

Rehabilitation of Israel's Rivers

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Once upon a time Israel's rivers were key elements in the country's natural landscape, with water flows estimated at between 300-400 million cubic meters. But no more. With few exceptions, nearly all the rivers have dried up. The reason can generally be traced back to water scarcity. Water was all too frequently trapped at its source in order to supply growing urban and agricultural demand. At the same time, the situation was exacerbated by continuous discharges of industrial effluents and municipal sewage into the rivers.

The situation, however, is changing. In November 1993, a National River Administration was established to oversee the restoration of the country's rivers. The administration, consisting of representatives of several government ministries and environmental organizations, is charged with coordinating efforts to clean up the rivers, restore landscapes, rehabilitate ecosystems, flora and fauna, and develop rivers for such purposes as recreation, tourism, education and research. Its goal is to entrust actual restoration work to local bodies while serving as a catalyst, coordinator and professional guide. Therefore, it has invested major efforts to set up regional river administrations, parallel in their aims and composition to the national administration, but with a local focus.

The progress made in recent years offers hope that the dismal fate forecast for the country's ailing rivers can be reversed. As a first step, the administration has formulated a model for river rehabilitation and established criteria for priorities. As a second step, it has initiated ecological and environmental surveys in order to collect data on water and pollution sources, hydrology, water quality, flora and fauna, historical and archeological sites, landscape sites, walking paths, land uses and environmental nuisances along the rivers. Most of the data has already been summarized and mapped, and serves as a basis for assessing the rehabilitation potential of each river slated for restoration. Moreover, in each of the surveys, such considerations as sensitivity to development have been incorporated in order to help secure biodiversity and to preserve natural vistas. Thus, in areas in which unique natural resources may be irreversibly threatened by development, conservation or minimal development is proposed. In less sensitive spots, more intensive development may be possible.

Water Quality Considerations

To a large extent, the success of the river rehabilitation program is dependent on the implementation of solutions to Israel's ever-increasing effluent quantities. Growing urbanization and population density along the entire coastal region, from Haifa to Ashkelon, has resulted in surplus effluents, which exceed the amount required for agricultural reuse in the region.

Until 1991, bodies involved in river rehabilitation were convinced that the prerequisites for river rehabilitation were elimination of all effluents and introduction of

fresh water only. However, successive years of drought have shown that the realities of water scarcity threaten to leave Israel's rivers dry if other means are not taken to replace or supplement fresh water supply. Today, the policy which once banned effluent discharge into rivers, no matter what the quality, is being replaced by a policy which allows the discharge of high-quality effluents into riverbeds when fresh water allocations are unavailable. The discharge of highly-treated effluents into Israel's rivers is meant to ensure water flow, the subsistence of ecosystems, and the development of recreation and leisure activities. However, effluent discharge is contingent on strict control measures which prohibit any discharge which threatens to generate aesthetic or sanitary nuisances, a deterioration in groundwater quality, or pollution of beaches.

In order to implement the program, effluent standards for each river are being set for such physical, chemical and microbial parameters as suspended solids, organic load, nitrogen concentrations, and indicators for pathogenic microorganisms. The right balance is being sought between environmental requirements (e.g., prevention of eutrophication and sanitary risks) and economic cost.

The Rivers

Twelve coastal rivers and two rivers in the eastern basin are currently undergoing rehabilitation according to approved master plans. More than 20 projects have been launched, from cleanups to widening of riverbeds, from drainage and soil conservation to landscape and park development. Within the context of restoration, recreation and tourism sites have already been created along sections of the Yarkon, Alexander, Kishon, Lachish, Harod, Taninim, Hadera and Jordan rivers.

The following examples illustrate some of the progress that has been achieved in recent years.

The Yarkon River

Stretching some 28 kilometers from Tel Afek, near Rosh Ha'ayin, to the Mediterranean, the Yarkon River meanders through Israel's most densely populated area, including the municipality of Tel Aviv. Deterioration of the Yarkon River began in 1955 when its waters were diverted via the pipelines of the National Water Carrier to provide water for irrigation purposes to the arid Negev in the south. As sewage replaced fresh water, habitats were destroyed and flora and fauna disappeared.

In an effort to improve the state of the river, the Yarkon River Authority was set up in 1988. The authority, consisting of representatives of 19 organizations and local authorities, is responsible for the cleanup, restoration and development of the river, making it suitable for leisure and recreation, including sailing, fishing and swimming. Hundreds of tons of garbage have already been removed from the river to restore its original depth and to facilitate its natural flow. Concomitantly, the river's banks were cleaned up, reinforced and raised, hiking and bicycle paths were established, and trees and vegetation were thinned. Major efforts are going into monitoring and pest control with an emphasis on environment-friendly pest and biological control methods including the use of natural enemies such as gambusias and BTI (*Bacillus thuringiensis israelensis*).

The success of the rehabilitation program is already evident in the return of flora and fauna to a restored 7.5-kilometer stretch of the Upper Yarkon near Rosh Ha'ayin. The region's new park offers visitors such additional attractions as historic sites, picnic grounds, playground equipment, fishing docks, and riverbank vegetation. Downstream, the renowned Yarkon Park already serves as the "green lung" for some two million inhabitants of the Dan metropolitan region. The Yarkon River Master Plan calls for the development of a continuous system of parks and open spaces for the entire region. Dubbed "Israel's Central Park," this system will be preserved as a green area.

The central part of the Yarkon River has proved more problematic, especially in light of the discharge of some 25,000 cubic meters of effluents from the adjacent municipalities of Kfar Sava, Hod Hasharon and Ramat Hasharon. However, here too, improvement is on the way. The inauguration of the Kfar Sava-Hod Hasharon sewage plant in 1996 and the launching of the Ramat Hasharon plant in 1999 have already made a difference, facilitating the return of purer water and fish to the river.

Today, major efforts are being invested in studying the river's hydrology, defining the quality and quantity of water required and investigating natural processes, with the aim of determining the carrying capacity and sensitivity to development of each segment of the river, both individually and as a part of the overall ecosystem. At the same time, the Yarkon River has been chosen as a model for a country-wide educational program on river rehabilitation, and a teaching and research center has been set up on its banks.

The Alexander River

The Alexander River, one of the longest rivers in central Israel (32 kilometers), is another fine example of river rehabilitation in progress. The wide open spaces still left alongside the river, in the midst of the densely populated central region of Israel, offer an unparalleled opportunity for recreation, leisure and nature protection.

Some 25 different pollutants, including domestic and industrial effluents, have been discharged into the river over the past 40 years. The continuous onslaught of pollutants has adversely affected water quality, destroyed the natural landscape, and played havoc with the unique ecosystem which once boasted a wide variety of different species of vegetation.

While various initiatives were taken to restore the river, an integrated and comprehensive rehabilitation program was launched only in 1995, with the establishment of a fifteen-member regional administration and a planning team. Effective coordination and cooperation led to real progress including an eco-environmental survey and a comprehensive master plan. Special attention is granted to the Nile soft-shell turtle (*Tionyx triunguis*) and to the preservation of its breeding sites along the river. With the exception of the Alexander River, this protected rare species has all but disappeared from Israel's coastline as a result of deteriorating water quality and water scarcity.

A 750 meter-long model stretch of the river has already been rehabilitated and features a park, picturesque walking paths and a small bridge. As in the case of other rivers, the treatment plant for the city of Netanya, completed in 1996, and the

construction of effluent treatment and disposal facilities in Emek Hefer's industrial plants have brought significant improvement. It is hoped that cooperation with the Palestinian Authority will stem the flow of pollution from the neighboring towns of Tulkarm and Nablus into the river and promote a better quality of life for all the residents of the area.

The Kishon River

Perhaps one of the greatest challenges facing river rehabilitation is the Kishon River, reputed to be the country's most polluted river. The 70 kilometer-long river starts in the Jezreel Valley and empties into the Mediterranean near Haifa. Analyses carried out on sediments in the water found high concentrations of heavy metals, originating in the industrial effluents from some of the country's biggest chemical plants, which have been discharged into the river for dozens of years, along with sewage and pesticide runoff.

Due to the complexity of the rehabilitation process, the regional environmental association of Haifa, in cooperation with the Ministry of the Environment, initiated a research study on the carrying capacity of Haifa Bay and the Kishon River. It provided essential information on a wide variety of subjects including water quality in the Kishon and its tributaries, pollution sources and emission discharges and concentrations.

Israel's second statutory river authority, the Kishon River Authority, was created in 1994, with the aim of rehabilitating and transforming the Kishon into a regional attraction. The rehabilitating scheme calls for a halt to all sewage discharge, sludge removal and treatment, riverside landscaping, flood protection and development of recreation and tourist facilities, including a Kishon River Park and fishing harbor. Further upstream, in the Kiryat Tivon area, before the Kishon enters the Haifa industrial zone, a three-kilometer stretch has already been transformed into a beauty spot.

As in other areas, the pace of progress will be dependent on putting a stop to all sewage and effluent discharge into the river. One step in the right direction is the current expansion and upgrading of the existing Haifa wastewater treatment plant. Another major advance is the 1997 agreement reached between the Ministry of the Environment and the seven major industrial polluters of the river, including Haifa Chemicals, a world leader in fertilizers and industrial chemicals, and the Haifa Oil Refineries, to comply with a stringent timetable for stopping all discharge of wastewater into the river by the end of 2003. While on-site facilities for pollution treatment will be fully operational at each of the plants by that time, improvements, as evidenced by monitoring results, are already evident. In fact, the first signs of life in the river a school of fish and a lone turtle were spotted in the fishing harbor on different occasions during the past year. The Kishon River Authority is hopeful that its intensive work on four fronts creation of a database, cessation of pollution, planning of parks and long-range planning for ecological rehabilitation will transform the Kishon River and its vicinity into the "green lungs" of the Haifa metropolitan area.

The Lachish River

Sewage and waste in the 70-kilometer Lachish River, which flows through the northern part of Ashdod, have plagued the city's residents for years. But this source

of dismay has now been transformed into a source of pleasure. In 1991, an intensive restoration project was initiated, and the Lachish-Ashdod Park was inaugurated in 1996. The park in the town of Ashdod, along the banks of the river, comprises grass areas, a 2.5 kilometer promenade, shady alcoves, observation points and picnic sites. A model on riverbank stabilization using different types of vegetation that are well integrated with the landscape was successfully implemented. Detailed plans are currently being advanced for the rehabilitation of different sections of the watershed area, which encompasses some 1000 square kilometers. The woodlands, nature reserves, national parks and archaeological sites will provide residents and tourists alike with wide expanses for rest and recreation.

The Harod River

The Harod River in the Jezreel and Beit She'an valleys, whose watershed basin encompasses over 190 square kilometers, flows into the Jordan River. The inherent potential of the river for tourist development has long been hampered by pollution deriving from domestic and industrial sewage discharge, agricultural drainage and fishpond waters. The establishment of a regional river administration has resulted in the completion of an extensive ecological and environmental survey, the preparation of a comprehensive master plan, and the advancement of detailed plans for the rehabilitation of different sections and the development of waterside parks. Since the rehabilitation process began in 1994, several river sections have been cleaned up and a recreational park has been established, a bridge dating back to the Mamluk period (14th century) has been restored and the first phase of the Beit She'an Park has been completed. An information kit, including suggested walking trails, was prepared along with a video presentation describing the past, present and future of the river. Hikers will encounter not only unique nature and landscape phenomena but also a glimpse into biblical events that took place in this area.

The Jordan River

The Jordan River needs no introduction; its religious, historical and cultural associations are known the world over. The unique geomorphic characteristics of the Jordan River, its serpentine route and its unique natural and landscape values make it an area with special environmental and tourist potential.

Yet, while the upper Jordan is noted for the high quality of its water (with salinity never exceeding 20 mg chloride/liter), the lower section of the river, south of the Sea of Galilee, shares the sorry fate of most of Israel's rivers. The once plentiful water flow has been greatly reduced due to the impoundment of water in the Sea of Galilee and the Yarmuk. The popular saying that more history flows in the Jordan riverbed than water rings all too true. The quality of water in this part of the Jordan is affected both by seasonal changes in salinity especially as a result of the diversion of saline springs away from the Sea of Galilee in order to reduce salination and by industrial and domestic effluents. Water quality in most sections is so poor as to preclude agriculture.

The National River Administration has included a 30-kilometer section of the lower Jordan River from the Sea of Galilee to the Naharaim Bridge in its priority list for rehabilitation. Accordingly, surveys were carried out, a river administration was established and a master plan is being prepared for the area. But the greatest hope

for the Jordan River lies in the regional arena. As part of the Middle East peace process, a proposal was drafted to promote cooperation between Israel and Jordan by rehabilitating the Jordan River, the common border between the two countries. As part of the project, both the quantity and quality of the river's waters will be improved. Treated or fresh waters will be returned to the river so as to ensure a steady and clean flow; convenient access to the river will be assured; plans to allow boats on parts of the river for possible reenactments of historic voyages along the river will be considered; and sacred sites serving as baptismal points along the river will be restored. The aim is to transform the Jordan River from an effluent channel to a flowing and vital river, a common border uniting neighboring states in cooperative projects for peace and sustainable development.

A Look Ahead

Growing environmental awareness, wide-scale cooperation, and the recruitment of financial resources have helped catalyze substantive progress in a number of Israel's rivers. Local river administrations have been set up, eco-environmental surveys have been completed, comprehensive and detailed planning has been initiated, and rehabilitation work has begun in practice. Concomitantly, spurred by court rulings and enforcement measures, both municipalities and industrial plants have begun to establish treatment plants and pretreatment facilities in order to achieve zero sewage discharge in coming years.

The importance of river rehabilitation in a densely populated country such as Israel has not eluded the policy-makers. Preservation of rivers and their environment is a key component in the integrated master plan for planning and building, which is currently nearing completion. The proposed master plan recognizes the essential function that the country's rivers play in the preservation of natural values, protection of aquatic habitats and provision of "green lungs" for recreation and leisure.

The results are evident throughout the country. A state-of-the art treatment plant for over 60% of Jerusalem's wastewater was inaugurated in 1999, bringing an end to the stench and eyesores which have long accompanied hikers and drivers along the course of the Sorek River. Plans call for the transformation of this area into a landscape reserve at the heart of the country, linking the Judean Hills to the east with the seacoast in the west.

In 1996, a wastewater treatment plant for the municipality of Hadera was established along the coastal strip, halfway between Haifa and Tel Aviv, helping to reduce wastewater discharge into the Hadera River. Plans are also being implemented to fulfill a twenty-year-old promise to residents of the area. As compensation for construction of Israel's first coal-fired plant at Hadera in the 1970s, residents will soon be able to enjoy a large park which will utilize the cooling waters of the power plant for a wide array of recreational and water activities.

In the north of the country, plans are being advanced to transform the Zippori River, which flows from the hills of Nazareth to the Kishon River in the Zevulun Valley, into a popular tourist site. This will combine natural attractions with dozens of historic sites, including the ancient city of Zippori (Sephoris).

River rehabilitation in Israel is no longer a dream. With the right doses of research, planning and resource allocation, Israel's rivers can once again achieve their full potential as vital ecological systems and as sources of pleasure and recreation for residents and tourists alike.