



State of Israel

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OF
ISRAEL

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TO THE

**UNITED NATIONS CONVENTION
TO COMBAT DESERTIFICATION (UNCCD)**

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NATIONAL REPORT OF ISRAEL 2006
TO THE UNITED NATIONS CONVENTION
TO COMBAT DESERTIFICATION (UNCCD)

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Introduction

This report constitutes an update to the Israeli reports submitted to the UNCCD Secretariat in 2000 and 2002. As such it is designed to supplement rather than repeat the information contained therein and report about recent activities and progress in Israel. It will also highlight those areas in which there has not been sufficient follow through of UNCCD related initiatives reported earlier.

It is important at the outset to consider Israel's climatic conditions. Some 95% of the country is either semi-arid, arid or hyper-arid with only 5% of the lands receiving sufficient rainfall to fall into a dry sub-humid category. Thus, Israel is almost entirely comprised of drylands. As the map below suggests, the greatest risk of desertification exists in the semi-arid zones in the center of the country, with soil degradation also occurring in the arid parts of the Negev surrounding the greater Beer Sheva region.

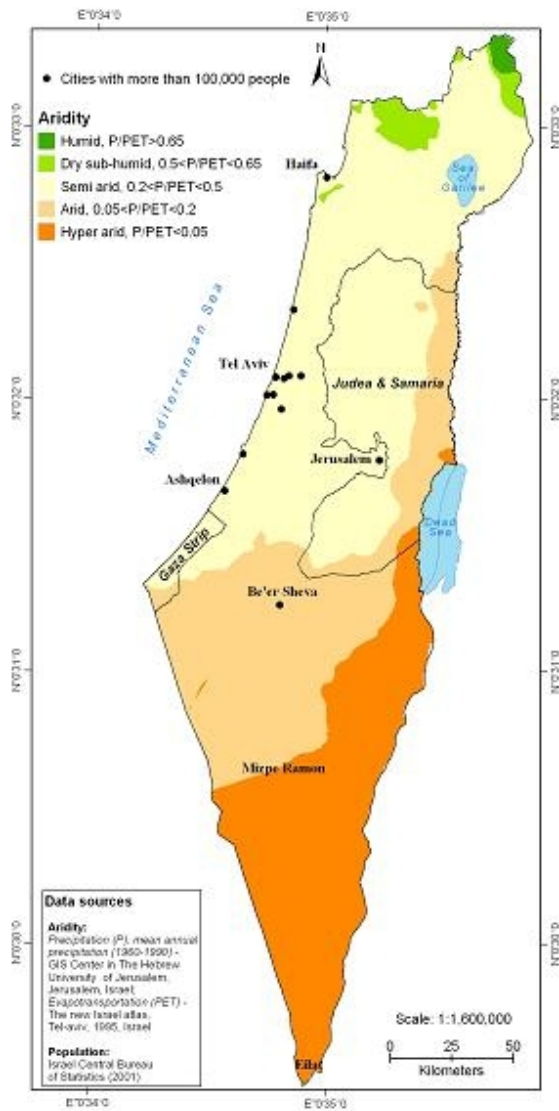


Figure 1: Aridity Index and Classification of lands in Israel. (Source: CLEMDES, 2004)

During the past several years, Israel took several measures which will strengthen its efforts to address desertification processes. Most of these activities were part of planning, environmental, and development strategies or policies for the sustainable use of natural resources. The majority were *not* specifically directed towards implementing a comprehensive national strategy to combat desertification or as part of a renewed local commitment to meet the expectations of the UNCCD. Nonetheless, frequently they make a significant contribution to Israel's ongoing efforts to reduce erosion, increase the productivity of lands in the semi-arid drylands, ensure agricultural yields in general, and promote afforestation efforts throughout the country.

The most salient new Israeli efforts associated with combating desertification can be divided into four general categories, and several sub-categories. These include:

I. New Comprehensive Planning Initiatives for Israeli Drylands

- Approval of National Masterplan 35 as a new long-term strategic plan that controls urban growth and balances development against conservation;
- Government adoption of the "Daroma" (Southbound) development plan to expedite settlement of the Negev region.

II. Upgraded Sustainable Water Management in the Drylands

- Upgrading of effluent recycling for agriculture;
- Construction and operation of new desalination facilities;
- Implementation of water conservation policies to prevent overexploitation
- Commencement of watershed management projects -- Nahal Beer Sheva, Nahal Besor.

III. Continued Afforestation in the Arid and Semi-Arid Regions

- Implementation of Masterplan 22 for Forests and Afforestation;
- Transfer of legal control of forests to the Jewish National Fund (JNF);
- Adoption of a national policy of sustainable forestry to ensure biodiversity, the ecological integrity of Israel's woodlands and the public's involvement in planning and access to forests as recreational resources.

IV. Policies to Promote Sustainable Agriculture in Vulnerable Regions

- Implementation of national soil erosion control policies;
- Ongoing promotion of national grazing strategy and associated regulation.

Details about the initiatives in these four areas will be integrated as appropriate into the seven thematic topics stipulated for National Reports under 1/COP.5.

1) Participatory processes involving civil society, non-governmental and community-based organizations

Israel has a relatively robust political culture which increasingly encourages the involvement of civil society. This is part of the general dynamics of national governance but is also manifested in many of Israel's activities to combat desertification.

There are three general areas through which public participation is encouraged in Israel.

- a) Open access to information;
- b) Participation by the public in formal decision-making;
- c) General awareness and educational outreach.

a) Access to Information: Public participation is first and foremost dependent on the ability to access reliable information about relevant activities in sufficient time to enable stakeholders to prepare an informed response. For almost a decade Israel has had a Freedom of Information Law in place which guarantees public access to all information and data that are held by the government that do not involve security or commercial "trade secrets". Government ministries are required to appoint a "supervisor of freedom of information" whose job it is to respond to the public within sixty days of a request for information.

The two agencies that are most involved with activities that combat desertification are Israel's Ministry of Agriculture and the Jewish National Fund (also referred to in Hebrew as – Keren Kayemeth L'Yisrael or KKL) a public corporation that oversees afforestation as well as water management projects in Israel. The Ministry of Agriculture has appointed a Ministerial supervisor of information, and runs a web-site with extensive information about the Ministry's policies. At the same time, the Jewish National Fund recently adopted a "Transparency and Public Involvement" position paper as part of its new series of "Sustainable Development Policies." Under the new policy, a "Public Complaints Coordinator," whose duty is to respond to requests for information, will be appointed. All new afforestation initiatives and major projects will appear on the internet site of the organization. In conclusion – a formal legal basis for accessing information, per se, is not a meaningful obstacle for public involvement – either by NGOs, academics, civil society or other community-based organizations

b) Public Participation in Decision Making: Public participation in decisions that might emerge as drivers of desertification (or prevention measures) is especially important in the sphere of physical planning. Since Israel's Planning and Building Law was enacted in 1966, affected individuals and organizations are authorized to file legal objections to development plans that would negatively affect them. These must be submitted to local and regional planning councils within sixty days of a plan's publication. Development plans that exacerbate desertification or pose a threat to soil fertility can be challenged accordingly by recognized public interest NGOs or members of the general public who perceive themselves as "aggrieved". The growing role of environmental impact

assessments in the planning process offers an important source of data for informing the public as it considers its response to plans.

In practice, awareness of desertification as a salient environmental problem in Israel is not an issue high among the agenda items of Israel's civil society. For example, of the ninety NGOs who are members of *Life and Environment* – the country's umbrella group for environmental NGOs – not one has combating desertification as a major or even secondary objective. Hence, there has been relatively little public engagement supporting or opposing local planning initiatives that might affect soil productivity, expand forestry, etc. in Israel's semi-arid and dry subhumid regions. At the same time, however, public involvement regarding the environmental aspects of proposed developments is extremely robust. With greater awareness, the potential for "bottom up" involvement to raise desertification issues is great. From a legal perspective, Israeli legislation and political culture is certainly open to such a development.

c) Public Education and Outreach Environmental education in formal and informal contexts continues to grow in Israel. A new government decision following the 2002 Johannesburg "World Summit for Sustainable Development" requires all government ministries to integrate sustainability into their operational strategies. The Ministry of Education has prepared a plan that will lead to an upgrading of the curriculum in areas that touch on "sustainability". Already dozens of schools have special environmental education tracks and some 5000 high school students every year take matriculation examinations in environmental science. Yet, in practice, desertification, for the most part, is not yet an integral part of the curriculum.

The only domestic institution that remains focused on issues involving desertification is the Jacob Blaustein Institutes for Desert Research (BIDR) at the Sede Boqer Campus of Ben-Gurion University of the Negev. As reported in the Israeli National Report of 2002, their graduate school program has over 120 students studying in six tracks:

- Desert architecture
- Desert ecology
- Man in the Drylands
- Solar energy and physics
- Dryland Agriculture
- Environmental Studies

The curriculum includes courses involving the geography of desertification, public policy to combat desertification and many other related courses involving the study of sustainable livelihoods in the drylands.

This June the BIDR hosted a public forum that marked the World Day to Combat Desertification for the first time in Israel. The symposium focused on grazing policies in the Middle East and was attended by Israel's Minister of Environmental Defense, Mr. Gideon Ezra. The program included a variety of scientific presentations as well as lectures by Israeli, Palestinian and Jordanian experts on the problems and achievements

of present policies to regulate grazing in their countries.

Between November 6-9, 2006, as part of Israel's involvement in the International Year of Deserts and Desertification, the BIDR will be a co-sponsor, along with the UNCCD Secretariat, of an international conference entitled: *Deserts and Desertification – Challenges and Opportunities*. The conference will focus on the difference in policies designed to create alternative livelihoods for sustainable living in desert regions as opposed to those that are required to combat desertification in arid, semi-arid and dry sub-humid zones. A variety of successful economic initiatives locally and internationally will be highlighted with one day dedicated to indirect drivers of desertification. Attendance by Israel's academic community, as well as NGOs and relevant public bodies looks promising as does that by the international community.

In conclusion, Israel's public awareness about desertification and involvement in the related participatory process to date has not been exceptional. While there is a general national pride at Israel's past achievements in reclaiming degraded lands during the country's 58 year history, the public remains largely unaware of the specific dangers posed by desertification. The modest public educational efforts that exist have not succeeded in turning the issue into a prominent topic on the country's broad environmental agenda. Nonetheless, many policies are in place that facilitate active public participation. It is hoped that the kinds of events which are taking place during the International Year of Deserts and Desertification at the BIDR and the heightened interest in the subject at the Ministry of the Environment will be a catalyst for greater public awareness and involvement in this issue.

2) Legislation, Policy Implementation and Institutional Frameworks

Israel's previous two National Reports (2000, 2002) did not provide great detail regarding the existing normative framework for combating desertification. The following section will describe many of the central statutory and regulatory instruments in this regard as well as provide information about implementation.

Although Israel has chosen not to prepare a National Action Program pursuant to the UNCCD, it has a rich and diverse legislative history of regulating land use activities to prevent desertification which dates back to the period of the British Mandatory Government after World War I. This section considers four different areas that together comprise the heart of Israeli desertification policy:

- A) *General Erosion Laws and Policies;*
- B) *Afforestation Law and Policy Implementation;*
- C) *Grazing Statutes and Policy Implementation;*
- D) *Water Legislation and Management Programs.*

A) *General Erosion Laws and Policies:* Among the first Ordinances promulgated by the High Commissioner during the British rule in Palestine after World War I were a *Sand Erosion Ordinance* and a *Forestry Ordinance* that specifically addressed problems of

overgrazing and deforestation. Appalled by the severe levels of desertification and erosion that had taken place during the millennium of Ottoman rule, the British Mandate government attempted to reverse trends that had left the vast majority of Israel as degraded, treeless "wastelands". This included soil conservation and afforestation efforts in the relatively wet northern Galilee region, the hills surrounding Jerusalem that had once been covered with forests, and the arid and hyper-arid Negev desert in the south.. Even today, many of the most critical statutes in Israel addressing desertification are actually Hebrew translations of British regulations which have only been minimally amended. The basic Israeli penal code promulgated in 1977 left intact a 1936 law which makes it a misdemeanor crime for persons and/or their animals to enter a planted field or a protected grazing area without an acceptable explanation; is the maximum penalty for violation is a three-month prison sentence. In practice, enforcement of this provision rarely leads to incarceration.

Under the Sand Erosion Ordinance, wherever the Forest Clerk concludes that eroded sands pose potentially negative consequences for agriculture or prospective cultivated lands, he is authorized to specify those specific measures necessary to save the lands from being degraded. The law focuses on the financial ramifications of expediting these activities and the ability of land owners to participate in the restoration work.

Another leading statute in the field is the old British *Soil Erosion (Prevention) Ordinance* of 1941. The law grants the Minister of Agriculture authority to promulgate five groups of regulations:

- 1) regulations to impose soil testing on lands and to declare them to be "special regions";
- 2) regulations that proscribe grazing of any sort on sensitive lands or even passage rights through them;
- 3) regulations to prohibit land cultivation in a special region;
- 4) regulations that limit land clearing activities in a special region; and
- 5) regulations that prescribe soil conservation activities in a special region.

The law also specifically exempts the government from any liability or civil fines for any activities conducted pursuant to the law.

In 1960, the Soil Conservation Regulations were promulgated by the Minister of Agriculture pursuant to this ordinance. The regulations declare lands falling inside "Drainage Basins" as special regions. The Director of the Ministry's Soil Conservation Branch is vested with the authority to stipulate specific instructions for grazing activities in these areas, including an outright ban on all livestock presence in them. Any land moving activities or cultivation in special regions, even those with the objective of soil conservation, must be conducted according to a program that is approved by the Director. The regulations also create "Soil Conservation Authorities" who are given responsibility for initiating soil conservation activities, including the powers to implement projects directly and to prepare soil conservation plans.

The law assigns the public a role in assessing these plans. They are open for public review so that anyone- including those with "an interest in the land" or who simply oppose the plan- is entitled to submit a formal objection within twenty days of its

publication. The local Soil Conservation Authority then passes the objection along with its response to the Drainage Authority that appointed it. Once approved, the local Conservation Authorities can enforce the plans through administrative orders or through their independent implementation of soil conservation measures.

From an administrative perspective, erosion control is overseen by Israel's Ministry of Agriculture, through the Department of Soil and Drainage that sits at the Ministry headquarters at Beit Dagan. Yet, the size of this department has shrunk dramatically in past years and is presently at less than 50% of its previous capacity, with the number of field offices reduced from six to two. Through its promotional work, the hundreds of extension service professionals who assist Israel's farmers are generally aware of soil conservation opportunities. Some of the erosion control work has passed over to local Drainage Authorities, several of which have emerged as effective local environmental agencies. This is particularly true in the Negev region.

Specific responsibility for erosion control research and understanding local runoff dynamics was placed in the hands of the *Erosion Prevention Station*. Established in 1953 at the recommendation of U.S. soil conservation expert Walter Lowdermilk, the Station's offices are located at the Rupin Agricultural College near the coastal city of Netanya, although the scope of its activities reaches the entire country. The Station has eight workers and it also employs some eight sub-contractors who work in the area. The Station's budget is 3 million shekels (\$670,000) and it serves as a professional facility for the Ministry of Agriculture with a mandate to design designing and promote erosion control and research programs.

The Station's recommended strategy for erosion focuses on reducing the quantities and the velocity of runoff in rainfall events, particularly in the agricultural sector. A variety of tactics are applied according to the specific soil conditions among the farming sector, the crop demands and of course anticipated rainfall quantities. Ideally, all precipitation would be captured on cultivated lands; whatever is not utilized by crops could be captured *in situ* for penetration into groundwater. Achieving this often requires the reduction of physical soil crusts which develop on vegetation-stripped lands and then prevent percolation and accelerate runoff. (It is worthy clarifying that most local rangelands are covered with biological crusts, which are in fact beneficial for soil quality.) In addition, the Station works to facilitate the implementation of standard "best management practices" for controlling soil erosion (conservation tillage, terracing, contour plowing, etc.)

In practice, eliminating runoff altogether has often proven to be impossible and in many regions government efforts focus on slowing the velocity of runoff so as to reduce its erosive effects. Accordingly, in many cases a "watershed" approach is required to control the erosive impacts of agriculture. Frequently, removal of land cover around agricultural operations has increased the velocity of runoff and exacerbated erosion downstream. For example, after recent rain events in the Beit Shean / Afula region, massive quantities of soil were washed onto roads that ultimately had to be collected and returned to the fields. An extreme case of degradation can be seen in the rural region around Ramot Menashe, where comparison of historic soil testing indicates that there has been a net loss of as much as 50 mm of soil since the 1950s.

With regards to "regulatory strategy", despite the enforcement authorities it holds, the Ministry of Agriculture's position in Israel has traditionally avoided command and control regulatory dynamics with farmers and preferred to engage them in "voluntary" erosion control efforts through subsidies and economic incentives. Farmers who can show economic losses through adoption of Best Management Practices (e.g., shift to no-till plowing) receive compensation under soil conservation entitlement programs. Many soil enhancement programs have been undertaken (e.g., compost and mulch dissemination) although funding at the Ministry is often insufficient to reach all priority regions.

Enhanced awareness among the farming community of Israel as to the potential benefits of soil conservation is a major objective of the Ministry. For example, it has undertaken promotional efforts to convince farmers to shift from field crops (e.g., wheat) on steep, hilly lands to fruit orchards, with the attendant promises of reduced soil loss. Often financial support is required to help a farmer or an agricultural community through such a transition.

Sociological currents also affect the dynamics of soil conservation. In the past, erosion control on kibbutzim (Israel's large communal farms) was the responsibility of a single community resident making coordination easier for government officials. Private farms (moshavim) constituted a more unwieldy form of community given the disparate conditions and personalities of farm operators. Today, however, with increased privatization among Israeli kibbutzim and the shift to independent revenue-making economic branches, administrative cooperation has become more difficult. Agriculture on kibbutzim increasingly is required to meet tough standards of profitability, making long-term investment in soil conservation less popular than it once was. At the same time, many farms have begun to show keen interest in a more aggressive soil conservation policy, and a series of field trips have been organized to take farmers to review model soil conservation projects. But inadequate funding from the central government still constitutes a major obstacle to implementation.

B) Afforestation Law and Policy Implementation: Soon after the British government assumed a political Mandate over Palestine, a Forestry Ordinance was enacted in 1922 in order to restore woodlands in the large tracts of degraded lands throughout what was then Palestine. The Law was later amended, but the present 1936 Ordinance which technically oversees afforestation in Israel has only been changed once in a minor 1964 amendment. According to the law, the Minister of Agriculture can declare any lands that are not privately owned to be a forest reserve that will be overseen by the government.

In Israel, only some 8% of lands are privately owned, meaning that theoretically, the vast majority of the country's territory can be readily designated as forests or nature reserves. Restrictions on human activities in forest reserves are comprehensive. Among the key limitations are proscriptions on:

- the taking of any wood products;
- the uprooting of any tree by its roots;
- burning or even removing bark from trees;
- the burning of weeds without taking precautions to prevent the spread of fires;

- allowing for cattle grazing in or near reserves;
- cultivating lands inside protected woodlands;
- damming any waterways; and
- taking up actual residence inside a reserve.

Fallen trees can be removed by adjacent villagers who historically had relied on these forests for wood supply, after receiving a permit to that end. The law also requires mandatory assistance in the combating of forest fires by local residents living within five kilometers of the forest. Penalties for violation of the law include incarceration for up to twelve months, a monetary fine and payment of the damage caused by the violation. Such strict rules helped reverse the historic trends of deforestation or degradation in local woodlands.

Over fifty years after the British Mandatory government established restrictions for behavior in "forest reserves," the Israeli government promulgated regulations that apply to visitors in *Nature Reserves*. As some 25% of all Israeli lands are designated to be reserves, and the majority of them are located in the southern arid and semi-arid regions, this has broad implications for land management in the drylands. Like most reserve systems worldwide, grazing is not allowed without a permit, hiking off marked trails is prohibited as well as driving or parking vehicles inside reserves.

Institutionally, according to a 1961 "covenant" between the Jewish National Fund and the Israeli government, afforestation and forest management are overseen by the JNF. Since that time, the Ministry of Agriculture is no longer officially involved in the field. The JNF is a public corporation owned by the World Zionist Organization and overseen by a publicly elected board of 32 directors. For a variety of historical and ideological reasons, by the 1960s, the JNF had forty years of experience in forestry and a substantial budget to implement an aggressive afforestation program throughout the country; Granting them responsibility for Israel's forestry made sense. Indeed, during the past fifty years, the organization has planted over 260 million trees, largely in areas with semi-arid climates and frequently on rocky, hilly terrain in which agriculture cultivation is not cost-effective and where the risk of land degradation is high.

Since the aforementioned "covenant", the most important statutory development in Israel's afforestation strategy was the government's approval of the National Masterplan for Forests and Afforestation (referred to locally by the Hebrew acronym: "TAMA 22") on November 16, 1995. As part of Israel's planning and building system, National Masterplan 22 zones different kinds of forests throughout the country according to the conditions existing in different climatic and scenic regions. A few dozen other Masterplans have been approved since the Israeli Planning system was overhauled by the 1966 Planning and Building Law. These include nationwide blueprints for roads, power plants, mining, garbage disposal, coastal and tourist development and, as of March 22, 1995, forests. Once the cabinet approved the national masterplan, the associated land designations carried the force of law.

The forestry plan in practice was prepared by JNF foresters in coordination with a range of government agencies. From a strictly legal perspective, the plan's normative prescriptions are brief with only fifteen sections in a seven page plan. The maps that

make up the Appendices to the plan are, however, extremely detailed, outlining forest location and the type of plantings. After Israel's Supreme Court responded in 1998 to a legal petition by a public interest organization, the JNF was ordered to prepare a formal, detailed plan for each forest that has to undergo public scrutiny and formal adoption process by planning authorities.

The scope of Israel's afforestation efforts in the drylands is worthy of mention. Under National Masterplan 22, the JNF is responsible for close to 200,000 hectares -- one tenth of the nation's lands. Some 60,000 hectares have already been planted, and the plan calls for 30,000 more, most of which are to be planted in the arid southlands. The remaining lands falling within the forestry masterplan are to remain as open spaces with natural woodlands preserved. While the JNF owns considerable real estate within Israel, the lands on which the forests of Masterplan 22 are located are largely owned by the government. In 2006, the Jewish National Fund signed a 49 year rental agreement with the State of Israel, essentially granting it ownership over these lands for the foreseeable future, a step that is expected to lead to more effective management.

The Masterplan reflects a new "ecological" sensitivity to forestry in Israel. The plan formally recognizes seven different types of forests from "Natural Forests for Preservation" to "Human Planted Existing Forests" and stipulates those areas in which indigenous flora must be maintained. Section 6(a) reads: *"The detailed planning of the forest in these areas will be made on the basis of the natural data concerning the entire area, taking into consideration preserving the landscape characteristics, the environment and the appearance of the land."* In 2005, the Jewish National Fund Board of Directors adopted a position paper outlining its commitment to "sustainable forestry" involving diversity in the planting of indigenous species, elimination of deleterious pesticides presently in use, public involvement in the planning of forests and allowing limited commercial activities to take place at the entrance to the forests.

In short, afforestation plays a significant role in Israel's general strategy to combat desertification. A more detailed description of specific dryland forestry techniques (e.g., savanization) appears in previous National Reports. The presence of large tracks of woodlands in areas with rainfall as modest as 250 mm/year has contributed to renewing soil fertility in parts of the Negev desert region in Israel providing grazing lands for the local Bedouin populations, recreational resources for the public and in many cases sanctuaries for protected wildlife.

Many experts believe Israel's present forestry laws to be antiquated and indeed the State Comptroller has called for a new forestry law to be promulgated that would replace the old British Mandate Ordinance from seventy years ago. For the past several years a committee comprised of experts from Israel's Ministry of Agriculture and the Jewish National Fund have worked on a draft "Forestry and Trees Law". The proposed bill would create a public council to oversee forestry and give the Ministry of Agriculture a formal role in drafting public policy in the field. Its passage is anticipated during the coming years.

C) Grazing Statutes and Policy Implementation

Almost from the country's inception, legislation to control grazing and to combat desertification was a national priority. Before other environmental and natural resources

statutes were seriously considered, one of Israel's first statutes expanded the British Mandate's "grazing prohibitions" with a particular focus on eliminating goats in public rangelands. Accordingly, in 1950, but a year after gaining national independence, the Knesset enacted the Plant Protection (Damage from Goats) Law. This one page statute prohibits grazing of goats on public lands, and even stipulates grazing standards on private lands to ensure that carrying capacity is not exceeded. A two-tiered standard for different soil conditions was established. Technically, the law remains in force today in Israel. Specifically, one goat is allowed for four hectares of rain-fed lands, while a single goat is allowed on one hectare if it is irrigated land. The Minister of Agriculture is empowered to ban grazing of goats on any lands while at the same time the Minister (or his representative) *can* grant permits for grazing. If private lands contiguous to an individual's house are fenced or if the goats are tied down, the Ministry can offer some flexibility, granting grazing rights after stipulating seasonal restrictions. The law is defined as a criminal statute and grazing violations, at least in theory, are punishable by six months incarceration and/or a fine.

The "Damage from Goats" law also includes provisions for enforcement that authorize inspectors from the Ministry to enter lands (but not private homes) where there is a suspicion of exceedance of the grazing standards. In the event that an inspector identifies lands in which more goats are present than are allowed under the law, he/she is entitled to confiscate the animals until the stocking density drops to a permissible level and sell the excess goats that have been taken. If no criminal action is filed within three months, all proceeds from the sales must be returned to the owner of the goat. The three month period also constitutes a "statute of limitations" after which criminal actions against violating livestock owners cannot be prosecuted.

Institutionally, Israel's Ministry of Agriculture oversees grazing in the country via its Grazing Authority. In fact this is a small department run by a Director and five regional workers whose positions are officially entitled "Grazing Planners". Yet, it has the responsibility of maintaining the sustainability of some 200,000 hectares of public rangelands. The authority oversees roughly three hundred thousand animals which are divided into two general groups: grazing by stationary farmers (typically in the Jewish sector) and nomadic herders (typically Bedouin), who migrate with their flocks according to the seasonal grazing opportunities.

The following is the estimated breakdown of grazing livestock in Israel in July 2006:

Type of Animal	Number of head in Agricultural Sector	Number of head in Nomadic Sector
Cows	60,000	
Goats	10,000	15,000
Sheep	30,000	185,000

Source: Israel Grazing Authority, Ministry of Agriculture, 2006

The Grazing Authority's staff is comprised of trained professionals trained in agronomy or animal husbandry. Their primary mission is to work with both the pastoral and the agricultural communities in extension support. The Authority's work focuses on assistance to land owners in the areas of seeding lands, fertilizing rangelands and pruning

woodlands to reduce fire hazards. Management activities can be as simple as facilitating the fencing of vulnerable areas in order to control grazing levels. For example, with the closing of several Israeli military training grounds, and the reduction (or cessation) of grazing therein, erosion rates dropped precipitously.

The Grazing Authority itself is not directly involved in enforcement activities. Ensuring compliance is the responsibility of the "Green Patrol" that serves as a mobile enforcement unit who has been authorized by law both to remove squatters from public lands and to impose penalties on livestock owners who exceed stock quotas in Israeli rangelands.

In recent years, the Grazing Authority has undergone a complete change in orientation with regards to "black goats" or goats in general. Present thinking at the Ministry of Agriculture now holds that during the 1950s there was a fundamental misapprehension about the ecological and practical contribution of goats to rangeland management. Since their phase-out as foragers, forests and woodlands have become overwhelmed with undergrowth making them impassible. This also creates a significant fire hazard. In practice, for several years now government policy has been *not* to enforce the outright ban. The Ministry of Agriculture's legal department is preparing a new "Grazing Law" which would integrate updated carrying capacity standards of animal numbers according to specific land conditions. As the tables above indicate, the goats have made a modest comeback and are "welcomed guests" by many forest and rangeland managers.

Enforcement of grazing restrictions, as mentioned, in general is conducted by Israel's Green Patrol. This inter-agency body today is formally based at Israel's Nature Reserve and Parks Authority. The Patrol has some 47 workers and rangers and provides enforcement services to a range of public land management agencies. When squatters trespass on public lands the Patrol has the authority to remove them, and for some thirty years has been active in preserving the integrity of Israel's Nature Reserve System and Israeli forests. In the past, this has created friction with local residents; tensions have emerged with the establishment of several illegal Bedouin settlements in the arid Negev region and attendant uncontrolled grazing that can exceed the capacity of the plants to regenerate. While the Patrol continues to take measures to prevent illegal grazing when it contravenes prescribed limits, tactically, the Patrol's approach has become more conciliatory.

Many Israeli herders operate according to long-term contracts with the Israel Lands Authority, or on occasion joint contracts with the Israel Lands Authority and the Jewish National Fund. As the Land Authority manages 92% of Israel's territory, it has the ability to stipulate grazing conditions on most of the country's lands that are susceptible to degradation. Seasonal contracts are often made directly with the forestry department at the Jewish National Fund as well. For instance, grazing rights to "stubble" to summer are also sold to herders. Typically, a symbolic charge is levied as a grazing fee – a couple of pennies per head of livestock per month are paid for grazing rights. These funds are transferred to the Israeli Ministry of Agriculture.

Notwithstanding the extensive grazing through Israel, a considerable portion of livestock rely on hay and other fodder during different periods to supplement rangeland grasses. As this increases expenses for livestock farmers, there is a temptation to exceed stipulated foraging limits. When grazing levels violate the stocking limitations stated in the

agreements, government enforcement action is taken with an iterative series of responses:

- 1) An enforcement warning is issued in a letter to the violator.
- 2) Government subsidies and grants are removed if there is no compliance with the demands.
- 3) If the violation continues, the rental contract will be cancelled and grazing rights revoked.

D) Water Management Programs

New Wastewater Reuse Standards: Israel's 2002 National Report reviewed the utilization of wastewater as a major component of Israel's agricultural infrastructure in the drylands. Indeed, in the semi-arid region, recycled wastewater constitutes the largest single source of irrigation water. Recently, two major developments in wastewater reuse policy are contributing to a general upgrade in the field. These can be characterized as both "quantitative" and "qualitative" in nature.

First, in response to three years of consecutive droughts, in 2000 Israel's government formally passed a resolution to increase wastewater reuse to 500 MCM by 2010 (bringing the total percentage recycled to 74%). In fact progress has been swifter than planned. As of June, 2006, 91% of Israeli sewage is treated and 72% is reused, primarily by the agricultural sector. This strengthens the future viability of agriculture in the drylands at a time when demographic growth and higher quality of life are raising demand for an increasing percentage of available fresh water.

Second, to maximize safety and minimize environmental risk from wastewater reuse, in 2001 the Ministry of the Environment called for the upgrading of water quality standards for both agricultural use of treated wastewater and its discharge into streams and rivers. Accordingly, a new standard was proposed in 2002 by an inter-ministerial committee (named the "Inbar Committee" after its chairman.) Its members included a range of stakeholders with an interest in wastewater (Ministries of Environment, Agriculture, Health, Finance, and others, as well as farmers and local authority representatives). The standard is dichotomous with *irrigation* standards based on considerations of soil, flora, hydrological and public health and *stream* standards determined by projected in-stream ecological carrying capacity. The Israeli government adopted the standards on April 14, 2005.

Until then, standards for wastewater treatment only included public health considerations, setting limits on organics and pathogens in wastewater. Regulations promulgated by the Ministry of Health in 1992 required treatment to a minimum level of 20 mg/liter biological oxygen demand (BOD) and 30 mg/liter total suspended solids (TSS) in every settlement with a population exceeding 10,000 people.

The 1992 legal requirement was soon deemed insufficient for several reasons. Due to the presence of pathogens in the treated wastewater, irrigation is restricted to certain crops (typically disqualifying field vegetables). Such wastewater also poses risks to soils (in particular salinization) and threatens groundwater sources. For example, the area over

Israel's coastal aquifer is irrigated with 50 MCM of wastewater annually, which contributes an estimated 17,500 tons of chlorides to groundwater in addition to undesirable concentrations of organic compounds, nitrates, and heavy metals. Israel's Hydrological Service reported in 2001 that about 15% of the water pumped from the coastal aquifer failed to comply with Israeli drinking water standards for chloride and nitrate concentrations, which are by no means strict compared with those of other countries.

Nitrate pollution of groundwater also can often be traced to use of fertilizers by local farmers as well as from irrigation with wastewater, which contains high concentrations of ammonia. Nitrate levels in the coastal aquifer have come to average 60 mg/l, with concentrations frequently exceeding 70 mg/l in traditional agricultural areas in the center of the country. The World Health Organization (WHO) recommended limit for nitrates in drinking water is 50 mg/l. The newly approved irrigation standard addresses the excess nitrogen by requiring nutrient removal for wastewater used in areas with high hydrologic sensitivity, limiting total nitrogen to 20 mg/l.

Salinity is another environmental hazard linked to wastewater irrigation that especially affects land productivity in the drylands. When wastewater is recycled, the salts present in the sewage are recycled along with the water. During storage in reservoirs, evaporation can lead to further elevation of concentrations, resulting in much higher salinity in wastewater than in the fresh water going into the system. High concentrations of salts (sodium, boron, chlorides) damage crops, salinize soils, and pollute groundwater. This can accelerate the salinization process and degradation of lands in arid and semi-arid regions.

In retrospect, the original "20/30" standard was largely based on the European practices, where the copious flows in streams and rivers allow for significant dilution. In the semi-arid and arid context of Israel, where rains are seasonal and most streams and rivers are ephemeral for much of the year, the only water flowing in streams is effluents. Existing levels of treatment did not produce meaningful restoration of ecosystems and recreational utilization of waterways.

The new improved standards promise to reduce environmental pollution and health risks, as well as eliminate the restrictive list of crops which may be irrigated with wastewater. Recycled effluent could then be permitted for use on any crop. This would allow for an even greater shift in water allocations to farmers from fresh water to wastewater, conserving fresh water supplies for the growing domestic sector while preserving the extent of crop range currently in cultivation in Israel's drylands.

The new criteria require sewage treatment to a 10/10 BOD/TSS level, with additional limits for boron, salinity, and heavy metals (which must be removed at the source) as well as nutrient removal in areas of hydrological sensitivity. The objective is to treat 100% of the country's wastewater to a level that allows for unrestricted irrigation while minimizing the risk to crops, soils and water sources. Although it has been officially approved, the proposed standard will take some ten years to phase in, given the economic

and financial aspects of the upgrade which are estimated to reach 220 million dollars. Table 2 offers a presentation of the new proposed standards.

Table 2: Proposed Maximum Levels in Effluent Reuse for Unrestricted Irrigation and Discharge to Rivers

Parameter	Unrestricted	Rivers	Parameter	Unrestricted	Rivers
Conductivity	1.4 dS/m		Arsenic	0.1 mg/l	0.1 mg/l
BOD	10 mg/l	10 mg/l	Barium		50 mg/l
TSS	10 mg/l	10 mg/l	Mercury	0.002 mg/l	0.0005 mg/l
COD	100 mg/l	70 mg/l	Chromium	0.1 mg/l	0.05 mg/l
Ammonia	20 mg/l	1.5 mg/l	Nickel	0.2 mg/l	0.05 mg/l
Total nitrogen	25 mg/l	10 mg/l	Selenium	0.02 mg/l	
Total phosphorus	5 mg/l	1.0 mg/l	Lead	0.1 mg/l	0.008 mg/l
Chloride	250 mg/l	400 mg/l	Cadmium	0.01 mg/l	0.005 mg/l
Fluoride	2 mg/l		Zinc	2 mg/l	0.2 mg/l
Sodium	150 mg/l	200 mg/l	Iron	2mg/l	
Fecal coliform	10 per 100 ml	200 p 100 ml	Copper	0.2 mg/l	0.02 mg/l
Dissolved oxygen	< 0.5 mg/l	< 3 mg/l	Manganese	0.2 mg/l	
pH	6.5 - 8.5	7.0 – 8.5	Aluminum	5 mg/l	
Hydrocarbons		1 mg/l	Molybdenum	0.01 mg/l	
Residual chlorine	1 mg/l	0.05 mg/l	Vanadium	0.1 mg/l	
Anionic detergent	2 mg/l	0.5 mg/l	Beryllium	0.1 mg/l	
Total oil		1 mg/l	Cobalt	0.05 mg/l	
SAR	5 mmol/l 0.5		Lithium	2.5 mg/l	
Boron	0.4 mg/l		Cyanide	0.1 mg/l	0.005 mg/l

The old standard for wastewater treatment did not set limits for salinity since salts cannot be removed during the treatment process (unless wastewater is desalinated). The proposed standard, however, does set sodium, chloride and fluoride limits. Strategically, salts must be treated at their source. Since 1994, the Ministry of Environment has enacted regulations designed to reduce the salinity of sewage. These include regulations on ion exchangers, controlling the use of salt in slaughterhouses (in the koshering process), discharge of brine to sewers, and the formulation of domestic and industrial detergents with reduced boron, sodium, and chloride content. Moreover, as desalinated water becomes a major source of municipal water, salt concentrations in effluents will drop.

Conservation and Demand Management: While national water policy traditionally focused on increasing supply, Israel's Water Commission has strengthened conservation and demand management programs as part of an overall national strategy. Traditional subsidies for agriculture are being phased out and rates for domestic users rise dramatically when usage exceeds basic levels. Nonetheless most economic analyses suggest that demand for water is highly inelastic and that pricing is not the key to controlling demand. Rather, a combination of technology diffusion, education and regulation has kept urban water consumption steady despite a trebling of the population and the GDP during the past forty years.

Among the more successful technological innovations has been the approval of a new water-saving standard for toilets and introduction of double-volume (6 liter/3 liter) flush basin toilets in new buildings as well as flow regulators on taps and showers. Another government grant program led to massive retrofitting in all public and municipal buildings to upgrade leaky and wasteful plumbing infrastructure.

Regulation is also a part of the policy package. City governments for many years were fined if leakage in local delivery systems exceeded 15%. (The overall average loss in municipal systems nationally is estimated at roughly 9% which is extremely low by international standards.) In a new proactive program, a fee embedded in water prices goes directly into a "Plumbing Restoration Fund" which makes annual grants to cities to maintain infrastructure. Individual car washing using hoses is prohibited year round (buckets with towels are permitted) and commercial car-washes must install water recycling systems. Non-drip irrigation in cities is banned except during the summer months and then limited to night-time hours to reduce evaporation. There have been a few cases where Municipalities were fined by Israel's Water Commission for day-time irrigation. Public awareness campaigns continue to remind Israelis about their vulnerable hydrological reality. Educational initiatives focus on children, with popular television shows receiving funds to feature water saving opportunities.

The most dramatic increase in efficiency can be seen in Israel's agricultural sector. During its first sixty years, while the country's population grew seven-fold, agricultural production expanded sixteen-fold. Water usage, however, did not increase. The invention and introduction of drip irrigation in Israel during the 1960s was the single most important innovation in local agricultural development although its dissemination was market-driven and had little to do with government intervention.

3) Resource Mobilization

There are several areas where Israel's government investment in activities and research that address the drivers of desertification is significant. For example, the Ministry of Agriculture, through its Volcani Institute of Agriculture Research and satellite stations, budgets some 70 million dollars for applied research, much of it to bolster sustainable agricultural initiatives in the drylands. The Jewish National Fund recently increased its funding of experimental agricultural stations in the country's periphery to over two million dollars.

Yet, in other areas, the financial contribution of Israel's government and related institutions to address the drivers of desertification has dwindled over the years. There is no formal budget-item or dedicated personnel for UNCCD implementation at the Ministry of Foreign Affairs or at Israel's Ministry of Environment. This is manifested in reduced funding for afforestation, erosion control, and regulation of activities that cause desertification as well as missed scientific opportunities. For instance, the Erosion Control Station has been unable to utilize new tools, such as remote sensing to optimize its efforts. The Station's overall budget remains a very modest 5 million shekels (1.1 million U.S. dollars) even as it is charged with a critical task for Israel's future. (At the same time, water quality programs, for which funds are often more available to reduce non-point source contamination than for soil conservation, may provide an additional

source of funding and support for hydrologically related erosion research initiatives.)

The past few years have also seen a dramatic drop in the budget of the Jewish National Fund which quickly translated into a sharp reduction in the allocation for afforestation activities. In 2000 the JNF allocated close to 30 million dollars for forestry. Due to a variety of budgetary problems, in 2005 that budget item was cut in half to \$15 million. The increased level of donations during this period from JNF affiliated organizations in countries around the world has made a substantial contribution to allowing the Jewish National Fund to maintain its general scope of operations.

An exception to the trend of lowered societal investment in desertification-related activities is the aforementioned program to update sewage treatment and expand reuse of effluents. The ten-year 220 million dollar plan should leave a lasting imprint on water management in Israel's drylands. While there are clearly strong environmental justifications for improving wastewater quality, the economic benefits were less obvious to decision-makers and depended on whether a macro- or local-level perspective was taken. Upgrading wastewater treatment facilities will require significant government infrastructure investment, at both the national and local levels. Initial investments in upgrading or constructing new treatment plants are typically covered or subsidized by the national government, while operating and maintenance costs are the responsibility of local authorities. A key part of the recent government's "wastewater decision" was to list those sewage treatment plants that were to receive priority in upgrading, based on hydrological considerations.

The economic aspects of the treatment upgrade in Israel have proven controversial and arguments among government authorities over how to deal with the costs have not been fully resolved. In addition, opposition from local authorities and farmers (the producers and consumers of wastewater) delayed the approval of the proposed standard. Yet, ultimately the proposed budgetary commitment was not reduced and the resulting compromise and the new standards should enable farmers in the drylands to receive higher quality effluent and broaden their range of crop opportunities.

Without a doubt the resources that are now being garnered to expand economic development in the Negev are unprecedented. The four billion dollars of public funds and matching eight billion dollars privately envisioned in the *Daroma* initiative (described in section 4 of this report) that will be allocated for projects in the arid Negev region can be viewed as a direct investment in "alternative livelihoods." On the other hand, with a declared goal of essentially doubling the population in the greater Beer Sheva and surrounding semi-arid and arid regions, the plan can also worsen desertification trends. Without a clear review of these ventures' impact on soil and land integrity, it is difficult to ascertain whether the investment can be classified as resources dedicated to combat desertification or projects that will make present dynamics worse.

4) Linkages and synergies with other environmental conventions/national strategies

Climate Change and Biodiversity Conventions: Israel is a signatory to most major multi-lateral environmental conventions including the United Nations Framework Convention on Climate Change and the Convention on Biological Diversity. The potential synergy

between these two treaties and the UNCCD are often raised. With regards to the Climate Change agreement, as Israel is not classified as an "industrial nation" under Annex I to the convention, the operational expectations from the agreement locally are low. Israel has conducted the necessary greenhouse gas audit and established a team through the Ministry of Environment to expedite local projects via the Clean Development Mechanism (CDM) framework of the Kyoto Protocols. There has been some research with regards to carbon sequestration potential in drylands forestry, but to date there have been no real climate-related initiatives that offer meaningful "synergy" for soil conservation and anti-desertification efforts, beyond those mentioned in Israel's 2002 report. Efforts by Israel's Ministry of Environment along with nongovernmental organizations to have the country voluntarily adopt a "carbon ceiling" and enter the Kyoto trading framework have not been successful to date.

Israel's implementation of the Convention on Biodiversity has been patchy. On the one hand, existing legislation and nature preservation initiatives in place at the time of the convention's inception covered many of the expectations from signatories. Nonetheless, over a decade after ratification by the Israeli government, a national action plan for biodiversity preservation has not been formerly approved. The establishment of nature reserves and the expanded protection of lands that are particularly vulnerable to degradation should undoubtedly be an important component of a national desertification strategy. Yet, to date such considerations have not been part of the preservation paradigm.

Certainly recent progress in biodiversity protection may have a positive impact on combating desertification. For many years, little progress was made in transforming the map delineating "planned" nature reserves into statutorily declared and protected sanctuaries. Israel's Minister of Interior is authorized to make such declaration after a long litany of consultations with affected national and local government agencies. Due to the energetic efforts of Israel's Parks and Nature Reserves Authority and lobbying by local NGOs, some 90% of these lands are now formerly zoned for preservation. Assuming that these havens are fully protected, this broad network of parks and reserves will undoubtedly be an important part of the long-term strategy throughout Israel, not only for biodiversity protection, but also for combating desertification inasmuch as human activities inside reserve boundaries are minimal.

Synergies with National Development Strategies: Two major planning initiatives that fall within the category of "national strategies" have progressed during the past year, and both are likely to influence dramatically Israel's land allocation, management and economic initiatives within the drylands. The first, *National Masterplan 35* is a comprehensive plan which attempts to create a long-term strategy for the anticipated population growth in the country. This National Plan is the *statutory* expression of the 2020 *conceptual* program that was described in some detail in Israel's 2002 National Report (p. 7). *National Masterplan 35* limits present trends towards urban sprawl and attempts to ensure the integrity of large swaths of agricultural lands. Of course the nature reserves and parks, which make up some 30% of the country's land resources, along with forests which comprise an additional 10% of land holdings are also integrated into the Masterplan. As

such, it has enormous potential for leveraging activities associated with desertification control. For instance, the Master Plan maintains and expands the extensive agricultural zoning of lands in Israel's semi-arid zones and the forests there. However, critics point out that the orientation of the Masterplan in these areas speaks only of "conservation" and preservation – rather than addressing restoration per se of degraded areas, which could have been an important contribution to combating desertification.

Public involvement in the preparation of *National Masterplan 35* was intensive. The Society for Protection of Nature in Israel, the country's oldest and largest environmental NGO, has representatives on the National Planning Council and has filed dozens of objections and corrections to the plans, many of which were accepted. The Jewish National Fund (JNF), with its public board of directors and an NGO persona was also involved. On the very day that the plan was approved by the Planning Council, due to protest by JNF representatives, the Beit Keshet forest, near Nazareth was preserved and included in the plan. Hence, public involvement expanded the protection in certain protected areas and preserved forested regions that would otherwise be subject to erosion.

Israel's Negev desert region contains a rain gradient that runs from hyper-arid to semi-arid regions. Most of the Negev's population lives in the arid, "northern Negev" region, surrounding and to the north of Beer Sheva. The area is considered economically depressed with average wages falling 11% below the national average (\$1,223 versus \$1,370) and an unemployment rate that is 14% - 25% higher than the national average. The region also includes some 150,000 Bedouin Arabs, many of whom are among Israel's poorest citizens, with numerous inhabitants living in illegal shanty-towns. The birthrate in the Bedouin sector, over eight children per family, is the highest of any ethnic group in the country and 54% of its population is under 14 years of age. Only 2.2 percent of Bedouins between the ages of 20 and 29 attend university – as opposed to a national average of 15%. The lack of economic opportunities for these communities is a driver which pressures many Bedouin to supplement their income through subsistence, pastoral shepherding, leading to overgrazing in some areas of the Negev.

In response to the perceived neglect of the desert region, in October 2005, Israel's government adopted the "*Daroma*" or "Southbound" project. As most of Israel's population lives in the coastal region of the country, the area from greater Beer Sheva to the south is often referred to as the "periphery". The project is designed to provide investment in the economic infrastructure in the southern districts and in particular provide employment and educational opportunities for the weaker socio-economic groups in this desert region. Much of the motivation for the initiative is sociological, to maintain the demographic balance throughout Israel, as well as "security" - dispersing the economic infrastructure away from the narrow Tel Aviv corridor. Investment in the Negev is to include transportation infrastructure, support for new communities and transfer of key industries and defense establishments to the area.

Presumably, much of the landscaping which is being planned for community development may have beneficial effects, but several development initiatives (roads, etc.) may be deleterious in this respect. The budget for the project is set at 17 billion NIS (4 billion dollars), an unprecedented sum by local standards, and the anticipation is that the government investment will be matched by some 8 billion dollars in funds from the private sector. There is little doubt that in terms of creating "alternative livelihoods" for

drylands residents, this is the most significant initiative of its type for Israel's semi-arid region in decades. The plan was prepared by an independent NGO ("*Daroma*") with government support. The planners elicited responses from key stakeholders, yet little if any responses of the public considered the potential of the development proposals to increase desertification.

An additional plan while not national in scope has important regional implications for the semi-arid region in the south of Israel as well as in the context of combating desertification and is therefore worthy of mention. Draining a significant percentage of the Israel's northern Negev region, the "*Besor/Beer Sheva*" stream constitutes the largest watershed in Israel the Beer Sheva/Besor basin area varies spatially in geography, climate, geology, land use, and vegetation. The catchment area spreads from the southern Hebron Mountains in the north within the Palestinian territories to Sede-Boqer in the south; from the northern Negev in its central section to the Mediterranean Sea in the west where the stream estuary is located in the Gaza Strip.

The climate in this basin is semi-arid to Mediterranean, characterized by a long dry season and short wet seasons, with two short transition periods during the spring and fall. The wet season occurs during the winter, influenced by Mediterranean fronts. Naturally, the Hebron/ Besor is an ephemeral stream characterized by a maximum of 6-7 flow events per year which can transport large volumes of water and sediments. On average there are 2-3 flood events per year, while some years may have no floods at all. The main land uses in the watershed are undeveloped lands, agricultural, and urban areas. Yet, industry, mining, quarrying, and manufacturing are important activities that influence the watershed and the stream water quality.

The major point pollution source is a raw sewage discharge from the city of Hebron into the Hebron stream. The Hebron Stream drains the domestic sewage of the city of Hebron and the Israeli settlement of Qiryat Arba (together app. 200,000 residents). In addition, untreated sewage as well as the wastewater from almost 100 industrial facilities flow to the stream. This source changes the fundamental nature of the ephemeral stream converting it into a de facto sewage conduit with a permanent base flow that continues for more than a 100 km downstream. Additional point pollution sources on the Israeli side of the watershed are treated effluents of very low quality that are discharged from local "development towns" such as Dimona into the Ar'ara – Beer Sheva stream; treated wastewater discharges from Ofakim into the Patish stream; and occasionally treated wastewater that leaks out of municipal waste facilities in the city of Beer Sheva into the Beer Sheva Stream.

Recently, two new plans for restoration of the Beer Sheva and the Besor streams were designed and approved by the planning authorities. The local Drainage District's status was upgraded to a "River Authority" giving it additional authorities to regulate environmental insults and challenges to the river. For the first time in a river restoration plan, stream bank stabilization and other erosion control activities were included. The preparation of the plan included participation of the Jewish National Fund which included operational objectives that would reduce the steady gulley erosion that is increasingly prevalent around ephemeral streams in Israel's drylands. Related measures include a ban on quarrying in and around the stream, physical construction to stabilize lands, and a range of planting to increase ground cover in the affected areas. Activities to implement

the plan have begun although they are still in the early stage of execution. As desertification in Israel is conspicuous alongside stream banks, the expanded focus of the restoration plan constitutes an important precedent for future activities.

5) Measures for rehabilitating degraded lands

As mentioned, considerable tracks of Israeli forests have been planted on lands that were degraded, frequently as a result of historic overgrazing or deforestation. In the region of Ramat Yisachar and in the Harod and Beit Shean Valleys, for example, during the past several years, steep hillsides which exhibit soil loss have been planted with trees to stabilize them.

In addition, the Jewish National Fund has begun a rehabilitation program at the "heads" of ephemeral streams and valleys, especially in the Northern Negev region where both rill and gully erosion has set in. A variety of indigenous, arid-land flora has been planted which serve to stabilize the banks. In addition, landscaping to reduce the gradient of steep stream bed sections has led to a slowing of runoff during the seasonal floods and reduced erosion. Furthermore, harvesting water runoff upstream to create reservoirs, grazing stands and savanna-like landscape has reduced the ferocity and velocity of storm events which in turn relieves erosive pressures on degraded lands, allowing them improved conditions to regenerate, without the periodic damage caused by violent flash floods.

For the most part, rehabilitation efforts in Israel are undertaken without a clear statutory mandate or regulatory framework. An exception to this is retired quarries. Almost all of Israel's mining takes place in drylands. When sites exhausted their supply of resources in the past they were abandoned and constituted a net loss of lands and frequently a locus for erosion. To address this phenomenon, in 1978 Israel created a fund for restoring land damaged by quarrying activities. Promulgated under the old Mining Ordinance, *The Mining Regulations (The Fund for Restoring Quarries)* require quarry owners to pay a proportion of the revenues from materials they extract into the publicly operated fund. The fund's money is then used to reimburse expenses incurred in restoring lands after the quarry is no longer productive. Old quarries have been transformed into parks, public amphitheatres or simply returned to the general inventory of open spaces after they have been landscaped and planted.

The fund has reserves of over 150 million shekels, but still has only rehabilitated a fraction of the four-hundred sites that require attention. Nonetheless, a number of old scars on the land are already starting to heal. Not all sites that require attention are of recent origin, especially in a country with a continuous history of human settlement that stretches back millennia. For example, in 1993 a quarry that dates from the period of the Second Temple in Jerusalem (operating 2000 years ago) was at long last restored. Presumably it will not take that long to repair other sites.

6) Drought and desertification monitoring

As a small country Israel is relatively manageable from the perspective of monitoring drought and desertification patterns. With the advent of GIS programs, mapping of the country became extremely common in numerous contexts. Considerable information exchange takes place between different agencies and researchers that all rely on PC-

compatible Arc-View software. The Jewish National Fund, for example, has made a substantial investment in monitoring its tree plantings, with GPS locations assigned to individual trees for ongoing monitoring. Israel's Meteorological Institute offers periodic rainfall projections with varying degrees of successful prediction.

Yet on the whole, existing state-of-the-art monitoring techniques, in particular remote sensing methods, have not been readily employed to assess the condition of Israel's lands and identify trends of desertification. It has been many years since a soil erosion inventory took place throughout the country. The Remote Sensing Lab in the Department of Solar Energy and Environmental Physics at the Blaustein Institutes for Desert Research at Ben-Gurion University has extensive experience in using remote sensing to identify trends in desertification. Yet, most of its recent research has been directed at regions outside the Middle East and there has been little financial support for local Israeli monitoring of soil conditions. The Ministry of Agriculture's Erosion Control Station has considerable interest in establishing a long-term monitoring program using remote sensing and historic aerial photographs to track desertification trends, but has been unable to garner the necessary resources.

7) Access to New Technology

From its inception, Israel has made a strong societal commitment to supporting science and technology. This has been manifested in several activities relevant to desertification risks. For example, the flourishing of agriculture in the country's semi-arid and hyper-arid regions is largely the result of a concentrated investment in research related to salt and drought-resistant plant species, animal husbandry for extreme climates as well as green/hot house technologies and aquaculture.

Drip irrigation: Water management is undoubtedly the key to much of Israel's success in agriculture in arid, semi-arid and dry sub-humid zones. The most conspicuous technology in this regard is drip irrigation. Developed in Israel during the 1960s, and initially marketed in 1965 by the Netafim Corporation, today these irrigation systems can be applied either on or below the soil surface. Drip irrigation attempts to increase water use efficiency through reduced runoff and evaporation losses, reduced leaching of water and contaminants below the root zone, and increased yields. The “secret” of the success of drip irrigation lies in the provision of optimum conditions for plant uptake of water and nutrients.

The most recent generation of irrigation technology involves subsurface drip irrigation (SDI). It is increasingly utilized to provide water and nutrients to plants while maintaining a dry soil surface. Drip emitters in SDI systems are positioned within the soil in attempts to alternatively conserve water, control weeds, minimize runoff and evaporation, increase longevity of laterals and emitters, ease use of heavy equipment in the field, and prevent human contact with low-quality water. Additional motivation for SDI comes in the form of savings of the extensive labor involved with seasonal installation and collection of surface drip system laterals.

Drippers are commonly buried 7 to 30 cm under the soil surface but can be found as deep as 100 cm (in date palm orchards). Development of SDI started in the 1960s but held limited interest and realized limited success until the 1980s following successful Israeli

development of surface drip irrigation. Today, subsurface techniques and systems for drip irrigation represent increasingly important components of agricultural and landscape irrigation.

Utilization of SDI systems is particularly beneficial in wastewater disposal systems, making them particularly relevant to Israeli agriculture in the drylands. Whether for simple soil-based waste disposal or for agricultural utilization, regulated flow and prevention of surfacing are extremely important when irrigation systems rely on effluents. SDI is a potential tool for alleviating problems of health hazards, odor, contamination of groundwater, and runoff into surface water. SDI particularly augments opportunities for reclaimed municipal wastewater in landscape and turf culture and in edible crops. SDI presents a unique opportunity to manipulate root distribution and soil conditions in drylands in order to better manage environmental variables including nutrients, salinity, oxygen and temperature.

Desalination: Desalination constitutes the most recently adopted technological component of Israel's water management strategy. In the past, prohibitively high costs limited the scope of desalination to reverse osmosis facilities in remote southern agricultural communities and at the Red Sea resort town of Eilat where the hyper-arid conditions offered no viable alternative water sources. New membrane technologies and the reduced energy and economies of scale associated with mass production allow for 1000 liters (1 m³) of very high quality drinking water to be produced on Israel's Mediterranean coast for a cost of less than sixty cents. Desalination facilities planned inland that will treat large local supplies of brackish groundwater, containing lower salt concentrations, are expected to make high quality, potable water at roughly 30 cents/ m³. Accordingly, on April 4, 2002 Israel's government decided to build a series of four new desalination plants that should together produce some 250 MCM of desalinated water divided among four desalination plants. This constitutes a 15% expansion of existing water sources. Thus far, the new desalinated water has been directed almost exclusively to the semi-arid and arid regions of Israel.

The first of the new desalination facilities to go into operation is a plant in Ashkelon, on the southern tip of Israel's Mediterranean coastline, located adjacent to the local electric power station. Subsequent plants are in different stages of planning and implementation along the Mediterranean. The plant guarantees a production capacity of 100 MCM/year. Initial annual production of the plant ultimately came to exceed the production projection by 10 MCM/year in order to allow flexibility in production levels. The project relies on reverse osmosis (RO) technology, which continues to offer the most feasible treatment, technologically and economically. In fact, it is the largest RO desalination plant in operation in the world to date. The basic concept for the construction is to operate two parallel 50 MCM plants. Most systems in the location will be doubled except for the intake system. It is also the first desalination project ever to beat a target price of \$0.52/m³. Surprisingly, recent increases in oil prices have had little effect on production prices.

While there have been concerns about the implications of privatizing water resources, there was no meaningful protest from civil society organizations about the shift in ownership and financing structure. The plant has been designed, constructed and will be operated by a private Consortium made of three companies called the VID desalination

company Ltd. The group signed an agreement with the Israeli government through a newly-established Water Desalination Authority. The project is governed by a BOT agreement ("Build, Operate, Transfer) entered into between the consortium and Desalination Authority for a period of 24 years and 11 months from the effective date of the agreement.

While concerns for the concentrated discharge of brine into the sea have been voiced, energy remains the greatest environmental challenge for the desalination process. Although the new facility has extremely high energy efficiency, the Ashkelon plant still consumes a quantity of electricity comparable to a city of 40,000 people. As such, the plant produces considerable greenhouse gas emissions. In the present case, the plant will be powered by electricity provided from two redundant sources: first, a self generating energy supply system that will be built next to the plant; and second, a 161 KV overhead line from the Israel Electric Company's grid. Providing a "double" source of electricity not only improves reliability of the energy sources but also enables the system to work most of the time on a continuous "base load," preventing frequent changes in the operation mode.

The high quality of the water produced by the desalination plant offers new opportunities for desert agriculture. The new Ashkelon plant incorporates a treatment process to address the natural boron concentration in seawater; with a removal efficiency of 92%, the process reduces boron concentrations down to a mere 0.4 mg/l. This solves a vexing problem faced by Israeli farmers who reused sewage with high boron levels. The desalinated seawater's chloride levels are so low (20 mg/l) that, ironically, the desalinated water is actually mixed into the national water grid to dilute the high salinity in the "fresh" water. When the city of Beer Sheva began using the desalinated water in winter 2006, chlorides in the sewage effluents it sent to the farms in the surrounding desert plummeted to 100-150 mg/l, concentrations that even critics of widespread sewage reuse find sustainable.

The Blaustein Institutes for Desert Research at Ben-Gurion University recently opened the Zuckerberg Institute for Water Research. Some thirty researchers and their graduate students address a range of challenges associated with water management and technology for arid environments, including desalination. Its formal mission is to carry out: *"interdisciplinary, cutting edge research and graduate education in water sciences, aimed at improving human well-being in drylands through technologies and policies for sustainable use of water resources."* Accordingly, the new institute's activities are of relevance to local and international efforts to combat desertification.