

Afforestation in Israel — reclaiming ecosystems and combating desertification

*David Brand, Itzhak Moshe, Moshe Shaler, Aviram Zuk & Dr Joseph Rivov,
Department of Forestry, Keren Kayemeth LeIsrael-Jewish National Fund*

Humans have lived in all regions of Israel since before Biblical times, with varying degrees of success. However, in the last hundred years, human activities and over-exploitation of natural resources have produced severe land degradation, erosion and salination.

Since its establishment in 1948, the State of Israel has embraced sustainable land management and has adopted public policies designed to restore, develop and manage its natural resources. About 240 million trees have been planted and regulations have been introduced to control grazing and ensure effective water management. Due to these activities, Israel is one of the few countries in the world that has more trees now than it had a century ago.

After the first pioneering stage of afforestation in Israel, which was initiated at the beginning of the 20th century, the Israeli Forest Service, Keren Kayemeth LeIsrael (KKL), launched a policy that encouraged the adoption of sustainable forest management practices for planted forests.

In 1995, the Israeli Government ratified a new National Master Plan for Forests and Forestry (NMP 22). Approval of this plan expanded KKL jurisdiction to areas beyond those of the planted forests, giving a statutory status to around 8 per cent of Israel's land. The plan affects 160,000 hectares (ha) of existing and proposed forestlands, covering approximately 7.3 per cent of Israel's total land surface which is 22,000 km². Five categories of forest type were

assigned by the plan as follows: planted forest (65,900 ha, 41 per cent); natural forest (60,000 ha, 37 per cent); park forest (26,600 ha, 17 per cent); coastal park forest (4,200 ha, 3 per cent); and riparian plantings (3,900 ha, 2 per cent). These forestlands are distributed as follows: 59 per cent in the northern and central Mediterranean regions and 41 per cent in the semi-arid southern region.

Following many applied studies related to Israel's semi-arid and arid zones, KKL developed advanced methods to harvest runoff water for the benefit of the trees planted in these areas. Advanced studies carried out in KKL forests in the semi-arid region demonstrated that the carbon sequestration rate in these forests is similar to that recorded in temperate forests in central Europe. These findings underscore the importance of establishing forests in semi-arid zones to reduce the greenhouse effect in addition to its contribution to the local residents' amenity.

KKL forestry operations focus on four main areas:

- Afforestation and reforestation in Mediterranean and semi-arid zones
- Ecosystem goods and services from planted forests
- Community forests
- International cooperation and capacity-building.



Afforestation in semi arid zone: Hiran Forest 1998 (left), 2008 (right)

Image: KKL Archive



Image: KKL Archive

Thousands of scenic roads, observation points, hiking and biking trails and natural parks have been developed

Afforestation and reforestation in Mediterranean and semi-arid zones

Israel is divided into three phytogeography regions: the Mediterranean region, the Irano-Turanian region (semi-arid) and the Saharo-Sindi region (arid). The Mediterranean region has a yearly average rainfall of over 400 mm, which in the North may reach 1,000 mm or more. The mean annual temperature is 19° C. This area is characterized by natural Mediterranean oak trees, pistachio, Aleppo pine and carob. The Irano-Turanian region extends from the Beersheba district in the Northern Negev to the high elevations of the Negev Mountains. The average rainfall in this region ranges from 150 to 400 mm and the mean annual temperature is 20-23° C. Isolated pistachio (*Pistacia atlantica*) and Christ's thorn (*Zizyphus spina-christi*) are native to this region. The Saharo-Sindic region extends in the south up to the Red Sea, and includes the southern part of the Jordan Rift. The average annual rainfall varies in this region from 25mm to 150 mm and the mean annual temperature is 25° C. Tamarisks grow sporadically or in groups in the sandy and partly salty soil and Acacia in oases and wadis.

Afforestation and reforestation in the Mediterranean region

The first generation of the afforestation project in the Mediterranean region was mainly based on pure, even-aged Aleppo pine forests, which were established on hills and mountains. Aleppo pine was later replaced by brutia pine because of its susceptibility to pests. In the coastal plain and valleys, eucalypts dominate the planted forests, which were the outcome of a massive national programme to reclaim and restore Israel's degraded Mediterranean landscape. Over time, a more complex set of forest stands evolved resulting from the re-colonization of native tree and shrub species into the understory, the diversification of simplified stand structures, and the planting of mixed species.

A 'near-native' type of forest ecosystem is currently evolving, embodying elements of the pioneer afforestation plantings, mostly pines, along with a regenerating native Mediterranean oak maquis.

Afforestation in semi-arid regions

Afforestation is practised on a large scale in the semi-arid regions of Israel as part of the effort to combat desertification and to rehabilitate degraded areas, as well as to provide ecosystem services for the people residing in the Negev, the Southern region of Israel. It is based on planting drought resistant species and on proper management of soil and water resources. There are two main planted forest types in the Northern Negev, depending on the topography and soil characteristics. The first type is common pure, even-aged Aleppo pine forests, mostly planted on hilly slopes. These forests were densely planted in the past, about 3,500 seedlings per hectare. Today, the planting density is about 1,500 seedlings per hectare. These forests are gradually thinned to leave only 300 to 500 trees per hectare. The second type is sparse planting ('savanization') of native species such as acacias and tamarisk, and exotic species, mostly eucalypts — up to 200 seedlings per hectare, on moderate slopes, plains and valleys.

This type of forest depends on water harvesting, based on ancient methods used by farmers in the Negev for food production. Today, modern techniques and knowledge provide the soil with the moisture needed to grow planted trees, natural shrubs and herbaceous vegetation. Runoff water, harvested on slopes along



Image: KKL Archive

The oases and wadis are home to groves of trees that provide welcome shade to people and animals

contour terraces, is a renewable and sustainable resource, which can be provided to the planted sites even during droughts. Terraces are up to 0.7 metres high and the distance between terraces ranges from 8 to 25 metres. Excess runoff water flows through a spillway system, avoiding erosion damage during extreme rain and flood events. Trees and pasture are developed along the terrace.

In areas with rainfall below 100 mm, trees are planted in limans (ponds) constructed in wadis and valleys. Limans are dammed sites, into which floodwater flows to the planted trees. The area of limans usually ranges from 0.2 to 0.6 ha and is supplied by watersheds 10-100 times as large. They can be used for recreation, fuel or shade.

Implementing water harvesting methods and afforestation on a watershed scale provides a means for flood and erosion control. Controlled grazing reduces fire hazard and provides additional runoff for planted trees. Soil-conservation measures, such as gully head and bank control and proper drainage of cultivated areas, are major components in the rehabilitation effort.

Natural forests in Israel

Nearly one third of the forests in Israel are unplanted 'natural forests'. They are mostly composed of Mediterranean vegetation, similar to the Californian maquis or chaparral. In protected sites, there are large trees of the same species that grow in the maquis areas. This indicates that maquis formation is the outcome of centuries of overcutting, overgrazing and fires. Natural forests are mainly located in the mountain regions in the central and northern regions of Israel and cover about 40,000 ha. The main tree species in the maquis areas are oaks (*Quercus calliprinus*, *Quercus boissieri* and *Quercus ithaburensis*), *Pinus halepensis*, *Ceratonia siliqua*, *Pistacia palestina* and *Cercis siliquastrum*.

Ecosystem goods and services from planted forests

Israeli forests, both planted and natural, are multifunctional, ecological landscape systems, which are managed for multiple services to the public

and ecology of their surrounding regions. The primary goal of KKL is to protect the planted and natural forest resources and maintain quality forested environments.

Timber production

In Israel, forests are not planted for timber production, but there has been some wood production as a result of forest management (thinning, sanitation operations and clear cutting after fires). The timber serves mostly for firewood and some industrial uses. As a result of the rising cost of fuel and other energy resources, the demand for firewood has increased significantly. In the last five years, a programme has been run in rural areas to provide families with free firewood from the forests. Non-wood/timber products such as mushrooms, fruits and herbs are also collected on a small scale.

Grazing pasture

Most of the forests in rural areas are used for grazing, mainly for cattle, but sometimes for sheep and goats. In open spaces, special groves are being planted to provide shade for animals as well as for honey production.

Recreation and tourism

KKL provides recreation and tourist services, park infrastructure and sustainable development for the more than 12 million people who visit the forests every year. Thousands of picnic sites, scenic roads, observation points, hiking and biking trails, playgrounds, natural parks and historic sites have been developed or reconstructed, all open to the public free of charge. KKL has initiated 'e-yarok', a green newsletter that offers information on activities, field trips and cultural activities in the forests.



Image: Moshe Shaler

More than 50 per cent of urban residents have visited the forests set up in partnership with KKL



Image: KKL Archive

Nature excursions provide opportunities for children to learn about sustainable forest management

Community forests

There is a growing need for urban forests and woodland around built-up areas in Israel. More than 91 per cent of the population in Israel resides in urban areas. Immigration to Israel, especially in the 1990s, has contributed significantly to the already high population growth rate and has created tremendous pressure on green open spaces, particularly on forests near urban areas.

The urban forests help to improve air quality, reduce city heat and radiation, maintain biodiversity, and create pleasant residential environments. In 2002 KKL assumed the strategic mission of improving the development and management of community forests in and near urban areas. The work is guided by the principle of partnership between residents and local authorities, increasing the likelihood that communities will maintain the forest for themselves and future generations.

Every community has its own forest team, which devises the forest vision and master plan and handles ongoing maintenance and publicity. Volunteers guide forest visitors on topics of botany, archaeology and environmentalism. Survey results show that more than 50 per cent of residents have visited nearby community forests for activities such as walking, biking or picnics.

The first community forest was planted in 1956 as a green belt around Jerusalem. By 1967, KKL had planted some million trees in the Jerusalem Forest, which today covers an area of 450 hectares. The forest has become the city's main site of nature excursions and recreation for city residents. In July 2011, there were 16 active community forests in Israel.

International cooperation and capacity-building

Over the years, KKL has actively cooperated with many countries and international organizations on a wide range of projects. KKL is at the forefront of technology in the following areas:

- Managing open areas and forests in semi-arid and arid regions

- Combating desertification
- Developing and implementing advanced methods for harvesting water runoff
- River and stream rehabilitation and water purification through wetlands and biofilters
- Land conservation through sustainable agriculture
- Research into and application of biological pest control techniques.

KKL shares and exports its knowledge and experience all over the world, and has participated in or sponsored numerous international conferences and workshops. Recent activities include a project with young adults in Rwanda, where KKL established a nursery and training programme that includes greenhouses and beehives for honey production. Other projects include helping India, Thailand, South Africa and other countries cope with serious infestation problems in large eucalyptus plantations by means of biological control, and sharing knowledge and experience with the Palestinian Authority in afforestation, forest management and firefighting.

Israeli forests, both planted and natural, are multi-functional, ecological landscape systems, which are managed for multiple services to the society and ecology of their surrounding regions. Since the 1980s, planted forestlands have undergone a transformation from pure, even-aged forests to a mosaic of mixed, multiple-use forests, with a greater degree of ecological stability, biological diversity and landscape aesthetic value. This process will expand as more and more stands are renewed and as new lands are added to the nation's forest inventory.