

MANAGEMENT OF WATER RESOURCES IN ISRAEL

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Despite the fact that its technological expertise in the realm of water use is among the most advanced in the world, Israel is in the throes of an ongoing water crisis, which is becoming progressively more serious, bringing the country to the verge of catastrophe. The damage to the country's three main reservoirs, as a result of excess pumping, salination and contamination, has not been adequately addressed at the systemic level, and no master plan exists to guide the activities carried out by the many bodies entrusted with authority for water management in Israel.

A review of present policies and subsequent reform are urgently needed, and the water problem must be accorded utmost priority on the national agenda, in light of the guidelines suggested by Agenda 21, in order to achieve a balanced and sustainable water management policy. This chapter surveys the various problem areas and proposes strategies for addressing them.

Introduction

Water quality and quantity are two of the most urgent environmental problems facing Israel over recent years. Located in a semi-arid region, Israel suffers from ongoing damage as a result of over-exploitation and contamination of its meager water sources. Because of the anticipated effects of climate change, the country is likely to face a continual decrease of

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precipitation during the coming decades, followed by a dwindling water supply from its wells.

According to some indicators, such as life-expectancy and per-capita income, Israel is considered a developed country. According to other indicators, however, such as growth-rate of the population, population density, and its semi-arid climate, Israel is more properly classified as a developing country. From the 1950s until the present, nearly all of the natural water sources (90%) have been consolidated and managed by the Water Commissioner. All Israeli residents living in officially recognized communities receive a constant supply of tap-water. Seventy percent of sewage water is collected and treated at some level or other.

In comparison to countries with abundant water sources, the average per-capita water consumption rate in Israel is not high, amounting to about 324 liters daily. In the West Bank this level of consumption drops sharply to about 50-80 liters daily. (For comparison's sake—California residents consume around 2000 liters daily).

In 1959, the Israeli legislature passed a comprehensive Water Law which, at the time, was one of the most progressive in the world, equipping the state with a system of laws and regulations governing water quality and treatment. According to the Water Law, Israel's water sources are considered public property, to be managed by the Water Commissioner. The Water Law grants the Water Commissioner far-reaching authority:

1. to determine water use and its allocation to various sectors;
2. to control pollution and manage water quality;
3. to determine the amounts of water to be pumped and to limit pumping when necessary.

However, despite the establishment of the Kinneret (Lake of Galilee) Authority, by the Drainage Basins Law 1957, and the River Restoration Administration, by the Rivers and Springs Law 1993, the condition of rivers in Israel has not improved, but has actually deteriorated. Despite the water regulations, which were amended in 2001, ongoing surveys reveal a broad variety of pollutants as well as increased salination of water resources.

The current water crisis is the product of a long history of management failures, lack of leadership and negligence, for which ultimately a succession of Israeli prime ministers and ministers should be seen as responsible. Instead of choosing a path of long term sustainable development, everyone

involved in water management in Israel has opted to over-exploit Israel's limited water resources, to spoil and ultimately exhaust them.

The current system of water management in Israel, as presented in the Governmental Report, is not sustainable, based as it is on maximum exploitation, exceeding the replenishing capacity of the resources. The Water Commission has drawn "red lines" for every single reservoir, below which water must not be exploited. Yet narrow sector-based and political interests have eroded all of these lines. In fact, the actual water levels have fallen well below the red lines, with the full knowledge and consent of the government. Israel's water crisis, therefore, can be characterized as the result of non-enforcement of regulations, misguided strategy, lack of long term planning, and a mismatch between levels of consumption and available water resources.

A wide chasm divides the law, theory and official policy of water management in Israel from its actual practice. Thus, for example, over-pumping and over-exploitation have been the rule since the 1970s, the levels of salinity and of pollution have been constantly on the rise, there is no watershed management strategy, resulting in the pollution and drying out of wetlands. Preferential allocations to the agricultural sector and the myopic approach of the economy's leaders have caused an irreversible dwindling of water resources, with little view to the future. The government, headed by the Ministry of Finance, has refused over the years to invest sufficient resources in pollution prevention, in purification of polluted water, or desalination of brackish water.

Today Israel faces an impasse. For the past year and a half the Water Commissioner has warned that the consumption of fresh water in Israel is not commensurate with the available resources. The former Minister of the Environment even declared that 40% of the water in Israel was unfit for consumption because of salinization and pollution. The following is a quote from the former Minister for the Environment, Ms Dalia Yitzik, as recorded in the ministry's own publication:

The current water crisis in Israel should not come as a surprise to anyone. The writing has been on the wall for years. Yet, shortsighted interests have allowed economic considerations to transcend environmental considerations. Instead of investing in desalination facilities and upgrading wastewater treatment plants, we paid little heed to our precious water sources. We watched unconcerned as water quantities in our aquifers dropped. We remained indifferent to the growing contamination of our water sources. Despite countless warnings about the impending water crisis by hydrologists and environmentalists, our decision-makers preferred non-action to action.

The difference between the rate of recharge to the rate of water consumption in Israel ranges from 350 MCM per year (a conservative estimate) to 600 MCM (according to other estimates), amounting to 30–50% of the water consumed in 2000. When compared with an average year, (based on the average of the past 30 years), the amount of water missing from the reservoirs in 2001 was 518 MCM. That year was characterized by a drop of the water in all reservoirs to the lowest points in documented history.

In February 2000, the government set up a National Information Headquarters for Water Conservation with the goal of reducing domestic consumption by 10%. The center spent an extravagant 2.5 million USD in advertising, but the gains were minimal, amounting to no more than 1.5% conservation in the household sector, in contrast with the 10% target. These poor results suggest that the public feels angry and alienated from the leadership in respect to the water crisis. In July 2001, the Knesset, Israel's parliament, decided to establish a parliamentary commission of inquiry, which was authorized to investigate the causes behind the water crisis, to find out who was to be held responsible for the situation and to propose remedies. At the time this chapter is being completed (May 2002), the committee's results have not yet been published.

The public has made clear demands, through actions of environmental groups and reports in the print and electronic media, that the government reduce the allocation of water to agriculture and expedite plans to begin projects for desalination of sea water and for reuse of treated effluent. The demands also call for a stringent enforcement campaign against polluters of water sources. The Water Commissioner, too, has requested approval for a proposal that the fresh water supply for agriculture and for public and private parks and gardens be drastically reduced, but lobbyists from the gardening and agricultural sectors succeeded in preventing the significant measures that the Commissioner wished to implement.

The international commitments that Israel took on to provide water to neighboring Jordan, subsequent to its peace treaty with that country, were made without fully considering the implications for Israel's water system, or the long term consequences of this commitment. The Water Commissioner reports that Israel is currently in fulfillment of its commitment to Jordan, as well as toward the Palestinian Authority, under the Oslo and Wye agreements. Nonetheless, these commitments will grow harder to meet if the region is not blessed with a succession of rainy years during the near future.

Water pollution

The drinking water that Israel provides to its residents is taken from the Kinneret (the Lake of Galilee, or the Jordan River watershed) and from various aquifers. The Water Commissioner's official publications state that Israel's yearly water production potential (on average since 1930) is 600 MCM from the Kinneret, 360 MCM from the mountain aquifer, 260 MCM from the coastal aquifer, 225 MCM from additional aquifers (Carmel, Eastern Galilee, Yarmuk, Western Galilee), and 245 MCM from other sources, as well as MCM from the West Bank, totaling 1810 MCM, of which 95.6 % are exploited (Water Engineering and Irrigation, Volume 12, 2001).

The quality of the groundwater in Israel is spoiled primarily as a result of anthropogenic factors, in addition to natural ones. All the water sources in Israel show increased salinization over the past decade. Intensive human activity is the most important cause of both point and non-point source pollution. Pollutants from untreated runoff, and nitrates from fertilizers used in agriculture, percolate into the water table; crops are irrigated with minimally treated sewage; gasoline leaks, and untreated industrial wastewater are other sources of pollution infiltration. Some 10% of the drinking water wells in the coastal aquifer have been shut down because of excess pollutants. In particular, chloride concentrations have been measured well above the recommended 250 mg per liter. In addition, there has been a steady rise in nitrate concentrations. For example, 60% of the coastal wells contain high levels of nitrates that are considered health hazards at present concentrations by most European countries. Environmental groups have long claimed that 70% of the water from the wells of the coastal aquifer is unfit for drinking.

Neglect of the pollution problem is a result of misguided strategy: instead of desalinating and purifying the polluted water, it is mixed and diluted with cleaner fresh water. For example, the saline/brackish water from the Lake of Galilee is mixed with the fresher water from the central mountain aquifer. The over-pumping practiced in all of the country's reservoirs causes a steep drop in the water quality as a result of infiltration/intrusion of brine. This results in high concentrations of the pollution in the reservoir when the quantity of the water is reduced. In effect, the problem is treated in an inverted fashion: instead of treating the pollution problem, wells for drinking water have been shut down over the past 15 years, because of the presence of various pollutants.

In Israel, many industrial zones and agricultural lands are situated near residential areas. Consequently, water for irrigation, sewage systems, and drinking water lie in close proximity to each other, and the local authorities are at a loss to protect the drinking water. Cases of water mixtures occur, despite the existence of regulations which require installing devices to prevent backflow and the preservation of a protective radius around water wells. During a recent incident, in the middle of July 2001, ammonia was discovered in the drinking water in the Tel-Aviv metropolitan area (Israel's most densely populated area), having entered the supply system for about 2 million residents. For a full 24 hours the Ministry of Health issued a warning that the water was unfit for drinking, and the contaminated water was discharged into the sea. Instead of planning for similar incidents in the future, the authorities and the media set out on the war-path to find out who was responsible for the incident.

On a more positive note, Ministry of Health data indicate that there has been a constant improvement in the levels of microbial contamination in water supplied to residents by the local authorities, during the years 1996-1999, with the number of outbursts of gastrointestinal infections decreasing during the years 1976-1999, and no outbursts at all registered in 1998 and 1999. This improvement is a result of reasonable compliance with the requirement to disinfect all provided water. However, the requirement to filter the water from the Lake of Galilee (Israel's only source of surface water) was not carried out until recently. Prior to that, installation of a central filter was delayed, from 1992, due to the Ministry of Finance's unwillingness to allocate the necessary resources.

Industrial plants, waste sites, and gasoline stations are a major cause of soil and water contamination. No centralized source of information exists about sources of contamination from industrial effluents and waste runoff. Enforcement against polluters and illegal waste disposal is insufficient. Between the years 1996-1999 for example, only 30 complaints were filed against industrial polluters. This is negligible compared to the number of actual transgressions. While the number of cases initiated has increased considerably during the past two years, the level of enforcement and severity of penalties is still woefully inadequate.

Law enforcement authorities in Israel, including the Environment Ministry, do not do enough to find the guilty parties, or to prosecute them, forestalling any application of the "polluter pays" principle. This past year, for example, an article published the discovery of carcinogenic materials and principle heavy metals in fish caught near the outlet of the Greater Tel Aviv sewage

facilities. Seventy-five industrial plants were listed as suspects but the relevant authorities ultimately chose not to file any charges. In 1997, during the opening ceremony of a national sporting event, four athletes died when a bridge collapsed and they were exposed to the contaminated Yarkon River waters. Yet no legal action was taken against polluters.

A study conducted by the Ministry of the Environment to examine fuel containers in gasoline stations found that 40% of the containers were leaky, causing contamination of groundwater. Only a few of the polluting gasoline stations were indicted. The regulations requiring sealing of gasoline containers, as outlined in the governmental report, apply only to the new fuel stations.

On the other hand, several positive steps have been taken toward preventing pollution from industrial and waste sites. For example, the Ministry of the Environment has enacted regulations requiring industry to discharge salt brine residues into the sea, rather than into the sewage system. During the past year, the Environment Ministry has acted vigorously to shut down illegal waste sites, which were a major source of groundwater contamination. These sites still must be removed and the soil underneath them restored, to prevent further pollution.

Information about water quality and social costs

In Israel, citizens are unable to receive information about the quality of the water supplied to their homes, despite recently enacted regulations. Notwithstanding recent amendments, Israel's water standards still lag behind European standards (in particular as regards nitrates and other inorganic minerals). The maximum concentration of nitrates that the WHO allows in drinking water is 45 mg per liter, while the Israeli standard was 90 mg, with 60 mg set as a target for 2006. The recommended concentration of chlorine is 250 mg per liter, while reports in Israel mention 600 mg of chlorine per liter as permissible in drinking water. The Health Ministry has failed to upgrade standards to levels acceptable in other developed countries.

No central source of information exists in Israel, which can supply reliable information about water quality to residents. The sampling data, which is collected by the Ministry of Health according to law, are not published except in internal Ministry reports that receive no other public exposure. This vital information does not even appear on the websites of the relevant government ministries. In contrast, the National Headquarters for Water

Conservation has made use of several public media, including the Internet, to educate the public about water conservation in the private sector.

The public does not have reliable data about the quality of the water it receives from the local authorities. This has led a large segment of the population, among those with the financial means to do so, to effectively vote no confidence in publicly supplied water by increasing consumption of bottled mineral water. The price of bottled water may be as much as 1000 times greater than tap water. Similarly, a large market has developed for household water purification systems, despite the fact that their utility is questionable.

Sewage

In 2000, recycled sewage effluents provided 25% (265MCM) of the needs of the agricultural sector, but ever since the 1990s, little advances have been made in this area. No comprehensive national survey about the composition of sewage has been conducted during recent years. Given the assumption that more sewage is produced, and because the percentage of reused water has not increased, it is reasonable to conclude that more untreated sewage ends up in the environment. Data from 1994 indicates that 32% of the sewage undergoes advanced treatment, 8% undergoes secondary treatment, and most undergoes partial treatment, while 17% of raw sewage is discharged into rivers or into the sea. It is worth mentioning the disparity that exists between the investment in sewage infrastructure in Jewish towns and Arab villages and cities. Sewage treatment in the Arab sector lags behind that of the Jewish sector and needs special affirmative action.

It is also clear that the pretreatment by many Israeli industries is extremely poor, leaving chemicals in the municipal waste system which cannot be broken down in the conventional sewage treatment. This leads to the systematic distribution of industrial solvents, metals and other contaminants by Israeli farmers as they irrigate, and such chemicals have been found in trace quantities throughout Israel's rural aquifers.

No good definition exists for effluents, which are vaguely defined based on generic European standards, with a minimal concentration of 20-30 BOD/suspended solids. Some claim that this standard was politically determined. Tests indicate an increase of minerals in groundwater, and also infiltration of carcinogenic chemicals. Irrigation with low-grade treated sewage damages the soil over time, impairing the sustainability of the environment. Indeed,

many experts argue that Israel's historical enthusiasm for wastewater recycling in agriculture has had disastrous consequences for ground water salinity. Without advanced wastewater treatment to drinking water levels, they believe irrigation with effluents should be discontinued. In actuality, in respect to uses of treated sewage no overarching policy exists that takes all the needs and problems into consideration.

Rivers and water as a resource for natural ecosystems

Israel has 12 main rivers and streams that flow into the Mediterranean, and 15 that flow into the Jordan river and the Lake of Galilee. In the past, most of the rivers were perennial, with the water-flow producing rich natural habitats. Today, virtually all of Israel's rivers and wetlands (97%) have dried out, and are polluted by a layer of toxic sludge originating in industrial effluents, agriculture effluents, municipal sewage, and highway runoff. The streams are filled with heavy metals, chemical compounds, and carcinogenic and toxic materials. Alongside the lack of enforcement against polluters, and the ongoing pollution, these surface water sources are pumped into the national water carrier system, leaving the rivers with little or no flow of fresh water. In addition, the recent drought years and excess pumping have reduced the natural output of the springs. For example, the Betzet Stream in the Western Galilee stopped flowing when its sources dried out in 2001 because of over-pumping carried out at a higher elevation point in the river basin. The Ministry of the Environment's attempt to promote a river reclamation program has been stymied as a result of a chronic lack of fresh water or purified water supply for the riverbed. Allocations to nature take a back seat to other anthropogenic needs. Given the lack of fresh water, a strategic decision was taken in the 1990s to reclaim rivers by supplying them with secondarily treated effluents. Yet during the current crisis, even this is often not carried out.

As mentioned, the condition of Israel's rivers has become so bad that when people fell into a shallow river and swallowed the contaminated water, a number of them died and dozens became ill. Many cases of cancer were recently diagnosed among veterans of the Israeli Navy seals commando unit who had conducted practice dives in the Kishon River, which drains into Haifa Bay. The Kishon area, home to many of Israel's largest petrochemical industries, is considered to be the most polluted of Israeli streams and rivers. The government established a commission of inquiry headed by former Supreme Court Chief Justice, Meir Shamgar, to investigate the sources of the Kishon pollution and the circumstances behind these incid-

ents of disease. As a result of an interim report, the Navy suspended its maneuvers in this stream, but this step was too late for the hundreds of veterans who may soon manifest the results of their protracted exposure to an extremely virulent toxic cocktail.

Misguided Strategy and Poor Leadership

For years Israel's official water policy was governed by the assumption that water was not a scarce resource. The role of the newly-established state was to "make the desert bloom", through the development of sophisticated modern agriculture. Fueled by this ideological zeal, the government was convinced that it must encourage agriculture and supply agricultural settlements with unlimited amounts of water at subsidized prices.

Since the 1970s, the water resources of the country have been in a state of "overdraft." Water reservoirs "go into the red," while administrators cling to the hope that next year's rains will replenish them. Because demand for water is constantly on the rise, supply keeps on decreasing. Experts warn that over-pumping can be practiced only under the condition that water quality is not jeopardized, and that irreversible processes are not set in motion. Regarding the current crisis, it is fair to say that the warning has long been on the wall, and that the warning calls were sounded at every level by scientists, public interest groups and even a few intrepid politicians. Yet, these warnings were not heeded, and policy was never revised to reflect the changing hydrological reality.

The Treasury's economists have operated on the assumption that water was not a scarce resource, and that all that needed to be done was to raise water prices, in order to adapt demand to supply. Their efforts, however, met with little success due to the political power of the agricultural lobby and a national commitment to farming. Yet, while demand management stalled, for more than two decades the Ministry of Finance blocked efforts to promote desalination projects. Only recently, in the midst of the present crisis, did it succumb to increasing pressure from experts and from the public and approved a series of desalination plants that will eventually provide about 500 MCM per year.

The Finance Ministry has also been responsible for the delay of a massive investment in additional water infrastructure. It only recently, in July 2000, approved measures such as disbursement of grants for development of sewage recovery systems, well rehabilitation, desalination of brackish water,

connecting private water producers to the network, as well as promotion of conservation measures in the municipal sector. In one of the great paradoxes of Israeli water policy, water fees to residents have served as a source of income for municipalities and local authorities, which mark up the price after paying Mekorot (the national water utility), and then reap windfall profits. This policy encouraged wastage of water, and was reformed only in 2001. Even if all the above measures are implemented in full as planned, it is hardly clear they will succeed in compensating for the huge cumulative deficit of the past decade.

Historically, efforts to raise the real price of water for agriculture were repeatedly blocked by a strong agriculture lobby. Even in 2001, at the height of the water crisis, the Prime Minister intervened in the professional decisions of the Water Commissioner and prevented cutting water allocations for agriculture, while he simultaneously approved lowering the red lines in all the reservoirs and the continuation of over-pumping. These actions were in direct contradiction to all the professional recommendations of the Water Commissioner, as well as those of experts from the scientific community. At the same time, with municipal water demand more inelastic, the increase in prices for the household sector did not yield the intended decrease in consumption.

Institutional Concerns

The post of Water Commissioner has long become politicized, filled time and again with appointees who serve the interests of the agricultural sector. Several Water Commissioners made decisions contrary to professional recommendations, and when non-political independent Commissioners were appointed, politicians obstructed their decisions, refused their requests and acted against their policies. Indeed, the tenure of such “professional” commissioners has been short, as politicians expedited their hasty dismissal.

The decentralization of authority in the sphere of water management in Israel is one of the underlying causes of the present crisis, and reflects Israel’s “inverted” strategy. Each of the following ministries plays a part in the maintenance of Israel’s water system: Finance, Health, Environment, Agriculture, Interior (responsible for the municipal authorities), and the Ministry of National Infrastructures. The diffusion of authority undermines cooperation, comprehensive planning, coordinated and efficient operation, and an approach that takes the complexity of the system into account. The

Ministry of Building and Housing, for example, reached the advanced stages of building a new city, Modi'in, without including the necessary sewage treatment plant, allowing sewage to be released into an inappropriate facility. Without the action of environmental NGOs who petitioned the Supreme Court, the city would still be without its own modern sewage treatment facility. Another example of the lack of comprehensive planning is the building of major highways (e.g. the Trans-Israel Highway), without any proper protection measures to capture and treat runoff, even when it clearly would reach water sources that supply drinking water to roughly 2 million inhabitants.

Activities of Environmental Organizations

Life and Environment, (the umbrella organization of environmental NGOs in Israel), has long been active in issuing warnings about the impending crisis, and in the attempt to bring information about the state of Israel's water economy to the awareness of the public and the relevant authorities. It has also acted to educate the public about conservation methods, and promotes the involvement of public representatives and members of parliament in addressing the water crisis. The environmental NGOs organized several conferences in 2001 to which the public was invited to learn about conservation methods, prevention of pollution from industry and agriculture, conservation technologies in the municipal sector, allocation of water for river reclamation, and more. Thousands of people attended these conferences, the first of their kind in Israel, including representatives of various authorities, decision-makers, and the public at large.

In addition, the Israeli environmental movement has committed itself to work for better enforcement of existing legislation regarding water and prevention of pollution. Several court actions have been filed by Adam Teva V'din, the Israel Union for Environmental Defense: to promote the installation of municipal sewage treatment facilities in cities like Safed, Ramla, Lod, Modi'in and Ra'anana; to confront the policy of closing down polluted wells; and to oblige the authorities to install a filter for the water originating in the Kinneret. The organization's suit against major polluters along the Kishon River led to a court-authorized agreement for construction of multi-million dollar industrial treatment processes, full compensation for losses to fishermen who joined the suit and the creation of an area environmental research fund. The Society for the Protection of Nature in Israel recently petitioned the Supreme Court to prevent a further lowering of the red line in the Kinneret reservoir. Life and Environment, in cooperation

with the Forum for Public Transportation in Israel, and many other organizations, petitioned the Supreme Court in an attempt to prevent construction of the Trans-Israel Highway, along Israel's water drilling lines, on the outskirts of the densely populated Tel-Aviv Metropolitan area (Gush Dan). A local grassroots organization in Modi'in petitioned the court, requiring that the authorities draft a comprehensive water and sewage purification plan for the city.

Other local organizations carry out activities that encourage the public's involvement in various areas, such as the exploitation of gray water, rehabilitation of a well in an Arab village (LINK for the Environment) or in a new desert settlement (SABABA) as well as rehabilitation of polluted rivers (Israel Forum for Ecological Art).

Environmental NGOs are active in the Israeli parliament, working to promote legislation that will protect water sources and prevent pollution. The center for policy at the Arava Institute for Environmental Studies has also set up a working committee to reform Israel's Water Law. Several proposals drafted by its researchers are currently on the Parliament's docket—including bills that would expand self-reporting by industry, make water quality violations subject to administrative fines, require greater water allocation for natural ecosystems, expand public representation on the National Water Council and prohibit over-pumping by the Water Commissioner.

Conclusions and Key Recommendations:

This chapter recommends that reform of Israel's water management policy be placed at the top of its national priorities, in accordance with the philosophy governing Agenda 21. As the Middle East peace process ultimately gets "back on track," Israel will have to confront the water needs of its Palestinians neighbors, needs that it recognized as legitimate in the Second Oslo Accord. Water management is therefore a vital issue impacting the future of the country and the entire region. Without proper management, Israel's residents could be placed in serious danger even in the near future.

Ten steps are required towards an integrated national policy:

Step 1: Preparation of an environmentally sound Master Plan for Israel's Water and Wastewater

According to Agenda 21, a master plan should be completed as soon as possible, which will address water supply and demand and protect regional watersheds from both a comprehensive and a particular viewpoint. Implementation of the plan must be overseen by fully authorized, environmentally committed government authorities.

Step 2: Creation of a politically independent National Water Authority, centralization of authority and pooling of resources

Balancing the water economy and implementing policy require a strong central authority and management of budgets under an independent body, which will not be subordinate to any given governmental ministry, or subject to partisan political pressure. The Authority needs to act without conflict of interests, with the sole priority of ensuring a balanced and sustainable water management strategy for all the citizens of Israel.

Step 3: Ending pollution and reclamation of water sources and ground

All existing measures must be enforced and implemented to identify and curtail all current sources of pollution, and to plan and carry out the rehabilitation of polluted soil and wells.

Step 4: Guaranteeing water quality in Israel, according to internationally accepted standards

Israeli water standards must be upgraded to those of the WHO. Existing regulations regarding the quality of drinking water supplied to citizens must be implemented and enforced. A permanent monitoring and testing system must be established, allowing for online access to drinking water data and recently approved regulations regarding publication of water quality must be implemented consistently and unambiguously.

Step 5: Internalization of external environmental costs in water pricing

The price of water in Israel does not reflect the external costs of environmental damage, or of damage to water sources, as a result of excess-pumping, salinization, and pollution. These external costs must be "internalized" into the price of water, so that it reflects real costs. In addition, price mechanisms must be used to regulate demand.

Step 6: Efficiency and Conservation

The government must lead the way in adopting more efficient water-saving practices within its own institutions. It should subsidize water saving and environmentally-friendly technologies, and enhance enforcement of various water-saving regulations, as well as invest in educating citizens and various sectors of the economy towards greater awareness. Israel has tremendous knowledge and experience in developing efficient water systems. Prudent exploitation of these systems and efficient management in local authorities can make a great contribution to improving efficiency.

Step 7: Agriculture—preventing soil degradation and establishing standards for effluent irrigation

The water crisis is just one of several crises that Israel's agricultural sector has had to confront. In the past, agriculture was subsidized through lower water prices. As a result of the water crisis, agriculture has been forced to relinquish about half of its water allocations. In 2001 the agricultural sector consumed 43% of all potable water (400 MCM), and received another 1/3 from treated effluents. Half of the 4 million dunams of land cultivated in Israel is irrigated with water conserving technology (drip irrigation or sprinklers). Agriculture has a critical role in the conservation of open spaces which, among other ecological services, provide percolating surfaces for groundwater, and emergency reservoirs. Tougher regulations for irrigation from treated effluents must be promulgated based on broader environmental criteria than the public health approach that has dominated at present. This is critical to the prevention of additional salinization of lands, and pollution of groundwater. Similarly, regulations need to be drafted to prevent pollution from general agricultural activity.

Step 8: Augmenting water supply and prevention of water losses

Additional methods for increasing supply must be developed and implemented, provided they meet the proper environmental criteria. Given the growing population in the region, desalination is an important part of a future water strategy. A systemic solution for increasing water supply will depend on proper allocation, including reuse of highly treated effluents for agriculture, and for river reclamation, desalination systems and possibly importation. A special emphasis must be made to develop efficient and environmental friendly means for preventing water losses. Israel's Law of Planning and Building must be amended so that it includes guidelines for collection of rainwater in public lawns and gardens within urban plans.

Step 9: Guaranteeing water supply for natural ecosystems

It is important that the government endorse a fundamental change in the prioritization of water resources and make a real commitment to the rehabilitation of rivers. Wetlands and streams with flowing water must be treated as endangered natural resources.

Step 10: Improved sewage treatment

Completion of infrastructure for collecting of sewage water in all communities in Israel, especially in Israel's Arab sector and conveying them to upgraded treatment facilities is a threshold environmental requirement that is long overdue. Planning of a nationwide system for the exploitation of treated sewage, while setting standards that will prevent salinization of soil and pollution of groundwater should be a central part of the country's future water supply strategy.

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