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Domestic and Regional Water Crisis

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Report Highlights:

Israel is currently facing one of its worst water crises ever. Mid-Eastern countries suffer also from a shortage, and the scarcity of water is used as a political issue. Israel's three main water sources – the Sea of Galilee and the mountain and coastal aquifers – are almost empty. Israel is renowned for its water recycling expertise, and a large part of the water used by agriculture is recycled wastewater. Israel has two large water desalination plants, and a third is expected to come online in 2009. Several more plants are planned, and by 2020, Israel should be able to desalinate 750 MCM annually, which is the amount currently used by the Israeli public. Recently the Israeli Water Authority has launched an advertising campaign urging Israelis to conserve water, and it already has cut potable and non-potable water supplies for agriculture.

General Information:

Section 1: The Water Sector in Israel

Shortage of water is perhaps the most crucial environmental and development problem in Israel. Recently Israel Water

Authority announced that Israel is currently facing the worst water supply crisis in 80 years, ever since they started keeping records.

Israel's water sources are limited by the country's geography, geology and climate. Israel is a small and narrow country; half of its area is desert. Precipitation, only in the winter, averages about 700-750 mm per year in the north and less than 35 mm in the southern tip of the country. Variations occur from year to year, with periods of drought or near drought interspersed with periods of heavy rainfall. Global climate change may magnify the pressure on Israel's water system by increasing temperatures and evaporation rates and changing the precipitation regime.

The Contributors to Israel's Water Crisis:

- **Increased water consumption** - population growth, rise in standards of living and demand for water.
- **Decreased water supply** - following four consecutive drought years, with the most recent drought (2007/8 and probably 2008/9) especially severe.
- **Decrease of about 20 percent of the space available for rainwater -** as a result of urbanization, there has been a significant decrease of the space available for rainwater penetration, mainly on the coastal plain.
- **Closure of drinking water wells** - past pollution events, which contributed to pollutant infiltration to groundwater for dozens of years, led to the closure of drinking water wells and to the inability of pumping some 80 cubic metes of water per year.
- **Global changes in climate** - a reduction in the available water volume in Sea of Galilee and the Jordan Valley at an average of some 110 MCM per year (about 6.5% of Israel's water consumption). This decrease is directly related to the decrease in precipitation. According to different studies, temperatures in Israel are expected to rise by 3.5-5 degrees Celsius in 2071 - 2100 in comparison to 1961-1990. Precipitation quantities in the winter are expected to decrease at a range of 15-75 mm, equal to a 10%-30% reduction. In addition, the number of extreme weather events is expected to increase in comparison to the present climate.
- **Delays in the introduction of desalination -** a decision to desalinate on a larger scale was taken in 2000, and it was projected that by 2008 Israel will desalinate about 365 MCM annually. However, at present, there are only 2 plants with a combined output of 138 MCM per year.

1.1: Local Consumption of Water

Israel consumes about 1.8-2.0 billion cubic meters of water each year. In 2007, Israel's total water use (agriculture, industry, and domestic [1]) increased 4 percent compared to 1995.

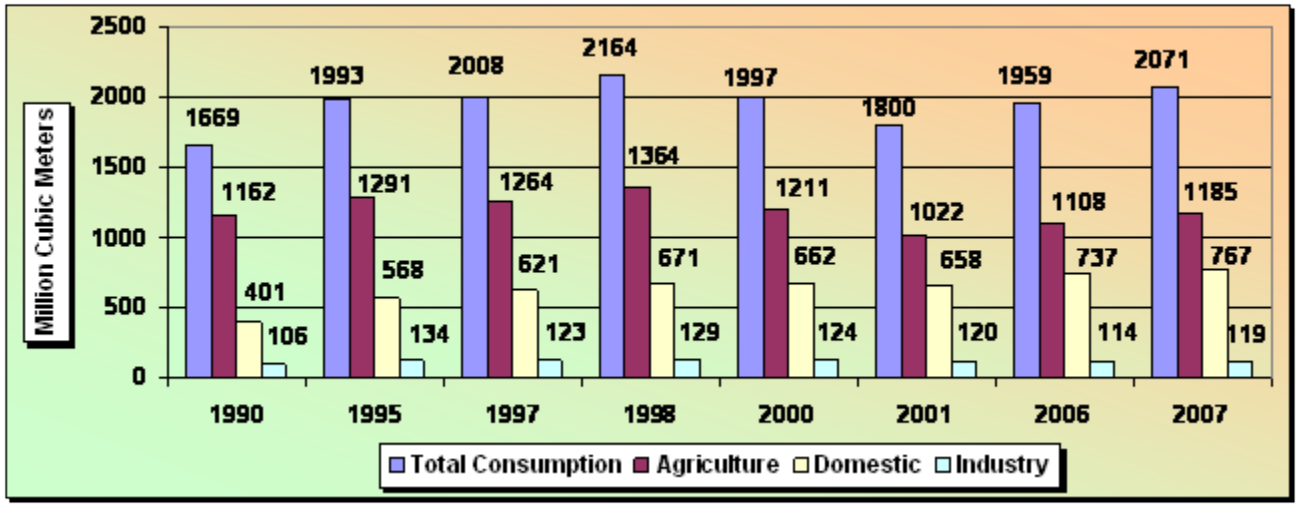
In 2007, out of the total water distribution, approximately 1,185 million cubic meters (MCM) were supplied to agriculture, 767 MCM (37 percent) for domestic consumption, and the remainder (5.7 percent) for industry. In addition to Israel's water use, according to regional peace agreements, Israel is obligated to transfer to Jordan and the Palestinian Authority 55 and 45 MCM of fresh water per year.

Out of total water distribution, the market share of water for agriculture decreased significantly during recent years, from nearly 70 percent market share in 1990 to 57 percent market share in 2007. On the other hand, the market share of water for

domestic consumption (household and public) increased from 24 percent market share in 1990 to 37 percent market share in 2007.

While Agriculture consumes about 57 percent of the country's total of 2 billion cubic meters of water a year, yet agriculture accounts for only 2 percent of Israel's GDP. Considering those numbers, there are questions whether agricultural growth in a desert climate like Israel's is really sustainable. Israel's ideology making the country bloom has encouraged heavy government subsidies for farming. Israeli farmers pay roughly 40 percent as much for their water as those who use it for nonagricultural purposes and urban residential users pay the highest prices.

Chart 1: Water Consumption in Israel, by Purpose, Million Cubic Meters



Source: Israel Farmer's Federation

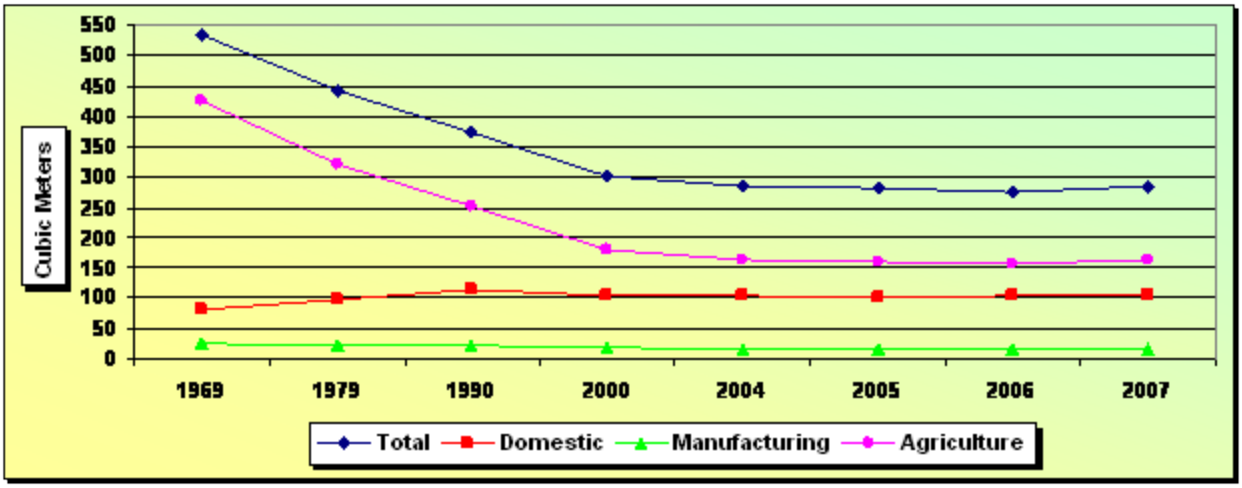
Table 1: Water Consumption in Israel, by Purpose, Market Share

Year	Agriculture	Domestic	Industry	
1990	69.6	24.0	6.4	100
1995	64.8	28.5	6.7	100
1997	62.9	30.9	6.2	100
2001	56.8	36.6	6.6	100
2007	57.2	37.0	5.8	100

Source: Israel Farmer's Federation

From 1969-2007, per-capita water consumption in industry has decreased by an average rate of 1 percent, while consumption in households increased at an average yearly rate of 0.8 percent. Over the same period, per-person water available for agriculture decreased by 61 percent compared to the volume of 1969. Despite the reduction, currently agricultural production per-capita is more than 160 percent of the quantity produced 45 years ago. According to these figures, water productivity is agriculture has increased about 2.6 times over the period. A similar increase was also recorded in industry.

Chart 2: Water Consumption Per Capita-(Water use divided by Israel's population)



Source: Central Bureau of Statistics, Statistical Abstract of Israel

Local water-saving methods have helped to reduce per-capita water use in the past 10 years from 115 cubic meters to 103 cubic meters today, e.g. dual-flow toilets (using 4.5 or 9 liters of water per flush) saves up to 18 liters of water per person/day - about 12 percent of the daily consumption.

Table 2: Average Water Consumption in Israeli Household, based on an average of 160 liters (42 gallons) per person/day

Toilet Flushing	55-60 liters – 35%
Drinking, Cooking and Dishwashing	30 liters – 35%
Bathing	55-60 liters - 35%
Laundry and Cleanliness	8 liters - 5%
Gardening	8 liters – 5%

Source: Israel Water Authority

1.2: Trend in Israeli Consumption of Potable and Non-Potable Water

In 2007, out of total water consumption, fresh water accounted for 68 percent, while the rest being non-potable water (see table 3). Contrary to established opinion, water consumption from natural sources in Israel has actually decreased since the Six-Day War (1967), even though the population more than doubled. This is due to increase in use of purified wastewater for agricultural irrigation combined with the two large desalination plants. Despite this, Israel is in a severe crisis because several cycles of drought years over the past two decades created steep drops in the level of Lake Kinneret and groundwater reservoirs, even though overall water consumption did not rise.

According to the Water Authority's data, the annual natural water consumption for 1967 was 1.4 billion cubic meters. In 2007 it was about 1.4 billion cubic meters. The rest, some 669,000 cubic meters, were supplied through purified wastewater and desalination plants. When the total natural water consumption is divided per capita, it yields another surprising statistic: Annual consumption in Israel decreased from 508 cubic meters per capita in 1967 to 170 cubic meters today. The latter figure also reflects changes in agriculture, since household water consumption rose steadily.

Table 3: Water Consumption in Israel, Potable and Non-Potable

Year	Agriculture			Industry			Domestic *Only Potable*	Total Potable	Total Non-Potable
	Potable	Non-Potable	Total	Potable	Non-Potable	Total			
1996	892	392	1,284	94	30	124	604	**1,590**	**422**
1997	854	410	1,264	88	35	123	621	**1,563**	**445**
1999	824	441	1,265	91	35	126	682	**1,597**	**476**
2000	729	408	1,137	90	34	124	662	**1,481**	**442**
2001	563	459	1,022	85	35	120	658	**1,306**	**494**
2003	562	483	1,045	84	32	116	698	**1,344**	**515**
2004	566	563	1,129	82	31	113	712	**1,360**	**594**
2005	544	583	1,127	85	35	120	715	**1,344**	**618**
2006	519	589	1,108	84	30	114	737	**1,340**	**619**
2007	551	634	1,185	84	35	119	767	**1,402**	**669**

Source: Israel Water Authority

Table 4: Water Consumption in Israel, Potable and Non-Potable, Market Share

Year	Agriculture		Industry		Grand Total Water Consumption	
	Potable	Non-Potable	Potable	Non-Potable	Potable	Non-Potable
1996	69	31	76	24	79	21
1997	68	32	72	28	78	22
1999	65	35	72	28	77	23
2000	64	36	73	27	77	23
2001	55	45	71	29	73	27
2003	54	46	72	28	72	28
2004	50	50	72	28	70	30
2005	48	52	71	29	69	31
2006	47	53	74	26	68	32
2007	46	54	71	29	68	32

Source: Israel Water Authority

Water Allocation

Water, as a resource in short supply, necessitated a legal framework and the prescribing of engineering, economic and administrative actions in order to attain its efficient utilization, in accordance with the goals set by the State. The method of

water allocations commenced, in effect, with the enactment of the Water Law in 1959. Most regions in the country were declared "rationing regions", meaning regions where water consumption was to be limited to fixed rations. Therefore, norms were established for agricultural consumption and crops for per capita domestic consumption and for industrial consumption. In addition, to setting fresh water quotas for agriculture, the Government of Israel determines water prices and initiating supply enhancing projects.

Since 1986 the Water Commission has been following a policy of fresh water quota cutbacks. In 2008 the fresh water quota for agriculture stood at 454 MCM, compared to 1,130 and 722 MCM in 1998 and 2005, respectively. In addition, as a result of the continued drought conditions in 2009, recently the Water Commission announced that fresh water quota for agriculture in 2009 will stand at 354 MCM, this is a 22 percent decrease compared to 2008. As a result of the recent decrease in fresh water quota for agriculture, it was agreed that local agriculture sector who suffered from the water decrease would receive compensation from the Israeli Government, and the compensation is estimated at NIS 258 million ($65 million).

However, in practice, starting from the mid eighties, large proportion of Israeli farmers apply less water than allowed by their quotas; e.g. in 2006 and 2007 the fresh water quota stood on 728 and 620 MCM, while the Israeli farmers used only 519 and 551 MCM, therefore utilized quota for fresh water stood on 71 and 89 percent, respectively (see table 5).

Table 5: Agriculture - Allocation and Consumption by Qualities, 1996-2007

		1993	1997	2000	2002	2003	2005	2006	2007	Average
Allocation (MCM)	**Potable**	1,133	1,150	756	598	668	722	728	620	**797**
	Non-Potable	374	421	434	488	492	541	560	600	**489**
	Total	**1,507**	**1,571**	**1,189**	**1,086**	**1,160**	**1,263**	**1,288**	**1,218**	**1,285**
Consumption (MCM)	**Potable**	846	854	729	535	562	544	519	551	**643**
	Non-Potable	279	410	408	486	482	582	589	634	**484**
	Total	**1,125**	**1,264**	**1,137**	**1,021**	**1,044**	**1,126**	**1,108**	**1,185**	**1,126**
% Utilization: (Consumption/Allocation)	**Potable**	**74.7%**	**74.3%**	**96.4%**	**89.5%**	**84.1%**	**75.3%**	**71.3%**	**88.9%**	**82.2%**
	Non-Potable	**74.6%**	**97.4%**	**94.0%**	**99.6%**	**98.0%**	**107.6%**	**105.2%**	**105.7%**	**97.8%**
	Total	**74.7%**	**80.5%**	**95.6%**	**94.0%**	**90.0%**	**89.2%**	**86.0%**	**97.3%**	**88.6%**

Source: Israel Water Authority

Section 2: Water Resources in Israel

To continue to supply the population with its water needs, under conditions of water scarcity, sustainable water management

policies, which relate to both quantity and quality of water, are being introduced. Israel entered the 21st century with one of its greatest water overdrafts ever. Today this cumulative deficit stands at some 1.5 billion cubic meters, an amount equal to the annual consumption of the country, in comparison to the average annual replenishment rate of major aquifers. Moreover, water scarcity is exacerbated by the deteriorating quality of water resources due to demographic, industrial and agricultural pressures.

The goal is to utilize Israel's natural water sources in a balanced way and to increase water supply from such sources as desalinated seawater, desalinated brackish water, effluents and more. Furthermore, river restoration action plans have been significantly advanced in recent years and enforcement against polluters of water resources has been stepped up. Preservation of Israel's water resources is one of the major challenges confronting the country today.

The deficit in the water balance (amount of water pumped out compared to rainfall) will reached 410 million cubic meters in 2008, almost twice as much as 2007's deficit. Altogether, the past four years' accumulated deficit is almost a billion cubic meters.

The long-term average quantity of replenishment water from major water resources amounts to about 1,800 MCM per year.

Table 6: Long-term Potential of Renewable Water

Resource	**Replenishment Quantities** (MCM/year)
The Coastal Aquifer	320
The Mountain Aquifer	370
Lake Kinneret	700
Additional Regional Resources	410
Total Average	**1,800**

Source: Israel Water Authority

2.1: Main Sources of Drinking Water in Israel

The main sources of fresh water in Israel include Lake Kinneret (the Sea of Galilee), the coastal aquifer and the mountain (Yarkon-Taninim) aquifer. These water sources are supplemented by marginal sources including seawater, effluents, floodwater and saline water, to meet consumption needs.

According to data provided by the Israeli Hydrological Service, the renewable recharges supply quantity of natural water available to Israel, based on the multiannual average for the past 16 years, is 1,175 million cubic meters. Natural water renewable recharges supply in 2008 was only 826 million cubic meters, 63 percent of the multiannual average.

Since surface and groundwater sources can no longer meet the demand of the population and the economy, Israel is increasing its development and use of treated wastewater, brackish water, water harvesting and desalination while promoting water conservation and remediation of wells. In 2008, the government decided to allocate additional funds for expanding Israel's desalination capacity, from the current level of 130 million cubic meters per year to 750 million cubic meters per year.

Natural Fresh Water Resources

2.1.1: Lake Kinneret (Sea of Galilee)

Israel's only surface water reservoir conveys water directly to surrounding areas and to other regions of the country via the 130 kilometer long National Water Carrier—the primary artery for supplying drinking water to most of the population. It has traditionally provided about a third of the country's domestic, agricultural and industrial water requirements.
Sea of Galilee – Main Facts

- Kinneret catchment basin: 2,730 square kilometers
- Surface area of the lake: 165 square kilometers
- Average depth: 25 meters
- Maximum depth: 44 meters
- Length of coastlines: 55 kilometers
- Length from north to south: 21 km
- Length from west to east: 12 km
- Storage volume: 710 million cubic meters
- Red line: -213 meters below sea level
- Black line: -214.87 meters below sea level

Lake Kinneret is the lowest freshwater lake in the world. The total average annual inflow of water into Lake Kinneret from its catchment basin amounts to a billion cubic meters, of which some 250 MCM serve consumers in the region, about 450 MCM are withdrawn from the lake to serve consumers throughout the country by means of the National Water Carrier and about 300 MCM are lost by evaporation.

Water levels in the lake, fluctuating in accordance with its use in the national water system and the amount of precipitation and inflow, have varied between 213 and 209 meters below sea level for several decades. However, due to the continuous drop in water levels since 1996, the Water Commissioner has lowered the minimum "red line" for limited periods of time to minus 214 meters in 2000, minus 215.5 meters in 2001 and minus 214.87 meters, which was defined as the black line in 2008. The risks associated with reduced water levels are formidable: ecosystem instability and deterioration of water quality, damage to nature and landscape assets, receding shorelines and adverse impacts on tourism and recreation. When the black line is reached, the pumps in the lake can no longer operate.
According to the Water Authority, Lake Kinneret lost 5.13 meters since the spring of 2004, equivalent to some 850 million cubic meters of water.

In light of the Kinneret's dropping water level, the Israel Water Authority launched a major water conservation campaign in 2008, titled "Going from Red to Black". The campaign relates to the constantly declining level of the Kinneret's water level, which dropped below the "red line" in the summer of 2008 and is expected to reach the black line by mid 2009. In winter 2007/8. rainfall in the Kinneret watershed was only 60 percent of the annual average, following three years with less than average rainfall.

2.1.2: Coastal Aquifer

This sandstone aquifer extends along 120 kilometers of the Mediterranean coastline. It is naturally recharged by precipitation and artificially recharged by water from the National Water Carrier, effluents and excess irrigation water percolating from agricultural, industrial and domestic land uses as well as from streams and wadis. The aquifer is also a valuable storage basin since sandstone layers hold water efficiently. It has a mean annual recharge of 250 MCM in addition to 50 MCM of agricultural drainage. It has traditionally provided about 15 percent of the country's domestic, agricultural and industrial fresh water requirements.

2.1.3: Mountain Aquifer

This limestone aquifer underlies the foothills in the center of the country. The basin is comprised of three sub-aquifers: the Western Basin, known as the Yarkon-Taninim Aquifer, flows in north and westward directions and discharges in the Taninim Springs on the Mediterranean coast while the Northeastern and Eastern Basins discharge in the Beit-Shean Springs and the Jordan Rift Valley and Dead Sea. It has traditionally provided about a third of the country's domestic, agricultural and industrial fresh water requirements. The Yarkon-Taninim Aquifer is regenerated by precipitation with average annual renewable recharges of about 350 MCM.

2.1.4: Relatively smaller aquifers are located in the Western Galilee, Eastern Galilee, Golan Heights, Jordan Rift, and Arava valley.

Other Water Resources

2.2: Sea-Water Desalination

Currently Israel has two large seawater desalination plants along the Mediterranean coast currently producing 138 MCM per year, and a third is expected to be operational by the end of 2009; A 108 MCM desalination plant at Ashkelon [2] (the largest in the world) is operational as of November 2005, a 30 MCM desalination facility in Palmachim ($100 million plant) is operational as of May 2007, a 100 MCM desalination plant in Hadera is expected to be operational by the end of 2009, Israel's fourth desalination facility at Soreq, which will produce 100 MCM a year is due to come on line in 2012 and will cost about NIS 1.5-2 billion ($500 million) and an additional 100 MCM plant in Ashdod is in the planning stages. Currently all desalination plants in Israel are using Seawater Reverse Osmosis (SWRO) technology.

It is estimated that the cost to desalinate a cubic meter of sea water is about NIS 2.80 ($0.7).

As a result of the announcement made by the Israel Water Authority that Israel is currently facing the worst water supply crisis in 80 years, ever since they started keeping records, on June 1st, 2008, the Government of Israel decided that by 2013, Israel should be able to desalinate 600 MCM annually, representing one-fourth of the country's water consumption, and by 2020, Israel should be able to desalinate 750 MCM annually, which is the amount currently used by the Israeli public.

The first decision to desalinate on a larger scale was taken in 2000 as a result of Israel's growing water scarcity. All tenders issued for desalination facilities stipulate stringent threshold levels for water quality and provide incentives for even higher water qualities, especially in terms of chloride levels, in order to allow for irrigation without the attendant problem of soil salinity.

Simultaneously, plans and tenders are also being advanced for desalinating saline water and connecting these facilities to the national water system. The potential of brackish water desalination has been estimated at about 200 MCM based on brackish water sources throughout the country including saline springs in the Kinneret, Dead Sea and Arava, Jezreel Valley, Negev and Coastal Aquifer. Desalination of this water will serve local needs while helping to solve the problem of growing salination of natural sources of water through the utilization of this water.

2.3: Wastewater

In 2007, out of a total of 480-490 MCM of sewage produced in Israel, about 97 percent was collected in central sewage systems and about 78 percent (380 MCM) was reused for agricultural irrigation and the remainder was treated in some kind of degree and was released to the environment (mainly to the sea).

In 2007, treated wastewater constituted about 31 percent of consumption by the agricultural sector and 17 percent of Israel's total water consumption.

The use of treated wastewater (effluents) in Israel is one of the highest rates in the world. Israel, which is considered to be a leading country in the world in technologies for treated waste water use in agriculture, has acquired much experience in adjusting the treatment level of the wastewater treatment plants and the qualities and characteristics of the treated wastewater to land and crops.

Local authorities are responsible for the treatment of municipal sewage. In recent years new or upgraded intensive treatment plants were set up in municipalities throughout the country. The ultimate objective is to treat 100 percent of Israel's wastewater to a level enabling unrestricted irrigation in accordance with soil sensitivity and without risk to soil and water sources. In 2007 there were about 135 sewage treatment plants in Israel, of which about 35 percent of Israel's total wastewater (about 170 MCM) undergoes treatment in the Dan Region Wastewater Reclamation (DRWR) Project which produces high-quality effluents. The DRWR system consists of facilities for collection, treatment, groundwater recharge and reuse of municipal wastewater from the Tel Aviv metropolitan area (central part of Israel).

As a result of the continued shortage of water, recently the Water Authority announced that by 2012, the Water Authority will invest NIS0.915 billion ($230 million) in treated wastewater infrastructure, and by 2020, treated wastewater for the agricultural sector will total 600 MCM.

The cost of treating 1 cubic meter of wastewater is about NIS 0.84-1.26 ($0.21-$0.32), depends on effluent's quality.
In December 2007, the Water Authority has approved the "Inbar" committee standard for treated wastewater formulated by the Ministries of Health and Environmental Protection. Implementing the standard will cost NIS 1 billion ($250 million), which will be invested in sewage treatment plant upgrades over the next ten years. The economy is expected to make a profit of $120 million a year from the sale of treated wastewater for agriculture.

The "Inbar" committee mandates that local authorities implement tertiary level sewage purification, up from the currently mandated secondary purification level. Current regulations, promulgated by the Ministry of Health in 1992, require secondary treatment and relate to compliance with two parameters only: concentration of organic matter and level of suspended solid matter (20 mg/liter BOD and 30 mg/liter suspended solids). The new regulations set more stringent standards for these parameters and add another 34 parameters (including nitrogen, phosphorous, heavy metals, salts,

etc.). Local authorities will have to ensure that the sewage, which is discharged by industrial plants and businesses in their jurisdiction complies with the stringent requirements of the law.

Wastewater- Facts for 2007

- About 490 MCM of wastewater are produced in Israel
- About 380 MCM of the effluents are reclaimed (79%)
- About 4% of the wastewater is discharged to cesspools (20 MCM)
- About 97% of the waste is collected in central sewage systems
- Approximately 83% of the total wastewater, is at least at 20 (BOT)/300 (TSS) quality (410 MCM)
- Approximately 153 MCM of the effluent is at improved 3rd degree quality (31%)

Table 7: Trend in Israeli Treated Wastewater, MCM/Year

Year	Total Wastewater	Treated Wastewater	Reuse	Reuse % of Total Wastewater
1963	137	41	10	7%
1967	139	53	16	11%
1971	183	69	22	12%
1975	209	108	34	16%
1980	226	133	52	23%
1987	270	212	180	67%
1994	389	309	254	65%
2000	422	360	285	67%
2006	470	450	355	75%
2007	490	470	386	79%

Source: Israel Water Authority

2.4: Brackish Water

Brackish waters are defined as saline waters with a total dissolved solids (TDS) levels of 1,000 to 10,000 parts per million (ppm).

In 2007, about 235 MCM of brackish water were pumped from various boreholes throughout the State and used directly as a source of supply. In 2007, about 201 MCM were used by agriculture (fish ponds and irrigation) and the rest for the industry (mostly as cooling water). In Eilat and the Arava area (southern part of Israel), another 15 MCM per year of brackish water are desalinated, generating, at an average recovery or conversion ratio of 70 percent, a 10 MCM per year of potable water.

In 2007, brackish water constituted about 17 percent of consumption by the agricultural sector and about 11 percent of Israel's total water consumption.

Table 8: Brackish Water Consumption in Israel

Year	Agriculture	Industry	Total	Brackish Water as a	Brackish Water as a

				Percentage of Total Water for Agriculture	Percentage of Total Water for Industry
1996	76	29	105	5.9%	23.3%
1998	96	35	131	7.1%	27.1%
2000	100	33	133	8.8%	26.6%
2002	146	35	181	14.2%	28.7%
2004	184	30	214	16.3%	26.5%
2006	190	29	219	17.2%	25.5%
2007	201	34	235	17.0%	28.5%

Source: Israel Water Authority

2.5: Storm Water

In 2007, storm water constituted nearly 4 percent of consumption by the agricultural sector and 2.2 percent of Israel's total water consumption. All storm water are been consumed by the agricultural sector. Storm-water consumption in Israel has remained essentially constant for the last 11 years (see table 9) and this is due to low investments in infrastructure. In order to increase the storm water capture, it is essential to invest in storm water infrastructure improvements, such as pools, drains and pipes.

It is estimated that the maximum potential water storm capture in Israel is about 70-80 MCM per year.

Table 9: Storm Water consumption in Israel, MCM

1996	1997	1998	2000	2002	2004	2005	2006	2007	Average
46	62	79	49	54	52	52	44	46	**54**

2.6: Water Providers and Infrastructure

Mekorot Water Company, which is a government company, provides about 75 percent of Israel's drinking water and 70 percent of the total water needs of the country and the company also operates the National Carrier. It has a total of about 3,000 installations throughout Israel, providing pure water, desalinized water, sewerage reclamation, rain enhancement, infrastructure, and more. The other suppliers are private well owners, municipalities, and regional cooperatives. Municipalities are required to collect and treat their sewage and several cities have cooperative projects with agricultural interests in their vicinity.

The National Water Carrier of Israel - is the largest water project in Israel. Its main task is to transfer water from the Sea of Galilee in the north of the country to the highly populated center and arid south and to enable efficient use of water and regulation of the water supply in the country. Up to 72,000 cubic meters of water can flow through the carrier each hour, totaling about 1.7 MCM per day. The length of the carrier is about 130 kilometers (81 miles). The northern section makes its way through tunnels and open canals, with occasional ponds for water concentration. Further south the water is conveyed through a water pipe concealed deep in the earth. Work on this large scale project began in 1953 and ended in 1964. The Syrians objected furiously, claiming that Israel had no right to make changes in this region, which was a designated open area not subject to change by either side. The United Nations exerted a great deal of pressure, which left Israel with no choice but to build the National Water Carrier from the northwest section of the Sea of Galilee.

Section 3: Water Legislation in Israel

The Water Law of 1959 establishes the framework for the control and protection of Israel's water sources (under the responsibility of the Ministers of Agriculture and National Infrastructure and of the Water Commissioner) and includes water pollution prevention provisions (under the responsibility of the Minister of the Environment). Water is defined in Israel under the 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. *Water Law* - http://www.sviva.gov.il/Enviroment/Static/Binaries/Articals/Water_Law_1.pdf

Additional laws deal with the prevention of sewage and effluent discharge into water sources. The Minister of the Environment is authorized to protect water quality, to prevent water pollution, and to promulgate regulations on these issues. In recent years, enforcement against polluters of Israel's water sources has significantly increased. In 2007, more than 50 beaches were closed to the public by the Ministry of the Interior as per the recommendation of the Ministry of Health due to sewage bursts. From 2001-2007, about 220 verdicts were handed down in water pollution cases, and fines totaled about 23 million shekels ($5.8 million) were imposed by the courts.

The Local Authorities Sewage Law of 1962 prescribes the rights and duties of local authorities in the design, construction and maintenance of sewage systems. This law requires each local authority to maintain its sewage system in proper condition.

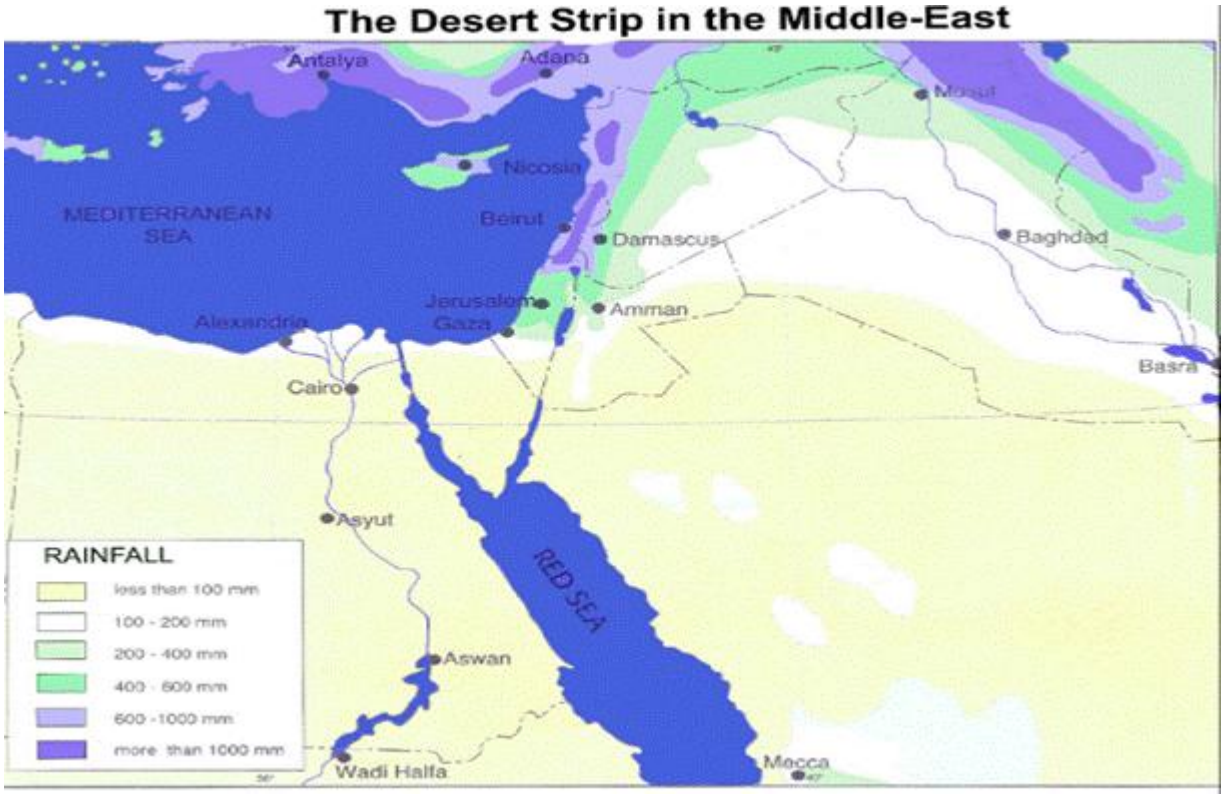
The Streams and Springs Authorities Law, 1965, empowers the Minister of the Environment to establish an authority for a particular stream or part of a stream, spring, or other water source. The functions of such authorities include nuisance abatement and pollution prevention.

Extensive use is made of the Licensing of Businesses Law to implement requirements on industrial effluent treatment in various industries (e.g. textiles, food and metal) and in the treatment of wastes generated by dairy farms.

Section 4: The Middle-East Continued Water Crisis

The water shortage is not unique only to Israel. Most Mid-Eastern countries suffer from a shortage, and the scarcity of water is used as a political issue. Population growth always expanded to the limits of the scarcest available resource, which was usually water. In addition, the Middle East suffered a severe region-wide drought in 2008, with substantial crop losses reported from western Turkey and Israel through eastern Iran, and it is estimated that drought conditions will continue in 2009.

While representing about 5 percent of the total world population, the Middle East & North Africa (MENA) region contains only 0.9 percent of global water resources. According to the World Bank, MENA is the world's driest region. Water availability per person is around 1,200 cubic meters per person per year, compared with the average of about 7,000 worldwide. Half the region's people already live under conditions of water stress. Water availability per capita is expected to halve by 2050, a trend that will likely be exacerbated as climate change make countries hotter and drier.



Agriculture uses about 85 percent of the region's water. Seven countries in the region are using more water every year than is available to them, mainly by over-pumping aquifers. The greatest need is to manage water for agriculture more efficiently, by pursuing efficient options for reusing water, desalination, and modernizing irrigation as well as implementing orderly mechanisms for the transfer of water to high-value urban and industrial uses.
As with all natural disasters, this crisis also does not recognize borders. Israel, Jordan, Syria and the Palestinian territories share up to 75 percent of their water sources. These four countries are interconnected as far as their water sources are concerned and the solutions to problems related to water shortages have to come from cooperation among them.

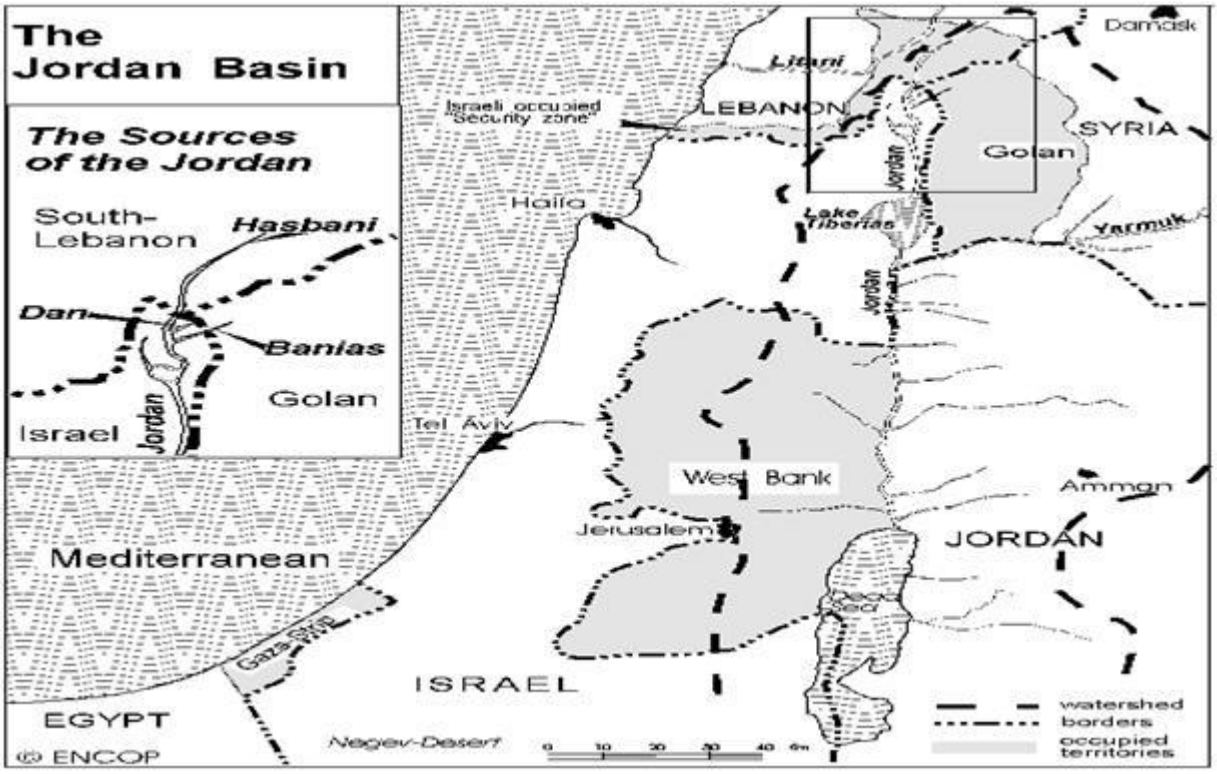
Syria is going through its worst drought in four decades, some 750,000 Syrians have lost their crops, 59,000 herders have lost their animals in 2008. The Syrian Government estimates that about 200,000 families have suffered direct severe impact of the drought.

Jordan's environment minister, recently said Jordan had slipped near the bottom of the list of water-stressed countries as a result of climate change and pollution, which have depleted or contaminated water sources. The country has a deficit of 600 MCM of water every year. While the global average water requirement is 1,000 MCM a year per person, the allocation in Jordan is around 600 cubic meters.

The Palestinians are bearing the brunt of depleted water sources and pollution. According to Palestinian Water Authority estimates, the West Bank's water shortfall is about 42-69 MCM. Its consumption is 79 MCM making emergency supplies needed. Throughout the West Bank, per capita consumption is about 66 liters (for domestic, urban, rural and industrial use), far below the World Health Organization's 100 liter minimum for personal needs. In Gaza Strip, only 10 percent of

available water is suitable for drinking.

The map below, show that Israel, Jordan, Palestinian Authority, Syria and Lebanon share the waters of the Jordan River and its source tributaries. Attempts to use the water for different projects by different countries have resulted in constant friction. The dispute between Israel and Jordan was settled in the peace agreements (1994), which provide for supply of water by Israel to Jordan, and joint development of water resources.



4.1: Water and its Interaction with the Regional Peace Agreements

The issue of water here is so critical that it features in peace agreements.

Israel-Jordan: As part of the 1994 Israeli-Jordanian peace treaty, Israel and Jordan have agreed on allocations of water from the Jordan and Yarmouk Rivers and from Arava ground-waters. In addition, Israel has agreed to transfer to Jordan 50 MCM of water annually from the northern part of the country. In addition, the two countries have agreed to cooperate to alleviate the water shortage by developing existing and new water resources, by preventing contamination of water resources, and by minimizing water wastage

Israel-PA: Water is one of six final status issues on the Israeli-Palestinian peace process agenda along with Jerusalem, Palestinian refugees, security, Israeli settlements and borders. Israel has also been supplying the West Bank and Gaza with water. The West Bank receives 40 MCM per year and Gaza receives five MCM. Palestinian towns and cities produce an estimated 56 MCM of sewage per year, 94 percent of which is disposed in cesspits or discharged without treatment into streams. International organizations that give aid to the Palestinians have helped to alleviate some of the problems. The U.S. Agency for International Development inaugurated a $45 million water supply project in Hebron in 2008, which was

intended to significantly improve the quality and distribution of drinking water to about 550,000 Palestinians in the southern West Bank. According to USAID's Web site, it has provided $734 million to the Water Resources and Infrastructure activities of the Palestinians since 1993. They are working to rehabilitate deteriorated water networks, replace old water pumps, and repair badly deteriorated sewage systems.

West Bank Streams Monitoring:
http://www.sviva.gov.il/Enviroment/Static/Binaries/News/west_bank_rivers_monitoring_report_1.pdf

Table 10: Water Transfer from Israel to the Palestinian Authority and Jordan

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Average
PA	37.2	40.2	39.9	39.3	41.8	41.1	44.4	43.6	47.7	47.7	**42.3**
Jordan	59.0	44.5	54.2	46.1	52.4	54.9	55.4	53.9	54.3	51.0	**52.6**
Grand Total	**96.2**	**84.7**	**94.1**	**85.4**	**94.2**	**96**	**99.8**	**97.5**	**102.0**	**98.7**	**94.9**

Israel-Syria: Water is very important in political negotiations between Israel and Syria. If Syria were to get the Golan Heights in a territorial compromise, as has been discussed in peace negotiations in the past, Damascus could divert water from the Lake of Galilee, which provides a third of Israel's water. This is no small concern for Israel.

Israel-Lebanon: Lebanon and Israel share water from the Hasbani and Wazzani rivers. The waters flow from southern Lebanon into the Jordan River and Israel's Sea of Galilee, which is Israel's largest freshwater reservoir.

4.2: Water Links in the Area

Dead Sea – Is located in the Syrian-African Rift Valley, is the lowest place on earth - 420 meters below sea level. It is also the world's saltiest large water body. The Dead Sea is bordered by Israeli, Jordanian and West Bank Palestinian populations. The water level in the Dead Sea drops by more than a meter each year primarily due to the siphoning off of its main resource, the Jordan River, by Israel, Jordan and Syria. Over the past three decades, the water level has fallen by approximately 25 m. In addition, the sea's length (north to south) has decreased from 75 km in the beginning of the 1900s to 55 km today, and sinkholes have appeared along the shoreline. The dramatic lowering of water level mainly since the 1970s is largely attributed to the diversion of water sources upstream of its basin to meet domestic, agricultural, tourist and industrial demands and to the mineral extraction industry which has been established on both sides of the lake - Israel and Jordan. This negative water balance, which is expected to increase in the future, has a significant impact on existing and future infrastructure and development plans, natural and landscape values, the image of the region and the lives of local residents. A study, proposed by the World Bank, will determine the feasibility of creating a canal to transport water from the Red Sea to the Dead Sea. The project was identified during a pre-feasibility study in the late 1990s. However, there are risks associated with the project, including the high costs for construction, possible changes to the Dead Sea's chemical composition and potential damage to the surrounding environment due to canal leaks.

Jordan River Basin - The Jordan River Basin originates on the borders of Israel, Lebanon and Syria. The Jordan River passes through Israel and makes up most of Jordan's border with Israel and the West Bank. The Yarmuk River, a major part of the basin, feeds into the Jordan River just below Sea of Galille and borders Israel and Jordan. Israel consumes marginally more of Jordan River waters than does Jordan; consumption in the Palestinian territories is estimated at one-tenth the Jordanian amount. The Jordan River Basin has been a point of conflict in the past. In the 1950s and 1960s Jordan, Syria and Israel made unilateral attempts to divert water away from the basin, resulting in a series of armed clashes. These conflicts were put on hold after Israel took the Golan Heights in 1967, giving it control over the headwaters of the Jordan River, which stopped Syrian diversion projects, and led to a 1970 agreement between Israel and Jordan. The annex to the 1994 Israel-Jordan Treaty of Peace details joint efforts to manage and share the flow of the Jordan and Yarmuk Rivers.

Mountain Aquifer - Israeli and Palestinian populations are the primary users of mountain aquifer water, which lies primarily beneath the West Bank. It has traditionally provided about a third of the Israel's domestic, agricultural and industrial fresh water requirements. For West Bank Palestinians, the mountain aquifer is the only source of freshwater. As mentioned above, the mountain aquifer, is a vital water source for both Israelis and Palestinians. Yet the sewage and industrial effluents generated by some 2.8 million people who live in the Judea and Samaria region endanger both the aquifer and public health.

The 1995 Israeli-Palestinian Interim Agreement contained provisions acknowledging the water rights of the Palestinians, set out mechanisms for joint management of water and sewage systems in the West Bank, and established a Joint Water Committee to oversee implementation.

An example of cooperation between the Palestinians and the Israelis: A direct cooperation between the municipality of the Palestinian town Tul-Karem and the neighboring Israeli regional council Emeq-Hefer has been crucial in rehabilitating sewage treatment in the area. The project includes ponds in Tul-Karem, which provide initial treatment for Tul-Karem sewage. The partially treated wastewater then flows under the separation barrier, the controversial blockade that separates Israeli and Palestinian areas, into a treatment plant established by the Emeq-Hefer municipality for continued processing. The joint project has been operating despite a tough political climate and serves as testimony that water cooperation can work and draw communities together.

4.3: Previous Regional Water Plans

In the past a few regional water plans were developed in order to solve the area's water crisis, and one of the most famous plans was the Johnston Plan (1954-1957) - Eric Johnston, the water envoy of US President Dwight Eisenhower, developed a water plan for Israel. According to this plan, water from the Jordan River and Yarmuk River would be divided between Israel (40%), Jordan (45%) and Syria and Lebanon (15%). Each country would keep its right to utilize the water flowing within its borders, if it caused no harm to a neighboring country. Whilst this plan was accepted as fair by Arab water experts, Arab politicians rejected it out of hand.

[1] Domestic=households and public

[2] http://www.water-technology.net/projects/israel/