "compensates" the people of Israel for any environmental damages inflicted upon the aquifers from pumping, translated into some sort of charge above the costs of pumping and transport. This is *not* the same as pricing water on the basis of its true resource value, but it does seem to be a first step in the right direction of pricing water in an economic way. Be that as it may, the new surcharge is itself irrational and discriminatory, equal to NIS 0.146 for agricultural users, NIS 0.256 for industry, and NIS 0.596 for residential use.[38] (In addition, the new law created a mechanism for periodic adjustments in the rates.) So while adding a surcharge that is intended to raise somewhat the prices of water, this new reform, because it does nothing to eliminate water price differentials and, indeed, adds an additional layer of price discrimination with all the waste and misallocation that this implies, is a regression.

In a rational economic allocation mechanism, those who use the water should compensate society for the foregone economic value of the water. To charge too little for water is to create incentives for its waste and overuse. It also serves to discourage development of new more expensive sources of water, even when extracting that water costs far less than its resource value for the economy.

If the water were indeed sold to users for its full value, then all farmers for whom the water generates *less* value than that associated with this full price, would be automatically "priced out" of the market and excluded because of their inability to bid competitive rates. So the less efficient and less productive farmers would be driven out, leaving only the more productive. The auction pricing

would also eliminate the excess demand for water, which — as noted — is the root of the over-consumption problem.

Periodically water prices in Israel are raised temporarily, especially during serious droughts. When this occurred in late 1992, assertions were made by the farm lobby that "high" water prices had caused numerous farmers to abandon their fields and grow nothing. While the assertions were doubtless false and mere political posturing, if they were true the abandonment of these fields should have been welcomed by the policy makers as a great sign of success. It would have meant that the least efficient users of water were being nudged out of the market, and water use was being made more rational and efficient. Hence all such "field-abandonment" stories should have justified even more increases in water prices, and not the wholesale price cutting the lobbyists themselves were seeking.

All water prices in Israel are far below the level of social opportunity costs. It should be emphasized that the correct levels of these social costs can only be identified accurately through auction. Anything else is academic speculation. Any increase in water prices would lower demand. But at current prices there is enormous excess demand (beyond supply). This means that a price rise would contract this excess without having much effect on actual consumption, which is supply-determined. While the rise in price would not lower total water consumption, it *would* increase the efficiency of the use of existing water supplies. It would eliminate the least efficient and most wasteful uses, those which are not economical *even* at these still-too-low prices.

Water pricing and allocation in Israel is largely a process of rent allocation. If a unit of water is worth 100, and if user A pays 20 while user B pays 30, neither is paying the correct costs. In both cases, the user is being granted rent or patronage equal to the difference between the price he pays and 100. Obviously, users would prefer to pay less and earn higher rents. Because of gross underpricing, virtually all water users are allocated some rent in this way, although the rents vary widely across users. It should be emphasized that rent allocation is primarily income redistribution, and has relatively little impact on water distribution or water use efficiency as such.

Having said this, we may nevertheless describe the rent distribution process in general terms. The main beneficiaries are farm interests that pay the lowest prices and so extract the highest rents. Urban users obtain their water through the municipalities. The municipalities pay a price of about three times what farmers pay for water, and then resell the water to urban consumers, including households and industry, with markups of 100-200 percent. For the municipalities water allocation is an important revenue source due to these markups. So urban consumers end up paying many times what farmers pay for water. But even these high urban prices may be below social costs and the resource value of water. As for fairness and egalitarianism, the reader may draw his own conclusions.

Farmers are paying too little, both because they pay far less than urban users and because they pay less than the social resource costs of the 64 percent or so of the country's water they use.[39] To make matters worse, different farmers do not pay identical prices. There are almost no two farm users who pay the same price. Lobbying for lower water prices and water subsidies is another form of rent seeking and political lobbying.

2. Official Water Price Discrimination

We have been emphasizing that *no* water prices in Israel reflect the actual resource value of the water nor the social opportunity costs of water use, the criteria by which economic logic indicates that water should be priced. Water prices all across the board are *too low*. But beyond being too low, water allocation is further distorted by water policy because a perverse set of incentives is created through highly discriminatory differential pricing. This system creates pricing differences that vary across types of consumers and across individual users within groups/types of consumers. Obviously those paying the lowest prices have incentives to expand consumption and to use water even when the value added from its use is quite low.

As of 1999, the prices charged for water are based on the data in table 1.

Table 1

Water Prices (May, 1999)

Use of Water	Price Per Cubic Meter (NIS)
Agricultural use	
High-quality water	
Up to 50 percent of the user's 1989 allotment	0.691
The next 30 percent of the amount of the user's 1989 allotment	0.833
The rest of the amount currently allocated to the user	1.118
Average	**0.818**
Runoff or partly salinated water (average price)	0.606
Recycled waste water (average price)	0.488
Household use (average price by Mekorot)	1.374
Industrial use	1.330
Prices charged by municipalities*	
Hotel use	1.610
Gardening in public areas	2.540
Other urban uses	4.130
Residential use (average)	3.460

Source: Based on Finance Ministry, *Budget Proposal for 2000: Water Economy* (Jerusalem: Finance Ministry, 1989), p. 54. [Hebrew]

* Prices for August 1999.

As can be seen in the table, there are numerous prices for water, with the highest prices many times the lowest. Even when restricting discussion to clean water, the price differences are vast. The general pattern of prices has changed little over the decades since Israel was created. Agriculture benefits from the lowest prices and urban residential users pay the highest prices. The

special low rates charged hotels are as good a piece of evidence as any that political lobbying ultimately explains much of the unfairness behind the pattern of pricing.

Even within agriculture, there are clearly wide differences in the prices actually paid by users. Farm water supplies are not provided to users with a linear pricing function. This means that any user pays different prices for different units of water that he receives from the same source. Each unit has the same resource value and costs of provision, but different prices. This resembles somewhat the nonlinear pricing of electricity for households. The highest marginal water price for agriculture is 62 percent higher than the lowest price for clean water.[40] Because farmers, like everyone else, make decisions on the basis of marginal prices and marginal costs, the main factors constituting economic incentives, this system creates a hodgepodge of conflicting and confusing incentives.

While hypothetically every Israeli farmer faces a complex of all three pricing tiers, the size of the allotments at each tier (the quantities provided at each of the three prices) is also an archaic leftover from historic allotments, at the moment based on 1989. Suppose a kibbutz or moshav that was an inefficient farm producer in the past has converted considerable chunks of its farmland into industrial, urban or residential use. Since it is left with far less farmland, it is also far more likely than others to be facing the lowest tier of the three-tier pricing vector for its water. Meanwhile other producers who have expanded production, perhaps thanks to efficiency and competitive advantage, are penalized because they have no doubt surpassed their 1989 allotments of water and so are paying at the margin at the highest of the three tiers. So the water system once again punishes the efficient while rewarding the inefficient.

To illustrate the problem of water price discrimination, suppose that the cost of pumping and transporting a given quantity of water to farmers is $1 million. There are many different farmers who would like to use the water. For some, the water can be used to generate net export earnings of $5 million (after all other costs besides water have been deducted). For others it would generate export earnings of $2 million. In an open auction, the price that would be assigned to this water would then be $5 million and not $1 million. It is worth $5 million in terms of the economic value that it can generate. There are alternative uses for the water that generate $5 million. To forego those uses would be to forego the $5 million in economic value they create. If however the water is priced not by auction but by the bureaucracy in an administrative manner, nothing prevents the water being allotted to the less productive farmer. Perhaps that farmer has better political ties. If the less productive farmer is awarded the water, $3 million in export earnings is lost. Such lost economic value is to be found throughout the Israeli farm sector, and to a smaller extent in the industrial sector, thanks to water policy.

The situation in Israel is even worse, however, since the bureaucracy would be, in the above example, pricing water at less than $1 million. If, for instance, the bureaucracy has priced the water at $0.5 million, farmers are encouraged to use the water even if it only generates a slightly higher value. Not only are export earnings lost, but the taxpayer foots the bill for the underpriced water while the farmer profits.

3. Subsidization of Water Uses

A major budget item for the Ministry of Agriculture consists of these supports and subsidies. (This does not include debt bailouts for farmers or government investment grants.) The result is that farmers are paying much too little for water to begin with, and many are also getting subsidies to cover this underpriced water and cash compensation when their water allotment is reduced. Water subsidization has been one of the most expensive forms of subsidization in Israel in budget terms. With the expectation of cuts in subsidies for public transportation, water subsidies will be the main remaining budgetary subsidy in Israel.

Subsidization continues to be a major item in the water section of the central government's budget. The proposed budget for 2000 even has water subsidies growing in real terms. The fiscal 2000 budget allots NIS 298 million (approximately $73 million) for direct water subsidization, which is about 27 percent of the entire water system governmental budget.[41] Until fiscal 2000 the central government also subsidized water in the form of reimbursing to local authorities the VAT payments they paid for water consumption.[42]

One other form of indirect subsidy involves seasonal water use. It is more expensive to pump water in summer months, yet there is no surcharge for this water to force users to compensate for the cost. (There was a surcharge added to summer consumption during 1978-1988, but it was dropped, apparently due to political pressure from farmers.) A last form of indirect subsidy has been underpricing of the pumping and distribution services of Mekorot itself. As noted above, Mekorot has not charged enough to cover its own capital depreciation and has repeatedly approached the Finance Ministry for budget support and rescue.

4. Other Distortions

Until recently a major source of distortion in the water market was something known as the water equalization fund. This fund operated somewhat like the equalization fund (or energy entitlements program) for petroleum that operated in the United States in the 1970s and like a similar fund for petroleum that operates in Israel. The idea was to penalize those with access to cheap water sources (such as farmers with their own wells) and distribute the proceeds to those who use more expensive water sources. Predictably, the rationale was again fairness. The result, however, was to distort further water allocation. The equalization fund payments eliminated the incentive to seek out and exploit cheaper water sources, as the savings would have been expropriated by the fund. It subsidized the uses of the most expensive sources of water. The operation of the equalization fund over decades shows the obstinacy of Israeli policy makers in refusing to draw simple economic lessons or to learn from policy errors made overseas. The water equalization fund was finally eliminated in Israel in 1999 as part of the Arrangements Law (Hok Hahesderim), and in its place a set of differential tariffs for drawing water from the various sources of water (including wells) was introduced.

There has been a tendency in Israel to absorb much of the transport differences for water consumption in different parts of the country, especially for water pumped from the Sea of Galilee and transported through the National Water Carrier (Hamovil Ha'artzi). The idea is that it is considered unfair to ask farmers far from the source of water to pay their own way in terms of water transport costs. This creates a further distortion, leading to overuse at destinations far from the source. The traditional justification has been on grounds of subsidizing population dispersal to distant areas. Leaving aside a discussion of whether the government should be involved in population dispersal at all, water subsidization is an inferior method for achieving this result. Simply subsidizing directly the relocation of people and capital to peripheral areas of the country would accomplish the same goal without motivating overconsumption of water.

V. Why Commercialization of Water Rights is Needed

In recent years economists have been promoting new ideas for eliminating many of the damages from politicized, administrative, non-market systems of water allocation such as Israel's. These include allowing commercial auctioning and even trading of water rights on a sort of water exchange, somewhat resembling a stock exchange. This idea is already being implemented with notable success in California.

It should be emphasized that no Israeli water is auctioned and it is explicitly illegal to resell water rights in Israel under the current system. This is in sharp contrast with California and other dry areas, where the water markets may be distorted but where resale of water is explicitly permitted. The resale neutralizes much of the damage from water policy there.

In November 1991, the water commissioner appointed by Minister of Agriculture Rafael Eitan (who espoused vaguely market-oriented farm economics), Dan Zaslovsky, proposed taking 20 percent of farm water and allocating it through an open competitive auction. This proposal was greeted with great protests from the farm sector and was quickly dropped. This was the first time a serious proposal was raised to commercialize part of the allotment of farm water in Israel. Economically, the only thing wrong with the proposal was that it would have auctioned 20 percent of farm water rather than 100 percent. In any case, one of the first actions of the new Labor government that was set up following the 1992 elections was the sacking of this water commissioner and his replacement with one who was friendlier to farm interests.

Why is it harmful to allocate water administratively rather than through auction? The answer is that an auction identifies the potential users of water who can produce or extract the greatest economic value using it. Because the water produces the most for those farmers, they are capable of bidding the highest prices in the auction. Thus the winners in the auction are also the most productive producers. Under the politicized administrative allocation, the winners are the farmers with the most political influence.

The auctioning of water can also expand export performance of the farm sector. Indeed, the lack of such auctioning of water rights is itself a major impediment to efficient farm exporting.

Water Auctions

Economists have long argued that the best method for allocating water rights is through open, competitive auction. Farm users should submit bids for water use in the same way that bids are submitted for issuings of, say, government bonds. The allocation would go to the highest bidders. Total water quantities to be sold should be determined by an independent panel of engineers and economists with no ties to farm interests, based on hydrological and environmental considerations. The auction should be based on two forms of bids, again as in bond issuings. The municipalities, industries and small farmers would be permitted (but not required) to submit noncompetitive tenders, where they stipulate the amount of water they wish to buy, agreeing in advance to pay the average price that the auction will produce from the competitive bids. All other users would submit a competitive tender, stipulating a price.[43]

At the auction, first the quantities of water requested by the noncompetitive tenders would be reserved and set aside. The remaining amount would be sold to those who submitted competitive tenders, starting with the highest price bid and working down the list of tenders until the full amount of water has been allotted.

At that point, secondary market trading in water rights should be permitted. A water rights exchange (like a stock exchange) could operate, or water rights brokers could operate even without an exchange. Anyone would be permitted to buy or sell water rights in this secondary market. If the government wished to do so for political reasons, subsidies and supports for water use could continue, even when allocation took place through auction (although economic efficiency would require full elimination of the subsidies). Low income farmers and other water consumers could be supported and compensated in other ways, besides water subsidization.

The California Model

The best example of application of economic principles to water use has been in California's Central Valley. California resembles Israel in some ways. It is a semi-arid area in which rain falls primarily in the winter, with a near rainless summer. The Central Valley is one of the most fertile and productive agricultural producing areas in the world. Much of the water used for irrigation in the valley comes from the Big Thompson Project, which diverts much of the water from the Colorado River, in some ways reminiscent of Israel's National Water Carrier project.

Like Israel, water use rights have traditionally been distributed in California to farmers in a politicized and non-economic system by government bureaucrats.[44] Like Israel, federal water is sold to California farmers at highly subsidized prices, far below the true economic value of water resources.

Unlike Israeli farmers, California farmers have been permitted to trade their water rations in a sort of secondary market. A 1992 change in federal water law made transfer of water rights easier, and eased restrictions on water uses. The new law even permits farmers to make profits from such resale without regulation. California farmers are permitted to trade with other farmers,

and in recent years have been permitted to sell to urban water users as well.[45] (The history of the development of water rights in the western U.S., including California, is long and complex and differs from the development of such rights in Israel.)

Resale of Water Rights as Mitigation of Misallocation

Since March 1996, California water rights are traded in the world's first fully electronic bourse for water use rights. The bourse was launched by Wetlands Water District, which at first allowed farmers only to trade water rights with other Central Valley farmers. Some of the largest and wealthiest farmers and agribusinesses in the world operate in this district. The bourse replaced earlier primitive trading methods, often consisting of farmers meeting in cafes or over the telephone and buying or selling their water allotments. A bourse for water rights makes a trading market far more efficient.[46] Farmers and others have access to accurate price information and shop for the best water deals.

This approach breaks sharply with traditional water policy in Israel, where — as we have noted — it is explicitly illegal to sell water rights under the current system. Violators are subject to criminal prosecution. Periodically, the Ministry of Agriculture announces criminal investigations of illegal reselling of water and land rights.[47] These investigations may be carried out by the "Green Commando," the same quasi-police force used by the ministry to suppress other illegal agricultural activities, such as the producing of food by those who have not been granted a production quota. In California, however, and other dry areas where the water market is distorted by government policy, the resale of water is explicitly permitted with the effect of neutralizing much of the damage from water policy.

Perhaps the best argument *in favor of* this approach can be found in the main objection that has been raised in Israel by the agriculture lobby against it. The head of the main farm lobby said: "The problem with this situation is that the water allotments will then fall into the hands of those who can pay for them."[48] Exactly.

Sensible Water Policy is Environmentally Friendly

Interestingly, among the greatest enthusiasts for the idea of commercializing water use in California have been the state's environmentalists and "greens." Unlike Israeli environmentalists, who often still adhere to a reflexive anti-market political view, many environmentalists overseas have been moving to a political position in which there is great understanding and support for the ability of market incentives to protect natural resources and the environment, and control pollution. The Environmental Defense Fund, based in San Francisco, and World Resources Institute have been among the strongest supporters of the plan.[49]

American environmentalists had been critical of water policy in California's Central Valley for decades, arguing that it causes serious environmental damages. Because water was sold to farmers at prices far below its resource value, farmers simply dumped huge amounts of it on desert fields. Environmentalists believe that if water rights were commercialized and farmers

forced to pay prices equal to the true resource value of the water, the waste would end and water would be diverted to environmentally friendly projects, such as restoring salmon runs.

Commercialized water has also been useful in dealing with problems caused by drought. In 1991, many California farmers sold their water rights at a profit to the state's Emergency Water Bank, water that was later used to ameliorate serious droughts in California.[50] (Similar economic environmentalist alliances have been gaining ground in Florida, where expansion of farm acreage due to crop subsidization by the federal government, is threatening to destroy the delicate Everglades and other ecosystems.)

How Should the Water Bourse Work?

There should be no artificial impediments created by regulators to the formation of futures contracts for water rights and other water-based financial instruments which would be useful for hedging purposes. Commercializing water would expose water users to price fluctuations and risks. But these are not different from many other price risks faced in ordinary day-to-day operations by farmers. Markets have proven themselves skilled at creating risk-hedging instruments, some quite sophisticated.

An optimal policy would be to distribute and price governmental allotments of water through an auction to begin with.

VI. Privatization "at the Margin"

The Israeli government currently lists increasing competition as one of the goals of national water policy. The budget proposal for fiscal 2000 states as a goal: "Increasing business competition in the areas of the water system, especially in the reuse of waste water, granting the economic right to produce water, quality control and distribution of water, with the intention of reducing the costs of water supply."[51] Decision 136 of the government (1999) called for introducing elements of competition in water production, especially in water drilling. All drilling is supposed to be conducted henceforth through competitive tendering.[52] Despite a broad law that already requires the awarding of government contracts through competitive tendering, this had not previously been standard practice in the water sector.

In recent years, water utilities in many countries have undergone some form of partial or total privatization. The forms vary from private management of publicly owned utilities to actual privatization of ownership. Indeed, there are several large, private-sector, multinational corporations that operate water suppliers in different countries. The theoretical case for privatizing water utilities has been made by a number of writers, including the U.S. president's Council of Economic Advisers.[53]

Private-sector water-supply corporations have had an interesting history, especially in the United Kingdom.[54] In California alone, there are 433 privately operated but publicly owned water facilities. Atlanta recently privatized its water system. There have also been privatizations of water utilities in developing countries.[55] There have been a number of experiments with

privatizing water-related services, such as delivery and sewer services, including in the United Kingdom and the Ivory Coast. Private-sector firms are involved in the water system in many other countries, including France, Chile, Indonesia and Mexico. France's Suez Lyonnaise estimates that 360 million people around the world have their water supplied to them by the private sector, including the Atlanta system mentioned above and a very large ($3 billion) operation in Buenos Aires.[56] There have been suggestions of privatizing water in Israel.[57] Interestingly, Abu Dhabi seems far more seriously interested in implementing privatization of water and electricity than Israel.[58] At least two recent writers have suggested privatization and trade in water rights as a solution for regional water problems in the Middle East.[59]

Privatizing the main sources of water in Israel is not a realistic idea, for the simple reason that it is not feasible to establish property rights in a competitive setting for the water in the Sea of Galilee and the underground aquifers. If two or more corporations would have access to any of these sources, each would have motivation to overpump and underconserve. The over-consumption urge would be transferred to them, replacing farmers as the main driving force. This is a problem that has become familiar in other related settings, such as utilization of underground oil fields by two or more pumpers in Texas and elsewhere. Essentially the problem is that such arrangements grant pumping or utilization powers to private corporations without assigning property rights in the resource itself, which is in effect shared.

In addition, parts of the Israeli water supply system suffer from natural monopoly characteristics. Specifically the network of pipelines and aqueducts does. This is similar to what is found in some systems of wire networks for electricity and for telephones (at least before the age of cellular phones). Natural monopolies are defined as industries in which marginal costs always decline, where it is always cheaper to add an additional customer at the margin, and so where marginal costs are always below average costs. In such a system the largest supplier always has the lowest costs and so the greatest comparative advantage. The lowest cost provider is one who supplies the entire market, and so is a monopolist. Where networks of wires or pipelines must carry a service or product, it makes no sense to have duplicate competing networks, such as multiple networks of electric wires or multiple water pipelines to the same homes.

Having noted this, it is also important to emphasize that the economic thinking about natural monopolies has changed dramatically in the past two decades or so. Natural monopolies might justify the operation of *parts* of a system as regulated monopolies. But even when such technical conditions exist, there are generally other parts of the system that can be privatized or operated as competitive subsectors.

Perhaps the best example of this is the electricity utilities sector. Clearly network economies exist due to the necessity of operating through a wire grid. The natural monopoly argument, however, applies *only* to the grid itself and not to other segments of electricity supply and provision. In particular, it should never be regarded as justification for expanding the scope of the monopoly to vertically integrated additional components of the industry.

In recent years there have been intriguing developments in the privatization of electricity supply and the introduction of elements of competition, in many places.[60] Competing private-sector providers of electricity can supply it into the grid under conditions of price competition. Competition can be introduced in other ways as well, such as outsourcing and conducting of competitive tendering by public utilities.

One important potential for introducing competition and market efficiencies, even where natural monopolies operate in parts of the system, is through what might be described as competition at the margin. Here private producers supply the service or product into the grid alongside an existing large public utility or similar provider. Examples might be small electricity plants or water suppliers who provide their output to consumers through the network of wires or pipelines, sometimes as small supplemental sources alongside the main power plant or water utility. This sort of competition has been introduced in California, New York and other parts of the United States for electricity. Similar programs exist in other countries. Competition at the margin creates considerable price competition even when the main public utility or provider retains a large total market share.

Interestingly, in the late 1980s there was serious discussion of introducing privatization and competition at the margin in providing electricity into the national grid in Israel. The Czamanski Committee set up under then Minister of Energy Moshe Shahal made specific policy recommendations along these lines.[61] In the end no real competition was implemented in Israel, but it was the first serious attempt to raise the possibility of such competition at the margin in public utilities.

There are a number of areas in which this sort of competition at the margin could be introduced into water provision in Israel. These are:

1. Privatizing provision of water from all sources *other than* the Sea of Galilee and the two main aquifers. Private-sector corporations would be allowed to collect water, sell it, and pump it through the existing national pipelines and aqueducts. The sources of the water could be wells, creeks/wadis, runoff, and other secondary sources of water, as well as any rainwater collected.

2. Private provision of any water from desalinization. There has been a great deal of recent discussion of initiating desalinization projects in Israel.[62] In rather typical manner, the Israeli government has been debating the idea of operating *state-owned and state-managed* desalinization plants. Yet there is no reason whatsoever why these should be state owned. Indeed, one kibbutz (Maagen Michael) submitted its own proposal to set up a privately owned desalinization plant. Small experimental or low output mini-plants for desalinization already operate in Israel, mainly in the southern Arava desert. No better example exists of Israel's instinctive preference for socialist solutions than the case of desalinization. Indeed, the Israeli private sector is *already* involved in desalinization projects outside of Israel. In September 1999, IDE Technologies, a subsidiary of Israel Chemicals, and Oceana Advanced Industries, won a $120 million contract to build a plant in Cyprus.[63]

It is not clear whether or under what circumstances such desalinization in Israel would actually be profitable. Only opening the market to private-sector competition can tell. There are in fact several different types of desalinization. The most expensive is desalinization of sea water. The desalinization alternative most likely to be profitable or requiring the least subsidization is that involving waste water or mildly salinated water sources. Much of the policy problem is that the complete distortion of water prices in Israel makes it impossible to subject desalinization to a meaningful market test.

But even if there should be a decision to pursue desalinization that is not commercially viable at extant prices, for example out of strategic or political considerations, *even then* desalinization should be via the private sector. (It can be made "viable" by means of government subsidization as a second-best solution. A first-best solution would be to allow it to operate with no support under a regime of rational water prices. The latter alternative would be the only appropriate way to evaluate the commercial viability of desalinization.) Desalinized water could be fed into the national water distribution system, creating competition at the margin in much the same way that small electricity producers can do so in the electric grid.

3. Much of the same arguments from the previous point can be applied to other alternative sources of water provision. These would include such exotic proposals as construction of a water pipeline from Turkey, importing water via barges or tankers, and so on. Similarly, the proposals for digging a canal from the Mediterranean Sea (or even the Red Sea) to the Dead Sea could be included here. In all of these cases, there is no reason why the project should be undertaken by the public sector. (Nevertheless, all the proposals under consideration until now in Israel have been for state projects.) In all these cases the best way to evaluate their commercial viability is to eliminate the distortions in Israeli domestic water prices and to allow the private sector to make up its own mind as to whether the project is profitable. A second-best solution would be to offer a fixed and equal rate of subsidization (on grounds such as geostrategic considerations) to all private-sector entities wishing to pursue these activities at current water prices.

Introducing competition at the margin can resolve another aspect of the problem. The debate over water alternatives in Israel has been largely political. In other words, there is debate as to which broad policy alternative for resolving the water supply problems should be pursued *by the government*: conservation, desalinization, importing, and so forth. The entire public debate on water, as on most things, assumes any solution must be made by administrative, bureaucratic, politicized decision making. But the only efficient economic answer to the questions raised in this debate is to allow market forces to decide. With competition at the margin such market rulings in favor of one method or technology over others would be reached in a rational economical manner.

VII. Some Comments on the Strategic-Diplomatic Aspects of Water Policy

Water has always played a role in the Israeli-Arab conflict that goes far beyond its economic value.[64] Water has been regarded with emotional, nationalist and near-mystical

attitudes having nothing to do with its economic resource value. More than one Middle East battle has been fought over water. It continues to occupy a central place in the rhetoric of the conflict, and indeed the recent near-agreement between Israel and Syria over the Golan broke down in early 2000 in part over the water issue.

At the same time, the Middle East conflict and any steps toward its resolution are likely to worsen the water problems of Israel and the region. It is hardly possible that the Palestinians will seek to consume *less* water in the future than they now consume. Israel is obligated under the Oslo accords to provide water to the Palestinian areas. It is also obligated under its treaty with Jordan to share water with that country, and any accord with Syria is likely to exert pressures on the water resources of the Jordan Valley and Kinneret basin.

Any progress at all on the diplomatic front is likely to compound the excess demand for water and exert added pressures for overpumping with all this implies. This will make the overconsumption problem more severe and could accelerate the destruction of the aquifers. In addition, internal allotment policy by the Palestinians could magnify the misallocation problems, just like those created by policy in Israel. To date, the Palestinian leadership has exhibited no inclination or enthusiasm for market mechanisms and solutions. How likely is it that it will adopt water auction processes?

Interestingly, the commercialization proposals above for resolving the economic problems of water policy may also be a useful way to resolve the international aspects of water conflict in the Middle East. Commercialization could defuse the problem by converting water from an emotional-mystical problem to one of resource and rent allocation.

Much of the water conflict among Israel, the Palestinians, and other Arabs could be resolved if a joint water authority were to auction off regional water resources to the highest bidders, *regardless* of their nationality. Israelis, Palestinians, Jordanians and anyone else would be allowed to participate in the bidding. The revenues from these bids would then be allotted among the governments according to some agreed-upon distribution formula.[65] Conflict could then focus on this rent allotment formula, not on water itself. This would demystify the problem and detach it from charged nationalist emotions currently focused on water.

All this would amount to expanding the notion of commercializing water use to cross-border auctioning. It would guarantee efficiency of water use in the entire region. At the moment the political and economic-ideological heatedness of all players seems to rule out any such resolution.

Conclusions

Let us review: Israeli water policy is and has been for many years a nearly unmitigated disaster, producing waste, misallocation of water, and environmental destruction. In addition, water policy has had a direct and harmful impact on agricultural productivity and export performance. Israel's limited water resources could be exploited to produce greater economic value in agriculture and greater foreign exchange earnings for farm exports. This is prevented by the existing system of wasteful, politicized, administrative allocation of water.

The main problem with Israeli water policy is that it is a politicized system instead of a market system. Administrative and bureaucratic considerations dictate water allocation, not economic considerations. Water distribution is a mechanism for patronage and rent allotment, not a system of rational resource allocation. Political considerations, including the quest for fairness, override all consideration of efficiency in water allotment. The result is not merely enormous waste and misallocation but accelerating ecological disaster. And all of this will no doubt get worse due to the added demands on water resources resulting from the various Israeli-Arab accords.

The solution to these problems must come through the introducing of market incentives and price mechanisms into the water system of Israel. We have referred to this as the commercialization of water, where pricing systems select the most productive and efficient potential users of water and "price out" the less efficient. The best way to do this would be to auction off water rights in an open competitive manner. This should be accompanied by what we have termed privatization at the margin, or allowing the private sector to supply and allocate water in addition to Mekorot.

Overconsumption of water, which by now is a well recognized consequence of Israeli water policy, can only be eliminated by divorcing water consumption decisions from public agencies that are dominated by farm interests. There is no easy way to do this and the special properties of the Sea of Galilee and the underground aquifers make privatization non-feasible. The best alternative is through the professionalization of the administrative bodies making decisions regarding the total pumping capacity of these bodies of water. These decisions should be made by water engineers, environmental engineers and economists on the basis of hydrological and ecological considerations. Once the total pumping capacity is set, all prices for the water pumped should be set through a market mechanism, preferably an auction.

It is true that Israel is not the only place on earth where water has been politicized and water allocation is wasteful and antiproductive. In the United States, especially in the far West, water policy has long been inefficient and encourages overconsumption and underconservation. But the damages there have been reduced through the resale of water rights, something prohibited until now in Israel. The other important difference is that America is both a wealthy country and a water-abundant country. Hence, politically motivated waste and misallocation of water may be a luxury America and other countries can afford, but one Israel surely cannot.

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NOTES

[1] For a fuller discussion of the history of Israeli water policy and literature review, see Zvi Grinwald, *Israeli Water Policy Alternatives — Administrative and Operative Aspects of Water Allocation Policy* (Haifa: Samuel Neaman Institute for Advanced Studies in Science and Technology, Technion, 1980). [Hebrew]

[2] State Comptroller, *Report on the Administration of Israel's Water Economy* (Jerusalem: State Comptroller, 1990), p. 53. [Hebrew]

[3] *New York Times*, April 21, 1991. In Israel, a more recent example of criticism of water policy is "Whose Water is it Anyway?" by Nehemia Strassler, *Ha'aretz,* March 10, 2000. See also Dan Zaslovsky, "Water in Israel – Description of the Situation and Conclusions," *Mayim Vehashkaya* 393 (1999), pp. 13-22 [Hebrew] and Zaslovsky, "Water System Problems and Solutions," *Mayim Vehashkaya* 396 (1999), pp. 20-26. [Hebrew]

[4] State Comptroller, *State Comptroller's Report* 50B (Jerusalem: State Comptroller, 2000), pp. 296-310. [Hebrew]

[5] *Yediot Aharonot*, May 11, 2000; *Ha'aretz,* May 12, 2000.

[6] See *Ha'aretz*, May 12, 2000.

[7] State Comptroller, *Report on the Water Economy*, Figure 1; *Ha'aretz*, June 30, 2000, p. B-4.

[8] Finance Ministry, *Budget Proposal for 2000: Water Economy* (Jerusalem: Finance Ministry, 1989), p. 44. [Hebrew]

[9] *Yediot Aharonot*, April 18, 2000.

[10] Central Bureau of Statistics*, Statistical Abstract for Israel* 49 (Jerusalem: Central Bureau of Statistics, 1998), tables 6.1, 6.6, 13.16.

[11] Bank of Israel, *1998 Report* (Jerusalem: Bank of Israel, 1999), p. 304. [Hebrew]

[12] For elaboration of the legal aspects of water, see Richard Lester, "Legal Aspects of Water Quality Management in Israel," in Hillel Shuval, ed., *Water Quality Management under Conditions of Scarcity: Israel as a Case Study* (New York: Academic Press, 1980).

[13] Gila Menahem*, Water Policy in Israel: Policy Paradigms, Policy Networks and Public Policy,* Discussion Paper 1-99 (Tel Aviv: Pinhas Sapir Center for Development, Tel Aviv University, 1999).

[14] See, for instance, Yaacov Vardi, "National Water Resources Planning and Development in Israel – The Endangered Resource," in Shuval, *Water Quality Management*.

[15] There are quite a few articles elaborating how water policy works and what its damages are, including Menahem, *Water Policy in Israel*; Vardi, "National Water Resources"; Saul Arlosoroff, "Efficient Use of Water: Policy and Problems," in *Water in Israel* (Tel Aviv: Water Commission, 1973); Meir Ben-Meir, "Israel's Water Economy and the Predicaments of Agriculture, Panel Discussion," *The Economic Quarterly* 150 (1991), pp. 536-561 [Hebrew]; Eitan Hochman and Oded Hochman, "A Policy on Efficient Water Pricing in Israel," *The Economic Quarterly* 150, pp. 502-523 [Hebrew]; Ran Mossenson, "The Water Crisis in Israel: Public Regulation and Financing and Government and Public Accounting," *The Economic Quarterly* 150, pp. 479-487 [Hebrew]; R. Nativ and A. Issar, "Problems of an Overdeveloped Water System: The Israeli Case," *Water Quality Bulletin* 13, no. 4 (1988), pp. 126-132; Yuval Shilony, "Green Fields and Red Lines: The Acute Water Problem in Israel," *The Economic Quarterly* 150, pp. 488-501 [Hebrew]; Doron Weissbrod and Jaffa Yehudai, "Israel's Water Economy," *The Economic Quarterly* 150 (1991), pp. 524-535. [Hebrew]

[16] Dun & Bradstreet (Israel), *Dun's 100 Israel's Largest Enterprises 1999* (Tel Aviv: Dun & Bradstreet, 1999), pp. 114, 223.

[17] See Finance Ministry, *Budget Proposal: Water Economy*, p. 38.

[18] Israel has had a history of "two-tier" issuing of shares designed to retain corporate control in the hands of minorities of shareholders.

[19] See Dun & Bradstreet, *Dun's 100 Israel*, p. 223. Because energy costs are a significant part of the costs of pumping water, and because electricity prices vary by the time of day, there has been discussion in the government of charging different prices for water by Mekorot at different times of day. Note that other aspects of Israeli economic policy, such as preservation of the monopoly of the Israel Electric Corporation, indirectly influence water costs, prices and allocation.

[20] Finance Ministry, *Budget Proposal: Water Economy*, p. 38.

[21] The government seems clearly aware of this disparity; the budget proposal for fiscal 2000 notes that farm water prices do not cover the average costs of operation of Mekorot. According to the 2000 budget, water subsidies transferred to Mekorot amount to NIS 298 million (approximately $73 million). See Finance Ministry, *Proposed State Budget for 2000* (Jerusalem: Finance Ministry, 1999), pp. 127, 134-135, 162. [Hebrew]

[22] Finance Ministry, *Proposed State Budget for 1997* (Jerusalem: Finance Ministry, 1996), p. 162 [Hebrew]; *Budget Proposal: Water Economy*, p. 39.

[23] TAHAL today earns about a third of its revenues in projects outside of Israel.

[24] See, for example, *Ma'ariv*, October 6, 1992.

[25] There seems to be disagreement among hydrological experts as to how much damage the lowering of the level of the Sea of Galilee does to water quality there.

[26] David Amiran, *Rainfall and Water Management in Semi-arid Climates: Israel as an Example* (Jerusalem: The Jerusalem Institute for Israel Studies, 1995) [Hebrew], is a good review of the hydrological problems. Amiran emphasizes that the problem is less drought than the occurrence of a series of low-rainfall years.

[27] Susan H. Lees, *The Political Ecology of the Water Crisis in Israel* (Lanham, MD: University Press of America, 1998) finds that 80 percent of farmers say their quota is "insufficient."

[28] The importance of political clout in water allotment has been noted by others, including Miri Yunger, Naomi Carmon and Uri Shamir, *Who Benefits from Israel's Water Resources? An Effectiveness Study by Kibbutzim and Moshavim* (Haifa: Center for Urban and Regional Studies, Technion, 1993). [Hebrew]

[29] Mossenson, "The Water Crisis in Israel."

[30] While not well known, there are also water quotas established for industry in Israel by the Water Commissioner. Government Decision Number 4161 in 1998 proposed doing away with these altogether and moving to "price rationing" of water in industry, but has not yet been implemented. Water quotas for urban residential units were abolished in 1995. See Finance Ministry, *Budget Proposal: Water Economy*, p. 33.

[31] See, for example, *Ha'aretz,* March 17, 2000 and April 14, 2000.

[32] Menahem, *Water Policy in Israel,* which cites the Israel Hydrological Service.

[33] State Comptroller, *Report* 50B, pp. 296-310.

[34] *Ha'aretz*, May 14, 2000.

[35] Finance Ministry, *Budget Proposal: Water Economy*, p. 46.

[36] For a history of the developments in water "ideology" in Israel, see Menahem, *Water Policy in Israel*.

[37] See Finance Ministry, *Budget Proposal: Water Economy*, p. 24, for description of how this new "goal" entered water policy. The change was incorporated into the 1999 Arrangements Law (Hok Hahesderim). In addition, Government Decision Number 267, Sept. 5, 1999, called for surcharges on users of all sources of water that would equal those in effect for users of water from the coastal aquifer. See Finance Ministry, *Proposed Budget for 2000*, p. 135.

[38] Finance Ministry, *Proposed Budget for 2000*, p. 163.

[39] Finance Ministry, *Budget Proposal: Water Economy*, p. 47.

[40] See table 1. The lowest price for clean water, is NIS .691/cm. The highest price is NIS 1.118/cm, a difference of 62 percent.

[41] Finance Ministry, *Proposed Budget for 2000*, p. 162.

[42] Finance Ministry, *Budget Proposal: Water Economy*, p. 53.

[43] Government securities are auctioned in this way in many countries, including Israel.

[44] For a review and analysis, see Ronald H. Schmidt and Frederick Cannon, "Using Water Better: A Market-Based Approach to California's Water Crisis" (Federal Reserve Bank of San Francisco, 1991, mimeographed).

[45] For further discussion, see Ronald H. Schmidt and Steven E. Plaut, "Water Policy in California and Israel," *Economic Review* (San Francisco: Federal Reserve Bank of San Francisco, 1993), pp. 42-55.

[46] The advantages of allowing water trading in Israel were the subject of Ezra Sadan and Ruth Ben-Zvi, "The Value of Institutional Change in Israel's Water Economy," *Water Resources Research* 23, no. 1 (1987), pp. 1-8, which discusses the advantages to Israel of having trading in water rights.

[47] *Yediot Aharonot*, August 26, 1991.

[48] *Ha'aretz*, April 30, 2000, Water and Environment Supplement.

[49] *Wall Street Journal*, February 15, 1995.

[50] Interesting information on its operations can be found on the internet at www.waterbank.com.

[51] Finance Ministry, *Proposed Budget for 2000*, p. 162.

[52] Ibid., p. 164.

[53] See Council of Economic Advisers, "Promoting Competition in Traditionally Regulated Industries," in *Economic Report of the President* (Washington, D.C.: United States Government Printing Office, February, 1996); Robert W. Poole, Jr., ed., *Unnatural Monopolies: The Case for Deregulating Public Utilities* (Lexington, Mass.: Lexington Books, 1985); Reason Foundation, *Restructuring America's Water Industry*, Policy Study no. 200 (Los Angeles: Reason Foundation, 1996); and Nicholas Spulber and Asghar Sabbaghi, *Economics of Water Resources: From Regulation to Privatization*, Natural Resource Management and Policy series (Boston: Kluwer Academic, 1998). The California Chamber of Commerce has published a "How To" manual to help local authorities implement privatization of water utilities.

[54] Henry Buller, "Privatization and Europeanization: The Changing Context of Water Supply in Britain and France," *Journal of Environmental Planning and Management* 39(4), pp. 461-482 (December, 1996); Simon Cowan, "Competition in the Water Industry," *Oxford Review of Economic Policy* 13, no. 1 (spring, 1997), pp. 83-92; John Dickens, "Privatisation and Water," in Maurice Mullard, ed., *Policy-making in Britain: An Introduction* (London and New York: Routledge, 1995), pp. 160-180; Lester C. Hunt and Edward L. Lynk, "Privatisation and Efficiency in the UK Water Industry: An Empirical Analysis," *Oxford Bulletin of Economics and Statistics* 57, no. 3 (August, 1995), pp. 371-388; and Shuval, *Water Quality Management* (New York: Academic Press, 1980).

[55] Penelope B. Cowen and Tyler Cowen, "Deregulated Private Water Supply: A Policy Option for Developing Countries," *Cato Journal* 18, no. 1 (spring-summer, 1988), pp. 21-41. For a more general discussion of privatization experience in developing and developed countries, see UNCTAD, *Comparative Experiences with Privatization: Policy Insights and Lessons* (New York: UNCTAD, 1995).

[56] *Economist*, March 25, 2000; *Forbes* 162, no. 12, November 30, 1998, p. 323.

[57] D. Dery and Ilan Salomon, *After Me — the Deluge: Uncertainty and Water Policy in Israel* (Jerusalem: Jerusalem Institute for Israel Studies, 1995).

[58] *Middle East Economic Digest* 41, no. 34, August 22, 1997.

[59] Nir Beker, "Commerce in Water Crosses Borders," *Mayim Vehashkaya* 394 (1999), pp. 14-21 [Hebrew]; Ayal Brill, "Aspects of Regional Water Privatization," *The Economic Quarterly* 44, no. 2 (1997), pp. 241-262. [Hebrew]

[60] Kenneth Costello and Robert Graniere, *The Deregulation Experience: Lessons for the Electric Power Industry* (National Regulatory Research Institute, August, 1996); Michael T. Maloney, Robert E. McCormick, and Robert D. Sauer, *Customer Choice, Customer Value: An Analysis of Retail Competition in America's Electric Industry* (Washington, D.C.: Citizens for a Sound Economy Foundation, 1996); John C. Moorhouse, "Competitive Markets for Electricity Generation," *Cato Journal* 14, no. 3, 1995; Adam D. Thierer, *Energizing America: A Blueprint for Deregulating the Electricity Market*, Backgrounder no. 1100 (Washington, D.C.: Heritage Foundation, 1997); and Adam D. Thierer, *Electricity Deregulation: Separating Fact from Fiction in the Debate over Stranded Cost Recovery*, Talking Points no. 20 (Washington, D.C.: Heritage Foundation, 1997) provide excellent reviews of the issues.

[61] Czamanski himself describes the fate of the committee and its recommendations in the recently published Daniel Czamanski, *Privatization and Restructuring of Electricity Provision* (New York: Praeger, 1999).

[62] For information on desalinization around the world, see the International Desalinization Association, web site http://www.ida.bm.

[63] *Jerusalem Post,* September 14, 1999.

[64] For background, see Mostafa Dolatyar and Tim S. Gray, *Water Politics in the Middle East* (New York: St. Martin's, 2000); Alwyn Rouyer, *Turning Water into Politics: The Water Issue in the Palestinian-Israeli Conflict*, (New York: St. Martin's, 2000); Martin Sherman*, An Israeli Perspective on the Hydro-Political Aspects of the Conflict* (New York: St. Martin's, 1999).

[65] Auctioning has also been proposed as an optimal solution to another Middle East water distribution problem, namely, how to distribute shared water rights among two or more national users. See Howard Cohen and Steven Plaut, "Quenching the Levant's Thirst," *Middle East Quarterly* (March, 1995); Jad Isaac and Hillel Shuval, eds., *Water and Peace in the Middle East* (Amsterdam: Elsevier, 1994); Miriam Lowi*, Water and Power: The Politics of a Scarce Resource in the Jordan River Basin* (Cambridge: Cambridge University Press, 1993); Thomas Naff and Ruth Matson, eds., *Water in the Middle East: Conflict or Cooperation?* (Boulder: Westview Press, 1984); Aaron T. Wolf, *Hydrolics Along the Jordan River: Scarce Water and its Impact on the Arab-Israeli Conflict* (Tokyo: United Nations University Press, 1995); Aaron Wolf and John Ross, "The Impact of Scarce Water Resources on the Arab-Israeli Conflict," *Natural Resources Journal* 32, no. 4 (1992), pp. 919-958, and Amiram Sofer, *Rivers of Fire* (Tel Aviv: Am Oved, 1992). [Hebrew]