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Forests in Palestine

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Abstract

The Palestinian ecosystems defined here as West Bank and Gaza Strip, including East Jerusalem, are home to an estimated 23,159 hectares of forested areas. These forest environments provide a habitat for a great diversity of flora and fauna. This makes them an important key in protecting the biological resources of Palestine. Most of natural forest can provide a base for preserving very different ecosystems ranging from closed maquis forest to open grassland and batha. The Palestinian plant formations possess 60 species of natural trees and 90 of bush distributed all over Palestine. Natural, planted, and bare forests are the types of forests distinguished in Palestine. The natural forests are the main forest types inhabiting Palestine (79.1%), wherein *Pinus* spp., *Ceratonia* spp., *Pistacia* spp., *Quercus* spp., and *Ziziphus* spp. are the most representative tree species. Forests in the Palestinian Territories crucially contribute to the Palestinian economy through their non-timber forest products such as fruits, nuts, honey, wax, resins, dyes as well as timber/firewood as inputs for industry and heating. Perhaps the most important are the ecological functions of trees, notably by providing water retention, soil protection, biological diversity preservation, and climate stability. In addition, they represent a recreation center as a natural attraction. Little information has been collected about the contribution of forests to the economy in Palestinian Territories over the last centuries where successive wars and occupations did not give the chance for Palestinian development of research and inventory to take place. However, a Palestinian Forest Policy within the Ministry of Agriculture, Strategic Options, and Scenarios have been formulated with the aim to preserve forestlands and increase their areas, to conserve wild plants and animals and to organize their exploitation.

Key words: ecosystem, forest, native vegetation, maquis, garrigue

Introduction

Palestine, as part of the Eastern Mediterranean region, constitutes one of the rich ecosystems. It is the meeting ground for plant species originating from wide-flung world regions, as far apart as Western Europe, Central Asia and Eastern Africa. It is characterized by a large variety of wildlife resources and represents a rich base of flora and fauna where the natural biota is composed by an estimated 2,483 species of plants, 470 species of birds, 95 species of mammals, 7 species of amphibians, and 93 species of reptile that inhabit Palestine (Shmida, 1995). The country's proud history as the cradle of civilization and a focal point of the world's three monotheistic religions has long given it a global influence despite its small size. The extent to which historical Palestine has attracted the combined attention, and often-fervent intentions, of world civilization has been a source even of its ecological richness. Extreme geographical, lithological, edaphic and climatic heterogeneity account for shaping the natural resources and their relationships, in addition to prolonged influence of human activities in history, economics, and politics.

Palestine's geographical position has been both its blessing and its curse, being located at the crossroads between Eurasia and Africa, especially in the East-Southern corner of the Mediterranean Sea. This location is also



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nurturing the Palestinian biological diversity through the abruptness with which climatic zones, desert, steppe, Mediterranean woodland, and even oasis-join one another in this compact geographical area. The vegetation of Palestine comprises a considerable number of different types. The vegetal cover includes a variety of plant formations ranging from dense forests to thin patches of desert herbs passing through different forms of woodland such as maquis, garrigue and batha. The presence of such a rich plant variety represented by trees, shrubs and herbs that survive in different environmental conditions indicates their diverse genetic background. There are 60 species of natural trees and 90 species of bush distributed all over Palestine (Bregheith, 1995).

Long time ago, this land was very famous for its rich vegetal green cover. A visitor would have gazed across the different ecosystems noticing the oak, pine, olive, pistachio, acacia, figs, pomegranates, dates, stone fruits, the wild oleander bushes, the blaze springtime color of poppies, buttercups, orchids and a large variety of forage plants. All formed a unique potential for sustainable utilization. However, the landscape, ecosystems and vegetation of Palestine have been subjected for thousands of years to change on a large scale. The rate of natural destruction in Palestine is much higher nowadays with the appearance of new challenges facing biodiversity. Habitat loss, desertification, exhaustion of natural resources, loss of biodiversity, grazing, drought and soil erosion, fire, introduction of exotic species, urban and industrial development, tourism, population growth and movements, land confiscation, and trees uprooting as political impacts and surface and underground water pollution are all indicators of both human- induced changes in land use and mis-management of natural resources in Palestine.

Yet most of the Palestinian plant species have managed to survive, albeit some of them in small populations, and their habitats have been dramatically reduced in area or modified. In 1927, the British passed the first law for the protection and development of forests in Palestine. In the '30s, nurseries were established to distribute seedlings to the local government and people. After 1950, the Jordanian administration started to plant forests in the West Bank at a rate of 170 ha per year mainly with *Pinus* spp., *Cupressus* spp., *Acacia* spp. etc. The total planted forest area of West Bank until 1971 was 3,535 hectares. 23% of the official forest area has been destroyed between 1971 and 1999 and decreased from 30,074 hectares in 1971 to 23,159 hectares in 1999. 80% of forest reduction is due to intensive agriculture by Israeli occupation, 14% due to local Palestinian people's cutting, 6% due to a change to private ownership (MOA, 1999).

At present, Palestinian territories are divided into two geographical areas: the West Bank including East Jerusalem, and the Gaza Strip. The total area of the West Bank covers 5,820 km² while the Gaza Strip extends on 365 km² (ARIJ GIS, 2002) (Map1). The West Bank is divided into eight districts: Hebron, Bethlehem, Jerusalem, Ramallah and Al Bireh, Nablus, Tulkarm, Qalqilyia, Salfit, Jenin, and Jericho. The Gaza Strip is divided into Gaza, Khan Younis, Rafah, and Deir El Balah. These districts are divided on administrative rather than ecological lines.

The location of Palestine at the corner between the desert ecosystem from the South and Mediterranean Sea from the East, influence greatly the climate and the ecosystem and thus the plant geographical elements. Therefore, the closeness to the sea reduces the temperature in summers and increases it in winters. On the other hand, the Southern part of Palestine is affected, by the desert environment of the neighboring ecosystem, thus, causing a semi-desert climate.

The topographic variation directly reflects on climate as well as the distribution and diversification of agricultural patterns: from irrigated agriculture in the Jordan Valley, the lowest area in the world, to rainfed farming in the mountains. The population distribution and centres of urbanization are affected by the topography of the West Bank. The maximum concentration of built-up areas is found on the mountain ranges where climate is more suitable for human life than in the hot climate of the Jordan Valley. Furthermore, most of the West Bank rangelands are found on the arid Eastern Slopes. In addition to edaphic conditions, which are of great diversity. Among the obvious edaphic factors bearing on plant life, highest significance must be ascribed to soil properties. The country's soil is extremely variegated, ranging from deep, fine-grained, and very fertile, to



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dry stony desert. The dominant soil types of the West Bank are Terra Rossa, Rendzina, Alluvial, Gray Steppe, Hammada, and Saline soils. On the other hand, the dominant soils in Gaza Strip are Sandy soils, Loess and Alluvial soils. Map 1: Regional location of Palestine.



The climate of Palestine as a whole and the West Bank in particular, is of Mediterranean type, marked by a mild, rainy winter and a prolonged dry and hot summer. From North to South, the annual amount of rainfall decreases, while the temperatures increase. From West to East, annual rainfall and mean temperatures undergo similar, but less regular changes. Also, there is a gradual decrease in the annual, monthly, and diurnal averages of relative humidity from North to South and from West to East throughout the whole area. Rainfall is limited to the winter and spring months. Snow and hail, although uncommon, may occur anywhere in the area especially to the West and over the highlands (ARIJ, 1997).

The ecosystem in the West Bank, which is scarcely changed during the last million years, is divided into four longitudinal belts, namely Semi Coast, Central Highlands, Eastern Slopes, and Jordan Valley. These belts are well marked by differences in geomorphologic features, climatic and soil conditions, and plant life (Map 2). The main ecosystem of Gaza Strip, on the other hand, is the Coastal plain.

The Semi Coast and the Central Highlands constitute most of the West Bank land and lie completely under the semi humid Mediterranean climate. It receives adequate rainfall and has a favorable environment. The prevailing Mediterranean climate is favorable for several plants and is highly diversified, demonstrating at least 2,483 plant species.

Palestinian Territories are currently the home of 3.2 million inhabitants. The population growth rate is 0.04, which is very high. Demographic forecast shows 7.9 million inhabitants in 2025 (PCBS, 2000). Such rapid increase of both population and urbanization in the country has great impacts on natural resources and their development to meet market demand and to satisfy the rising human needs. In addition, Palestinians face lots of problems as they struggle to generate sufficient cash income to meet the most basic needs. Their difficulties escalate also because of the decreased area due to Israeli constraints, confiscations and continuous land degradation. At best, the overall results are static crop yields and widespread poverty especially in the years 2001 and 2002 and during the current Al Aqsa Intifada when the percentage of households reached 64.9% below poverty line (PCBS). Map 2: Main Agro-ecological Zones in the West Bank and Gaza Strip



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The Ministry of Agriculture (MOA) has finalized the Forest Policy, Strategic Options, and Scenarios on the basis of the analysis of the situation and constraints with respect to the nature of Palestinian forests and in line with the existing Agricultural Policy and other relevant policies, (e.g. National Biodiversity Strategy and Action Plan, National Policies for Physical Development). The aim of the strategy is to preserve nature and forest lands and increase their areas, preserve wild plants and animals and to organize their exploitation.

However, it is important to indicate at this stage that the current state of Palestinian knowledge about species and ecosystems is incomplete; detailed knowledge is still lacking on the current species distribution, population sizes, and economical value of forest trees. For most of the endangered trees, no conservation measures have been taken and the reserve networks are inadequate. Thus, taxonomic surveys and inventories are needed in order to develop a comprehensive study about the importance of forests to the conservation of natural resources and as a contribution to Palestinian economy.

Background statistics and information

Forest area and people

There are almost 93 major forests in the West Bank and 13 in Gaza Strip, covering 22,959 hectares, and 200 hectares respectively. Forests cover approximately 3.94% of the total area of the West Bank and 0.55% of the Gaza Strip. Most of these forests are located on fertile soil types (Terra Rossas, Brown Rendzinas, and Pale Rendzinas) and in areas enjoying favorable climatic conditions for agriculture. Natural forests form 79.1% of the total forested area in the West Bank, where most of them (85.3%) are located in the North-Eastern part of Tubas governorate. On the other hand, the planted forests cover 12.1% of total country forested area, being mostly concentrated in Hebron governorate (28.9% of total planted forests in the West Bank). Gaza includes only planted forests, which represent 0.9% of the total forests in Palestinian Territories.

Afforestation programs in the West Bank were first implemented during the British Mandate, and then the Jordanian Administration. In 1927, the first law for the protection and development of forests in Palestine were legislated by the British. About 230.6 hectares of mountainous and steep land in the West Bank were planted with *Cupressus* and *Pinus* spp. Afforestation continued during the Jordanian Administration and after that by the



Israeli occupation authorities. Forest rangers were appointed to implement the law enforcement on the site and all over Palestine.

In the early '30s, nurseries were established to distribute seedlings to the local governments and people as part of a Grand National Afforestation scheme. In 1935, at the British mandate period in Palestine, only 90 hectares were forested in Hebron and Nablus areas. In 1950, the total planted forest area was very little. Afterwards, the Jordanian administration started to plant forest in West Bank at a rate of almost 170 ha per year. The main species were Pinus spp. (Pinus pinea, Pinus halepensis, Pinus brutia, Pinus canariensis), Eucalyptus camaldulensis, Cupressus spp., and Acacia spp. The total planted forest area of West Bank until 1971 was 3,535 hectares (MOA, 1999).

In Gaza, the areas with natural value before 1948 comprised mainly shifting sand dunes along the coast. Afterwards, the Egyptian administration started to plant forest to stabilize the shifting sand dunes and the total planted forest area amounted to 4,200 hectares in 1971. Planting forest on sand dunes was a necessity to protect the hinterland, but had a controversial effect on biodiversity. It was done with a low density. Main species being planted were Eucalyptus spp., Acacia spp., Tamarix spp. and Atriplex spp. Other abundant natural perennial plants were Retama raetam and Artemisia monosperma.

Until 1971, forests were distributed over different parts of the West Bank and Gaza Strip and nurseries were present. Estimates of forest cover are based on the official forest area from Jordanian time (until 1971) and its changes up to now. This comprises most of the forests except for an estimated ha 1,000 of unregistered private forests. In Table 1, a detailed overview is given about the forest types and areas referred to 1971 and 1999.

Table 1: Officially designated forest area in 1971 and 1999 per district :

Origin	District	Area in 1999		Area in 1971	
		Ha	%of total	Ha	% of total
Bare land with sparse vegetation	Jenin	686	3.0%	1,203	4.0%
	Tulkarm	10	0.0%	10	0.0%
	Tubas	590	2.5%	600	2.0%
	Qalqilia	185	0.8%	209	0.7%
	Selfit	540	2.3%	540	1.8%
	Hebron	30	0.1%	30	0.1%
	Total	2,040	8.8%	2,591	8.6%
Natural forest	Jenin	1,955	8.4%	3,093	10.3%
	Tubas	15,632	67.5%	15,730	52.3%
	Qalqilia	0	0.0%	150	0.5%
	Selfit	631	2.7%	651	2.2%
	Ramallah	45	0.2%	60	0.2%
	Hebron	63	0.3%	63	0.2%
	Total	18,326	79.1%	19,747	65.7%
Planted forest	Jenin	680	2.9%	861	2.9%
	Tulkarm	109	0.5%	109	0.4%
	Tubas	165	0.7%	170	0.6%
	Nablus	239	1.0%	334	1.1%
	Qalqilia	68	0.3%	130	0.4%



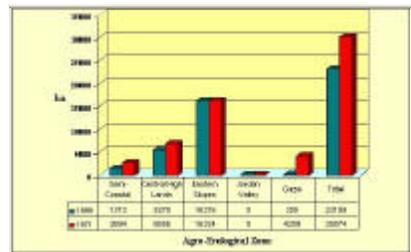
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	Selfit	12	0.1%	12	0.0%
	Ramallah	163	0.7%	408	1.4%
	Jerusalem	199	0.9%	279	0.9%
	Hebron	807	3.5%	972	3.2%
	Bethlehem	149	0.6%	259	0.9%
	Gaza	200	0.9%	4,200	14.0%
	Total	2,792	12.1%	7,735	25.7%
Total		23,159		30,074	

Source: MOA, 1999

Natural forests were occupying an area of 19,541 hectares with the Jenin district featuring the largest part (18,637.1 hectares). The most prevalent trees were *Ceratonia siliqua*, *Pistacia palaestina*, *Rhamnus* spp., *Styrex officinalis*, *Crataegus azarolus*, *Arbatus andrachini*, wild *Pyrus* and *Prunus*, and *Olea europaea*. The dominant shrubs and woody plants are *Sarcopoterium spinosum*, *Phlomis* spp., *Salavia* spp., *Organa syriaca*, and *Clematis cirrhosa* (Figure 1).

Figure 1: Officially designated forest area in 1971 and 1999.



As of 1971, Israel prohibited all forestry activities and closed forest nurseries in most districts of the West Bank. The only nursery left functioning was Wadi Al-Quof Nursery in the Hebron district, but its potential was reduced to only 10,000 tree seedlings per year. Since then, both types of natural and human-made forests were exposed to destruction perpetrated by both Israelis and Palestinians. Large areas of these forests have been confiscated by Israel and declared as closed military areas and military bases. The area of land confiscated was larger than 0.37 million hectares, including almost 93% of the total forest and rangelands of the Palestinian Territories. In addition, more than 3,850 hectares (out of 4,200 hectares) of forestland were damaged in the Gaza Strip between 1970 and 1995, despite the fact that it was a well-known habitat for several endangered plant species. As a result, the natural forest area has diminished by 59% of the 1970 one.

Palestinians also deplete forested areas through woodcutting used for fuel (either as biomass or for coal production). These activities, combined with natural destructive elements such as wind, snow, soil erosion, ageing, and accidental fires left dramatic scars on forests in the West Bank and Gaza. They resulted in a vast reduction of the natural and human-made forested areas.

From 1971 to 1999, the forest decreased by 6,915 hectares (23%) (from 30,074 hectares in 1971 to 23,159 hectares in 1999). The relative area covered with forests decreased respectively from 5.0% to 3.9% of the total area of Palestinian Territories. More than half of the decreased area was located in Gaza where 95% of the forests disappeared, leaving only 200 ha in 1999. Most of forest destruction (80%) in Palestinian Territories is attributed to Israeli occupation through construction of military camps (2%), settlements (77%) and by-pass



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roads (1%), where for example 670,000 fruit and forestry trees were uprooted by Israel only in the year 2001.

The 14% of forest destruction is due to cutting by local Palestinians. The demand on forest was mainly represented by fuel wood and grazing of sheep and goats. The high density and concentration of sheep and goat created pressure on the forested areas (especially on natural forests) and natural pastures. This can be attributed to the increase of livestock numbers and the closure of different areas by the Israeli occupants. The rest 6% of forest decrease is due to changes in private ownership.

In Palestine, as in any country bordering the Mediterranean Sea, forests have been playing a key role in the development of local civilizations. They are just as important and, if managed well and conserved from all forms of destruction, should continue to provide essential products and services in the future. On the other hand, people and their social organizations, are the most substantial agents of change of forest ecosystems. Resulting changes in both the extent and the structure of forests hold consequences for ecological functions and environmental health. Accordingly, it is important to understand how people have and may further change the conditions of forested landscapes in order to gauge the prospect of forest sustainability.

The cumulative human impact on landscapes is a consequence of all individual choices intended to pursue individual's goals in response to the general scarcity of goods and services produced by land in Palestine. It is ultimately the provision of goods and services, including environmental ones, such as clean water and air, that motivate social concerns for sustainable development, and it is only through social systems – e.g. resource markets, political status, that any substantial changes in forested systems could be achieved.

Specifically, a better understanding of how people make choices regarding land and resources in Palestine in pursuit of various benefits is needed. Timber is harvested from forests on the basis of its value. People value also fruits, nuts, resins, etc. People also set aside the forested land for recreation in the pursuit of peace and quiet as congestion increases, especially in Palestine where the population increases rapidly and the green areas are depleted much faster than in any other place.

However, as a long term research endeavor, it is necessary to improve the Palestinian knowledge of how human and natural systems interact while in the short run, it is needed to develop approaches for monitoring and forecasting human impacts on forest ecosystems. Criteria and indicators for social and biological components of forest ecosystems are the core of current sustainability initiatives.

Forest typologies

Natural, planted, and bare forests are the types of forests distinguished in Palestine. The total natural and planted forest area officially designated in the Semi-Coast and Central Highlands amounts to 6,442 hectare. Almost 80% of the officially designated forest area in 1999 consists of natural forest and most of the natural forests are located in the Eastern Slopes. The total designated forest area in the Eastern Slopes (15,065 hectare) is very high, but hardly contains closed forest. A more clear investigation of the forest types is needed to verify the data. Map 3 gives the official designated forest area, the land-use within it and the total closed forest cover in 1999. Map 3: Official forest cover in West Bank in 2000

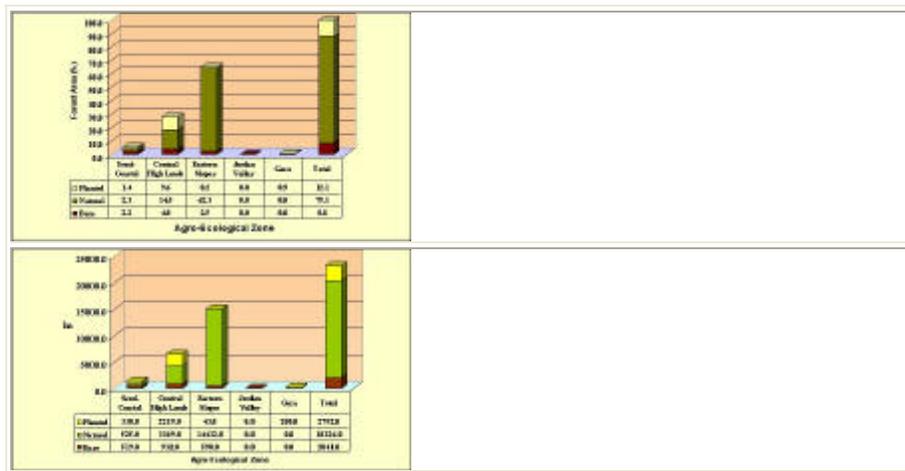


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According to an analysis of the total forest areas in each agro-ecological zone occurring in Palestine, it can be seen that forests distribution and typologies are different from a zone to another (Figures 2 and 3). The most important difference is the high official designated forest area in the Eastern Slopes, all located in Tubas district (9.5% of its surface).

Figures 2 and 3: Official designated forest area in ha and %.



The following types of forests can be distinguished per agro-ecological zone:

a) Natural forest land

In the Jordan Valley there are not official designated forests. There is a large area of natural forests, partly protected, as Israel declared them Nature Reserves. Along the Jordan River and around the Dead Sea there are



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large areas with riparian forest and wetlands, but since 1970, most of the area is inaccessible to the Palestinians because it is a military land. Main species are linked to the wetlands with closed reed, trees like *Tamarix jordanica* and shrubs like *Atriplex* spp., *Lycium* spp., *Nitraria retusa*.

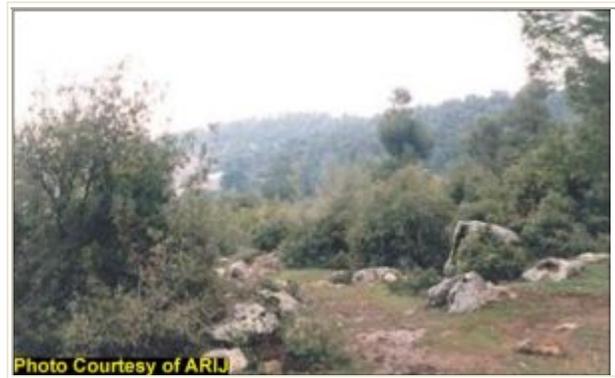
Most of the natural forest area is present in the Eastern Slopes amounting to 14,432 hectares or 62% of the designated forest area. Natural forest consists of a very open pseudo-savanna type with sparse large trees of *Ceratonia siliqua* and small shrubs like *Pistacia lentiscus*, *Rhamnus palaestinus*. The dry areas contain species like *Ziziphus lotus* and *Retama raetam*, while the dwarf shrubs, *Sarcopoterium spinosum*, are located at the edge of the Mediterranean area and grasses.

The natural forests in the Central Highlands are represented by Aleppo Pine and Evergreen Oak Maquis. Main tree and shrub species are *Quercus caliprinos*, *Ceratonia siliqua*, *Pistacia palaestina* and *Pistacia lentiscus*. Species of open garigue and batha are *Sarcopoterium spinosum*, *Cistus villosus*, *Phlomis viscosa* and *Thymus capitatus*.

The Semi-coastal region has some specific species in addition to those occurring in the Central Highlands, like *Euphorbia perelis*, *Senecio vernalis*, *Thymelaea hirsutum*, and *Lupinus palaestinus*.

Most of the natural forest in the Central Highlands and the Semi-Coastal region are present in Jenin district, with well developed dense evergreen Oak stands like Um Rehan and evergreen oak open woodland as Um Al-Tut.

The Coastal Region constitutes the main ecosystem in Gaza. Most relevant species are *Suaeda splendens*, *Salsola soda*, *Aster tripolium*, *Atriplex hasitatata*, *Ipomaea stolonifera*, *Salsola kali* and *Euphorbia peplis*. *Tamarix nilotica*, *Artemisia monosperma* and *Ammopila arenaria* are the main sand dune-fixation species. Most of the natural forests in Gaza were sparsely planted for fixation of sand dunes and are classified a planted forests.





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b) Planted forest land

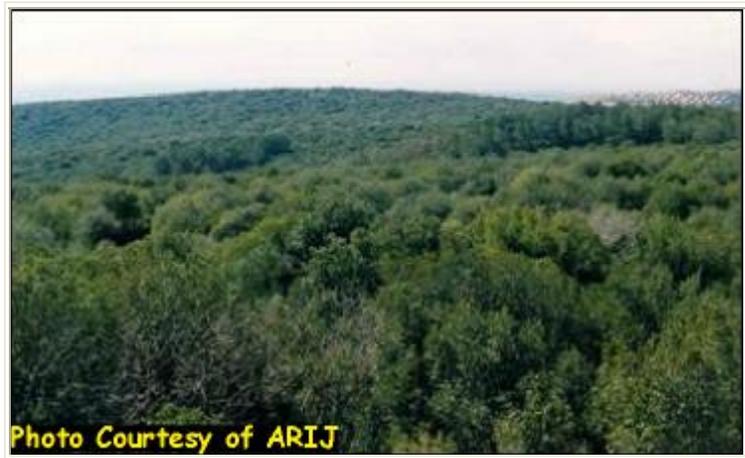
Planted forests constitute 12 % of the forest cover. The Coastal Region of Gaza was all planted at a very low density with species like *Acacia* spp., *Eucalyptus camaldulensis* and *Tamarix* spp.

Most of the planted forest in 1999 is present in the Central Highlands, occupying almost 10% out of 12% of total planted forest. Jenin and Hebron are the main districts with planted forest with respectively 2.9% and 3.5% of the total forest area.





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c) Bare forest land (sparse vegetation)

Bare officially designated forest area amounts to 2,040 hectares with 1,459 hectares present in the Semi-Coastal zone followed by Eastern Slopes and the Central Highlands. It must be stressed that also most of the natural forest area in the Eastern Slopes is currently bare and consists of only sparse vegetation.





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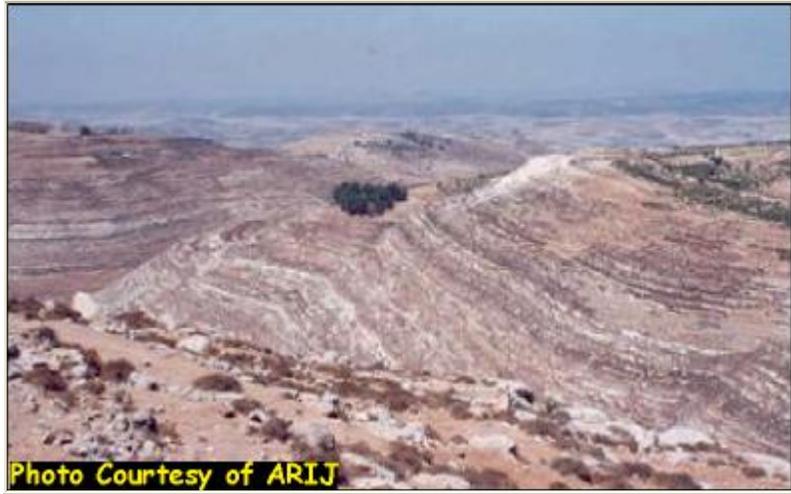


Photo Courtesy of ARIJ

Box 1: Tree Nurseries in Palestine:

The first nurseries within the Palestinian Territories were established as early as 1927. For more than 40 years, until 1970, a significant reforestation programme was implemented in the area of the West Bank. Forest seedlings were produced in five nurseries, of which four were located in agricultural stations. Total production of seedlings amounted to 2,100,000 in 1971. From 1970 till 1995, all nurseries in West Bank, except for Wadi Al-Quoff and Gaza, stopped operating, and the reforestation programme halted almost completely. Only 120,000 seedlings were produced during that time . All the nurseries were handed over from Israel to the Palestinian Authority in December 1995. They have been developed and rehabilitated since the creation of the Palestinian Authority and in 1999 a total of 850,000 seedlings have been produced. Species being produced in the governmental nurseries consist of about: coniferous trees like Pinus spp. and Cupressus spp. (40%), indigenous broadleaved species like Pistacia palaestina, Quercus calliprinos and Ceratonia siliqua (30%), exotic and ornamental trees, like Bauhinia variegata, Dodonea viscosa and Eucalyptus spp. (20%) and dry area species for rangeland rehabilitation like Atriplex spp and Acacia spp (10%).

Nurseries between 1971 and 1999.

Governorate / Nursery	Annual production of seedlings		
	1971	1971 till 1994	1999
Jenin	500,000	0	100,000
Tulkarem	250,000	0	0
Nablus	0	0	0
Ramallah	250,000	0	0
Jerusalem	0	0	0
Hebron-Wadi Al Quof	200,000	60,000	250,000
Hebron- Arroub	500,000	0	100,000
Gaza-Green Dam	0	0	250,000
Gaza- El Shati	400,000	60,000	150,000
Total	2,100,000	120,000	850,000



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Source: MOA, 1999

According to what is available at a Palestinian level the map 4 was produced to distinguish between the natural and planted forests. However, there can be a link between the Quezel Classification for forest types, and this map as Natural forests in Palestine are mainly the Carob-Lentisk Maquis, the Deciduous Oak Forest and the Evergreen Oak Maquis and Forest, and the Pine forests are the Planted type of forests (See box2). The natural forests included in the map do not include the nature reserves.

Map 4: Forests according to Forest Typologies in Palestine



Box 2: Palestinian forest typologies according to Quezel Classification (ARIJ) :

According to Quezel classification, the Palestinian forests can be divided into:

i) Carob-lentisk maquis corresponding to thermophilic wild olive and pistachio scrubs:

It is a rather dense carpet of low shrubs, consisting of *Pistacia lentiscus* and other associated species. It occurs scattered together with carob trees which often attain a height of 4 m or more. Both of the leading plants are evergreen. The carob-lentisk maquis occupies large stretches in Palestine. It is widespread on the Western foothills of the mountain belt, and it also occurs on the slopes of Galilee and Nablus. Besides, it occupies dunes and kurkar hills on the Coastal Plain. The soil varies from Terra Rossa to Rendzina and kurkar sandstone. In this association, numerous Mediterranean chamaephytes, such as rockrose (*Cistus villosus*), white rockrose (*C. salvifolius*), spiny broom (*Calycotome villosa*), Poiret (*Phlomis viscosa*) are accompanied. The association that exists in the northern parts, comprising Mediterranean shrubs such as olive tree (*Olea europea*) and almond (*Amygdalus communis*). The one that exists on sand dune has two leading species, *Ceratonia* and *Pistacia* together with a series of shrubs, such as white broom (*Retama raetam*), island sage brush (*Artemisia monosperma*), tea tree (*Lycium europeum*) .



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ii) The pine forest corresponding to the Mediterranean conifer forests of Aleppo pine, Brutia pine, Stone pine and Phoenician juniper:

This type of forests is dominated by Aleppo pine (*Pinus halepensis*) and is often accompanied by shrubs and trees of maquis and garrigue, such as kermes oak (*Quercus calliprinos*), mastic tree (*Pistacia lentiscus*), terebinth (*P. palaestina*), strawberry tree (*Arbutus andrachne*), algum tree (*Juniperus oxycedrus*), white rockrose (*Cistus salvifolius*), sage three-leafed (*Salvia fruticosa*), spiny broom (*Calycotome villosa*) and many other perennial and annual species. The Aleppo pine forest extends from the sea level in Lebanon to 800 m and more above it. It is confined and scattered on Rendzina soils all over the Mediterranean mountain range, clearly indicating its former sphere of distribution, especially considering that Rendzina soil moisture content is sufficient to support pine seedling during the summer. Larger stands have been preserved up to the present on Mount Carmel, in the mountains of southern Nablus. Pine forests are very susceptible to fire; unlike other forest and maquis trees, the Aleppo pine is not able to renew growth from its stump and propagates from seed only. Moreover, because of its high quality timber, it has been largely exterminated.

iii) Evergreen oak maquis and forest corresponding to sclerophyllous evergreen oak forest of holm oak, cork oak, and Kermes oak:

This is the most typical and common forest and maquis formation of the Mediterranean part of Palestine. The dominant type of association is the *Quercus calliprinos*-*Pistacia palaestina* association. This occurs generally in the form of maquis and comprises, apart from the dominating *Quercus* and *Pistacia*, a series of other Mediterranean evergreen trees and shrubs such as laurel (*Laurus nobilis*), strawberry tree (*Arbutus andrachne*), jasmine box (*Phillyrea media*); further the deciduous storax (*Styrax officinalis*), white thorn (*Rhamnus palaestina*) and azarole (*Crataegus azarolus*). The most typical climbers of the maquis are Clematis (*Clematis cirrhosa*), black bryony (*Tamus communis*), and Etruscan honey suckle (*Lonicera etruca*). The maquis affords shelter to great many beautiful bulb and tuber plants such as species of Tulipa (*Liliaceae*), Allium (*Liliaceae*), Colchicum (*Liliaceae*), Crocus (*Iridaceae*), Orchis (*Orchidaceae*), Ophrys (*Orchidaceae*), some shade demanding ferns, and others. Where the maquis is less dense, it offers optimal growth conditions for a wealth of annual and perennial herbs. This type of maquis is common throughout the Western mountain belt, from the foot of the Lebanon, up to the Judea Mountains (Jerusalem and Hebron) in the south. It is most characteristic of Mediterranean Terra Rossa, but occurs also on certain variants of Rendzina .

iv) Deciduous oak forest corresponding to deciduous forests of Zeen oak, Afares oak, Lebanese oak, Tauzin oak, hornbeam, ash and occasionally beech:

This type belongs to a large group of broad-leaved, deciduous forests. It reaches its southern limit of distribution and has different forms of association. It is possible to find it together with grass community dominated by kush (*Desmostachya bipinnata*). However, this association is almost totally destroyed by man and citriculture. On the other hand, a typical oak forest is the one associated and accompanied by storax (*Styrax officinalis*), and, under favorable ecological conditions, also by terebinth (*Pistacia palaestina*), azarole (*Crataegus azarolus*), jasmine box (*Phillyrea media*), clematis (*Clematis cirrhosa*), wind flower (*Anemone coronaria*), cyclamen (*Cyclamen persicum*) and black calla (*Arum palaestinum*).

v) Savannah forests (not included in Quezel classification):

This type largely consists of thorny acacia species, (such as *A. raddiana*), arabian jujube (*Ziziphus spina-christi*), mustard tree (*Salvadora persica*) and other tropical trees and shrubs which are distributed in the Jordan Valley, Dead Sea shore and in the Southern Coastal Plain. Arabian jujube (*Ziziphus spina-christi*) is widely spread in Gaza Strip and other places characterized by high temperatures. It is considered an important series of plant communities for the environmental balance in the valleys, coast, and Gaza Strip.



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vi) Riparian forests (not included in Quezel classification):

Consisting mainly of various species of willow (such as *S. acmophylla*), tamarisk (such as *T. jordanus*), and poplar (such as *P. euphratica*), these predominant near rivers in warm area. At the same time, forests of plane tree (such as *P. orientalis*), ash (such as *F. Syriaca*) and Mediterranean Elm (such as *U. canescens*) occupy cold areas water sources.

Forest functions

Just like elsewhere in the Mediterranean countries, forests in Palestine are economically valuable. Although timber here plays a less predominant role, many different non-wood forest products (NWFPs), such as fruits (food and/or feed), resins and fodder, contribute towards a diversified economy. Nowadays, wood is mainly used as a source of fuel and as an input for the production of tourist and decorative crafts.

Perhaps most important are the ecological functions of trees and forests-including micro-climate, filtration of air pollutants generated from urban areas, fixation of mobile sand, dunes and soils, protection of crops against the wind and regulation of the surface water flow through forests and woodlands. Recreation and eco-tourism are also applicable to forest areas to form a major economic source. *Cupressus* spp., *Quercus* spp., *Acacia* spp. and *Pinus* spp.; and *Eucalyptus* spp. and *Tamarix* spp. are the major species with economic value in the West Bank and Gaza Strip, respectively.

Afforestation is one of the principal means of controlling soil erosion. In the hills, forests prevent the topsoil from being washed away by the winter rains. Shelterbelts of trees moderate the onslaught of winter storms on adjoining fields and control wind erosion. Environmental considerations become ever more urgent with the rapid rise in population and the increasing road traffic. Air pollution constitutes a mounting menace. Forests, therefore, can serve as green belts for cities, reducing wind velocities, allowing dust to settle on the ground. They also reduce noise well beyond their perimeters. They can create a forest micro-climate with somewhat lower summer temperatures and higher air humidity. Forests could also induce a momentous increase in local rainfall amounts.

By retaining water, forests prevent or minimize excessive flooding during rainy periods and thus help prevent soil erosion especially in downstream agricultural areas. They often provide refuge for plant and animal species that are most important to keep the balance of nature e.g. certain insects and pollinators that cannot survive but in a forestry environment. Thus, forests notably provide water retention, soil protection, biological diversity preservation, and climate stabilization.

Forests can also be another form of a recreation center where parks, picnics, camping/playing grounds, and sports can be installed, which provide fun for children and adults and serve to develop their physical fitness. Planting trees can also serve landscaping the country for better view especially if forestation is taking place on naked rocky slopes.

In addition, forests mainly preserve tree germoplasm, source of new forestry species, produce fruits, nuts, honey, waxes, and other products conserve wild life and other natural attractions linked to tourism.

The main usage of forest and rangeland in Palestine can be summarized as follows:

- Fuel wood production from natural formation of pistachio and oak trees.
- Food from fruits and leaves of oak, pistachio, summaq, carob and others.
- Medicinal usage of oak fruits, pistachio, oregano, mint, phangnalon and others.
- Production of light drinks such as mint, carob and others.



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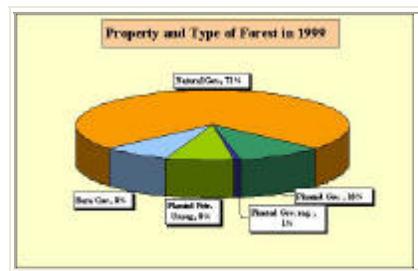
Broom and other household production.
Filters from Eurocaria and Rebudia.
Fertilisers for farming and nurseries from forest tree leaves.
Decorative plants in gardens and houses.
Souvenirs, handicrafts and other products linked to tourist industry from oak, pistachio, pine, olive and cypresses.
Paints and glue.
gums and honeyGproduction.
Pools in agriculture (genetic resources for fruit trees).
Rrecreational purposes.

Institutional aspects

Ownership and size of properties

Systems of forest ownership and management are diverse, however, in Palestine. The reserve system is applicable where the state is the major forest owner and private forest ownership is limited. This regime was mainly created and implemented during the colonial period of the British mandate. According to Figure 10 indicating the property and type of forests in Palestine, it can be noted that most of the forest area (91%) is under state ownership, while the rest (9%) is in private hands.

Figure 4: Ownership of forest area in 1999



It is also important to indicate that in addition to the total forest area – as provided by official statistics - an additional 1,000 hectares of unregistered private forests and line plantations are estimated to exist (Figure 10). In this way, natural and bare forest area makes up most of the total forest area (81%).

No records are available of forests recently planted around Israeli settlements or along by-pass roads. Plantations undertaken during the last 30 - 40 years cannot be regarded as a compensation for all the forests being cut and confiscated by the Israeli occupant.

Administration and policies

The history of the legal system in Palestine is unique. For centuries, different regimes have been enforced by various foreign powers. Laws that are currently valid are more or less those previously issued by successive ruling and colonizing powers: i.e. the Ottoman Empire (1517-1917), the British Mandate (1919-1948), Jordanian and Egyptian administrations (1948-1967) and the Israeli Military Occupation (1967-1994). Each administration inherited extant laws which were applied and later modified. The Palestinian National Authority (PNA) inherited this jungle of laws. Different laws are in force in diverse areas. However, the PNA (1994-2002) has



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formulated strategies concerning all issues, including forests, that would finally adjust the previous legislation.

The Forest Law issued in March 1926, during the British Mandate and its Amendments N° 8 (1928), N° 30 (1937), N° 7 (1942) are still valid in the Gaza Strip. In West Bank, however, it was replaced by the Jordanian Government with Law 81/1951. Another new law was declared 'The United Law of Forests' and was implemented all over the land under Jordanian control on both banks of the River Jordan. The two laws mentioned above included general principles related to the protection of existing forests, the establishment of new protected forests and their management. They also include the rules for rangers and the appropriate regulations and methods for obtaining a license to benefit from the forest products or grazing resources. Chapters 4, 5, 6, 7, and 8 are concerned with protected forest areas, protection of trees, monitoring the protected forests, penalties, and crimes, respectively.

During the Israeli occupation, several laws have been issued for the protection of natural resources. However, those implemented in the West Bank and Gaza Strip gave Israel the full control over Palestinian natural resources, mainly land for security reasons (especially building colonies). The outcome of Israeli laws that were passed for the West Bank could be assessed from the huge area of land that has been confiscated, as mentioned earlier. By 1991, this reached 65% and 50% of the total area of the West Bank and Gaza, respectively. Due to such policies and military regulations, there has been an increased rate of destruction and reduced biodiversity in the Palestinian environment. In addition to the closure of grazing areas, several military bases have been established causing changes in the topography, natural stream flow routing and increased soil erosion.

Several agreements were held between Israel and Palestine to help their cooperation in implementing principles and standards. They should conform with internationally accepted principles and standards concerning the protection of endangered species and of wild fauna and flora, including restriction of trade, conservation of wildlife migratory species and preservation of existing forests and nature reserves. According to Oslo II Interim Agreement, 'powers and responsibilities in the sphere of Forests in the West Bank and Gaza Strip shall be transferred from the military government and its Civil Administration to the Palestinian side. This sphere includes, inter alia, the establishment, administration, supervision, protection, and preservation of all forests (planted and unplanted)'.^[1]

However, over the past eight years, even after signing the agreements with the Palestinians, the Israeli government has persisted in its expansion of colonies and land confiscation. This is compounded by the contribution of a series of by-pass roads to be used by Israelis only to link their colonies and avoid contact with Palestinians. Thus, a natural outcome of these practices is the impediment of sound natural resource management schemes that will in turn have detrimental effects on the environment -mainly green lands -and render sustainable development virtually impossible to achieve.

Currently, there are major weaknesses in the policies, methods and mechanisms of enforcement in place to support and develop the multiple ecological, economic, social, and cultural roles of trees, forests and forestlands. However, a Palestinian Forest Policy, Strategic Options, and Scenarios have been formulated on the basis of the analysis of the situation and constraints with respect to the nature of forests in Palestine and in the view of the existing Agricultural and other relevant policies, mainly the National Biodiversity Strategy and Action Plan, and National Policies for Physical Development .

The administration of forests in Palestine is under the supervision of MOA in both the West Bank and Gaza Strip. The strategic options to obtain the long-term policy objectives are **as follows:**

1. Preservation of nature and forest lands, increase of their areas, conservation of wild plants and animals and organization of their exploitation;
2. Promotion and strengthening of the institutional structure and human capacity for



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- forest and nature;
3. Development of an adequate legislative framework for nature conservation, sustainable forest management and protection of plant and animal species, consistent with regional and international legislations, agreements and acts and integrated in different laws;
 4. Undertaking inventory, monitoring and research in forest and nature in order to get the basis for their planning and management;
 5. Increase of public awareness and enhancement of local knowledge and skills in the field of conservation and sustainable use of nature and forest;
 6. Development and increase of regional and international cooperation in forest and nature conservation.

[1] Israeli-Palestinian Interim Agreement on the West Bank and the Gaza Strip, Washington D.C., 1995.

Forest contribution to the economy

Gross national product (GNP) and employment

Gross national product (GDP) and employment:

The Palestinian GDP per capita reached US\$ 1,410.1 in 2000. However, the share of agriculture in the GDP has been declining. The sector contributes with 9.5% to the total GDP and employs only 13.4% of the labor force including those working in forestry. At the same time, forests contributed by 0.03% of the GDP (1.49 million US \$) in 2000. (PCBS, 2003)

Over the last century, employment in forestry has decreased both as number of jobs and working hours. This occurred especially during the last decades, when most of the tree nurseries were closed. Nowadays, the forest works are done under the Ministry of Agriculture (Forestry Department) responsibility and more forest rangers have got back their jobs.

It should be stressed that not only research and studies dedicated to forestry issue are limited, but also those analyzing the agricultural sector have failed to realistically depict this nationally vital issue.

Value of forest products including public goods and externalities

Forests in the West Bank are limited in areas and are not expected to be of significant commercial uses, at least not in the short or medium term. Annual wood production of natural forest ranges from 1.0 to 3.3 m³ per hectare for Oak forests and around 4.3 m³ per hectare for moderately dense Pine forests. The annual growth rate of wood in natural forest amounts to 0.2 m³ per hectare, which is much less than the threshold for commercial forests (1m³ per hectare). Artificial planted pine forests grow on average 3 m³/ha annually.

A major reason behind the reluctance and slow rate of forestation is the relatively high investment (at least US\$ 2,500-3,000 per hectare) and risks in terms of uprooting or overgrazing, which adds costs to the maintenance of such plants. Even nowadays, the irresponsible and uncontrolled cutting of trees endangers forests in West Bank. In addition, the Israeli occupation authority has followed a predetermined deforestation policy, for the sake of building or expanding colonies or by-pass roads.

In open areas, expansion in forestation is significant and sustainable only when implemented in marginal areas, which need reclamation. Forestation is economically unattractive and cannot withstand competition with other



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agricultural crops, even to those of low economic return in the short run. Reclamation of marginal areas and its forestation requires relatively high infrastructure rehabilitation, upgrading works and labor force training. It is essential that central government, NGO's, PVO's and local communities step in to carry out such development projects.

Direct use values

The use of the forest has been estimated by collection of data from traders and people in the market (Bregbiet and Qanam, 1998). It must be stressed that much data are lacking to make accurate estimates and it is often difficult to distinguish between products collected in the forest, agricultural land or in other ecosystems. Table 2 gives an overview of the estimated use and corresponding economic value for 1998 .

Table 2: Estimated amount and value of products from natural plants in Palestine in 1998.

Product	Amount (ton)	Price (\$/ton)	Total value (US\$)
Timber	2,500 (1500m3)	50	125,000
Firewood	2,500	30	75,000
Grazing	5,040	100	504,000
Seeds, stone fruits	500	400	200,000
Medicinal plants	700	350	245,000
Natural fruits	300	300	90,000
Dyes and colouring	50	300	15,000
Others	-	-	40,000
Total			1,290,400

Source: Bregbiet and Qanam., 1998

All the above values were calculated according the market price of each item.

More specifically, timber and firewood were valued on the basis of their market price on the roadside and the annual removals.

The value of grazing was calculated according to the hay price on the market and the amount of fodder yearly grazed. The grazing occurs in the agricultural lands; rangelands, as well as the forests. Number of livestock heads is not available. Grazing is however a free activity, constrained by no tax or any other regulations because it takes place mainly in nomans lands (ownership is unknown).

It is known that through the normal season when average annual rainfall varies between 100-250 mm the production capability of pastures does not exceed 12 kg of dry matter per dunum, taking into account that the moisture content of naturally dried forages is 12% after air drying. It can be deduced, therefore, that the West Bank's natural pastures, including those which are restricted or closed in the face of the Palestinians, have the capacity to support 27,000-30,000 animals annually. At present, however, farmer's area grazing their livestock on just 10% of this area as the remaining 90%, are inaccessible. Moreover, they are increasingly dependent on forage and concentrates as a supplement to grazing due to the thinning cover in pasture areas and the growing scarcity of many plants. Obviously farmers' net returns are also decreasing, threatening the viability of the livestock sector as a whole.



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However, Knowing that almost 200,000 animal heads are raised depending on grazing during the grazing season (180 grazing days) in pastures including woodlands in Palestine, therefore, the annual fodder consumption is 50,400 ton (1.4kg fodder/day* 180days/head*200,000 heads). The price of one ton of pastures fodder is 100 \$, therefore the value of the consumed forages is 5.04\$ million dollars. Estimating that only 10% of the pastures fodder consumption is from the woodlands, the total value of woodland grazing is 504,000\$ / year. However, it is worth mentioning that the livestock depend partially on grazing from pastures including woodland, while the rest of their feed is substituted by concentrates (0.7 kg/ day).

The value of seeds, stone fruits, medicinal plants and other natural fruits collected from the forests was estimated by means of their average market price and commercialized quantities. Dyes and other coloring items refer to the products made on the basis of natural plants growing in the forests and their valuation took into account the market price.

It appears that the current value of forest products reaches only US\$ 1,290,400 million in 1998, but this is due to the scarce statistics which only partially were able to estimate the forest values. Actually, some authors argue that forests are expected to have a higher annual production and economic value, close to US\$9 million (Bregbiet and Qanam, 1998). The reason behind this shortcoming lies especially in the lack of precise information about market prices and commercialized quantities (for the goods sold in the market) as well as relevant studies capturing the economic value of forest services consumed for free.

Even though there is a high lack of valuations in monetary terms, the direct uses of forest can be summarized as follows, The use of forest products can be summarized **as follows:**

Wood Forest Products:-

Wood trees such as *Cupressus sempervirens*, *Quercus ithaburensis*, *Pinus halapensis*, *Acacia* spp., are used as follows:

Crafts such as traditional ploughs, traditional coffee millers, and souvenirs;
Fuel wood for cooking and heating;
Charcoal;
carpentryClike pallets and agricultural packages.

Accurate figures about the total use of wood and wood based products in Palestine are not available. Neither are accurate estimates about the current wood production and total resources. An inventory of forests and standing wood volume is necessary.

Non-wood forest products - Food

Fruits produced from *Rubus sanctus*, *Crataegus* spp., *Pyrus syriaca*, *Prunus ursina*, *Prosopis farcta*, *Ceratonia siliqua*, *Zizyphus* spp., *Arbatus andrachne*, *Azarollus* spp., *Arbutus andrachne*, *Phoenix dactylifera*, *Ficus carica*, and others are used for direct consumption or prepared as marmalade.

Seeds and stone fruits produced from *Pinus pinea*, *Amygdalus communis*, *Pistacia* spp. and *Rhus corinaria* are collected from trees and shrubs.

Other forest and natural plants are part of the Palestinian culinary tradition such as *Majoran* spp., spices including *Rhus* spp., *Laurus nobilis*, *Capparis* spp. and mushrooms and sumaq.



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There is a potential to produce honey by bees pollinating in forest (especially through *Trifolium* spp., *Amygdalus communis*, *Centaurea cyanoides*, and others), other natural areas and agricultural fields.

Medicinal use

There is a well-known tradition for using dozens of natural plants for medicinal use, both from forest and open vegetation types. Examples are *Teucrium* sp., *Phagnalon* sp., *Artemisia* sp., *Plantago* spp., *Ricinus communis*, *Ceratonia siliqua*, *Olea europea*, *Ficus sycomorus*, *Citrullus colocynthis* and others.

Tannin and dyes

Tannin and dyes are made from *Quercus calliprinos*, *Rhus coriaria* and *Pistacia* spp.

Gums and Resins

Gums and resins come mainly from *Pinus halepensis*, *Cistus creticus*, and *Pistacia palestina*.

Handicrafts and decoration items

Handicrafts are produced from the wood of *Olea europea*, *Quercus* spp., *Pistacia* spp., *Ceratonia siliqua* and *Ziziphus spina-christi*. Decoration is used from plants like *Rhus* spp., *Cupressus sempervirens* and wild flowers.

Agricultural and silvo-pastoral use

Agro-forestry (the integration of forestry and agriculture) and silvo-pastoralism (the integration of forestry and pastoralism, range) occupy a large part of West Bank and Gaza. In addition, small natural elements are present like pools and streams, patches and lines of ruderal herbs, trees and shrubs, line plantations along roads and planted fences. These elements serve multiple purposes by integrating biodiversity values with production functions. All these elements also function and are often classified as ecological infrastructure, an ecological network for transportation and migration of plants and animals between larger habitats. From the 32% of West Bank and Gaza Strip classified as cultivated land, fruit trees, both irrigated and rainfed account for approximately 62%. Rangeland amounts to 32% of Palestine (BSAPP, 1999).

The use of forests and agricultural areas for rangeland is important but often results in degradation because of lack of control. Fruit trees being cultivated are mainly Olives, Grapes, Almond, Figs and Oranges. Multipurpose indigenous forest trees can serve as rootstock for fruit trees like Wild almond, Wild pear, Wild olives and *Pistacia palaestina* or be cultivated for the fruits like *Ceratonia siliqua*, *Craetaegus aronia*, *Pistacia atlantica*, *Pyrus syriaca*, *Prunus ursina*, *Amygdalus* spp. and *Ficus* spp.. Cactus is used for fencing and fruit production.

Because fruit trees are often planted in marginal areas and their use is extensive, they can increase biodiversity. Many shrubs, trees and herbs can grow in between cultivated fruit crops and they have an important function for wildlife. Fruit trees and fodder shrubs can be used for the reclamation and rehabilitation of land and have environmental benefits like prevention of soil erosion, temporary biomass fixation, filtering of the air and buffering of water discharge.

A very important use of the forest is grazing. It has a positive effect by increasing the open area in the forests, resulting in a higher level of biodiversity. However, due to forests ~~are~~ overgrazing, negative effects appeared: the whole cover of woody plants is being removed resulting in another ecosystem of dwarf shrubs and grasses (batha), which is currently too common (Kaplan and Gutman, 1996).



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Tourism

Tourism has a high potential, but is currently underused. Most of nature reserves are in Israeli hands and facilities for tourists are hardly available in the other forests and nature areas. In order to create public involvement and awareness about nature, visits and education are of utmost importance.

Indirect use value

Water related issues

There is complete lack of information related to water related issues such as the indirect use of forests as watershed and their possible management.

Carbon fixation

The role of forests in absorbing CO₂ from the atmosphere is known worldwide, being linked to the global carbon cycle. They are able to sequester carbon from the atmosphere and store it in biomass and soils. Forests have positive impact on the local environment as well as social and economic development. From a long-term perspective, the value of forests becomes higher especially when they turn mature. Natural forests, in particular, grow slowly but for longer periods of time, and thus their total absorption of CO₂ is considerably higher.

Assessing forest carbon stocks and their changes is usually entails expanding timber volume from forest inventories via so-called biomass expansion factors to estimate tree bio-mass which differ as a function of many variables such as species, age, stand structure and site and different factors apply to growing stock, growth and harvest (Brown, S. 2001). The Good Practice guidance of Kyoto protocol, offer a set of methods for national carbon stock change assessment in forests,

$C = (A \times i) - H$, Where

C: is current annual carbon stock change of the managed forest in tonnes,

A: is managed forest area in hectares,

I: is current annual carbon sequestration in tonnes per hectare of managed forest,

H: is annual fellings on the managed forest in tonnes carbon. (Schoene, D. 2001)

In this case no studies have been conducted in this field and no reliable and accurate data is available to calculate the necessary variables of the annual carbon stock change equation.

However, a simple evaluation to carbon sequestration was attempted; in any case, its valuation remains truncated due to incomplete information. It could be cautiously assumed that on the 23,159 ha of forests, there are around 7,719,600 trees and on the average, they sequester some 6 kg CO₂. Applying a C transformation coefficient of 0.27, it results a value of around 4,406 tC corresponding to a monetary 88,120 \$. In any case, it does not account for the C released by wood losses, thus the valuation should be regarded with much care.



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Option, bequest and existence values

There is a total lack of statistics and no literature dealing with option, bequest and existence values of Palestinian forests. Forests are open to local people for recreation, collection of timber wood, fruits, medicinal plants etc., however, with no control on the number of visitors to the forests or the quantities used and extracted from the forest. The Ministry of Agriculture mainly the forestry department is trying to build their monitoring system and increase their involvement in the forest management especially through the employment of more rangers in the official forests distributed in the West Bank and Gaza strip.

Negative externalities linked to forests

Landscape, vegetation and flora of Palestine have been subjected for thousands of years to change on a large scale. Deforestation, transhumance, grazing, agriculture, fire, plantation forestry, introduction of exotic species, urban and industrial development, tourism, population growth and movements and land confiscation as political impacts have dramatically altered the face of Palestine. In this place, the biomass is now made up of remnants of natural and semi-natural vegetation in a mosaic of agricultural land, planted forests, wasteland, roads, industrial landscapes and urbanization. Today many plant wild species occur in small, fluctuating and poorly dispersed populations as a result of habitat fragmentation and face extinction or severe genetic loss.

The people that arrive in ancient geographical Palestine were hunters/collectors. Their habits and numbers were such that they interfered little with their host ecosystem. But once they began settling and farming the fertile valleys and hillsides, they encroached quite radically upon the ecological status quo. Cultivated crops replaced native vegetation, as vines and orchards replaced native forest and shrub land, maintained with terracing and man-made irrigation channels and drainage ditches. All was fine as long as this network of human alteration of the native plant and landscape received the attentive human maintenance it required.

Unfortunately, such continuity was prevented by the succession of wars brought to the area (Byzantines, Mongols, Crusaders, Mamelukes, Turks, Israelis and others) by subsequent waves of conquerors who killed or drove out the farmers. The so –called human improvements and cultivated vegetation were left abandoned and fell into ruin, leaving the soil, now deprived of even its native cover, subject to extensive erosion. This was especially true at the higher elevation where the scantiness of the soil, combined with the erratic rainfall of the region, made it difficult for the original vegetation (mainly forests) to reassert itself.

Successive cycles of trees cutting and neglect characterize the history of Palestine's arable land down through the centuries, as one invader followed another, bringing wars, often in close succession, which violated the countryside and left the landscape drastically and permanently changed. Thus, forests in Palestine were subjected to accelerated changes as the successive occupations did not stop and did not give a chance for their regeneration. Cutting trees for several purposes, mainly for colonies constructions, continued, despite the fact that it is now happening intensively for more than 50 years.

These Israeli military activities are probably the most environmentally damaging. A total of 2,975 hectares of land were shaved by Israeli forces in the Gaza Strip, between September 2000 and March 2001 (Israeli army uses this expression to indicate complete removal of any living thing from the surface of the area). The documented cases of cleared land from trees in the Palestinian territories already reach 271,797 trees, as reported by MOA. If an average tree sequesters about 6 kg of CO₂ a year, then the total additional load of CO₂ will remain in the air, amounting 1.6 million kilogram or 1,630 t/year, adding more GHG.

In addition to the successive wars and political constraints, other direct pressures on resources continue, such as



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the intensive use of wood, rapid population growth, economic growth, forest fires, development of tourism industry, lack of research, inventory and monitoring of forests, scarce extension and public awareness and lack of Palestinian laws related to forests. An example is the effect of the herdsmen and their flocks where the local black goat, nibbling away at the young shoots and bark of trees, hastened degradation of the forest and its conversion into low scrub. Shepherds also felled trees, which they needed for firewood; to the present day, Bedouin women with large bundles of twigs on their heads bound for their encampments are a familiar sight in many Mediterranean countries.

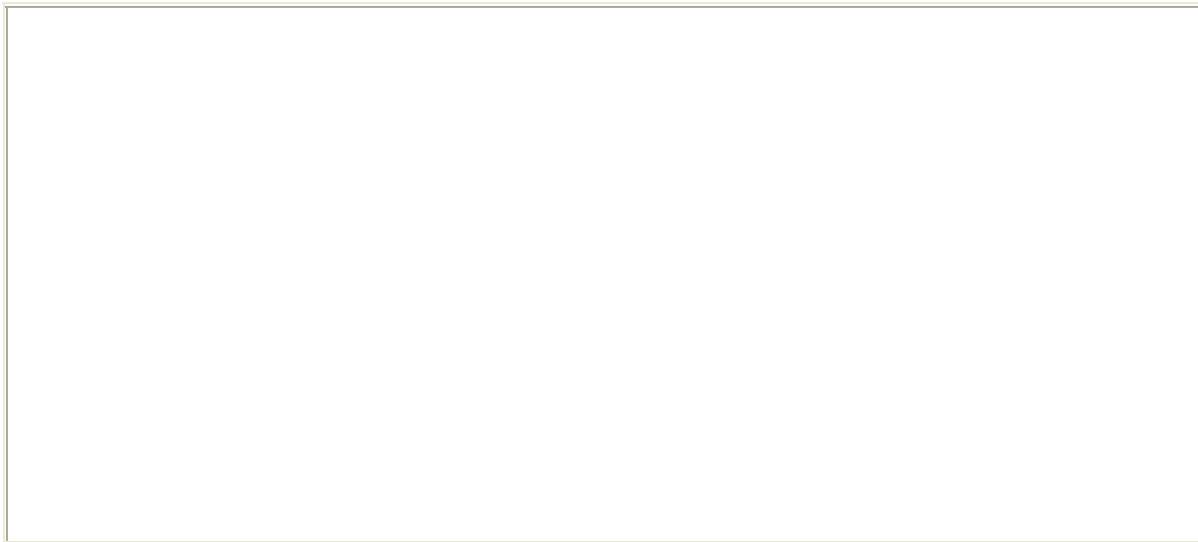
It is worth mentioning that, at this stage, estimating these negative externalities in monetary terms is not possible due to the insufficient data related to many variables and more particularly, the complete lack of quantitative information. Anyway, overgrazing is one of the major factors damaging the forests that are under the Palestinian control. However, its negative effects in terms of soil erosion, desertification, and species loss could not be estimated, neither in quantitative and monetary terms.

Towards the Total Economic Value of Palestinian forests

The contribution of forests to the Total Economic Value (TEV) is measured not only by the tangible products they provide, but also by the services they offer, which in this case is difficult to quantify. A significant proportion of forest products are consumed by those who collect them, with the amount collected varying according to seasonality, access and options. Most of the available information related to the contribution of forests to the national economy is descriptive and often site-specific. No studies quantifying the part of household inputs, labor allocation, income and costs attributable to forest products have been conducted.

However, despite the shortage of information related to the value of negative externalities, bequest, option and existence values, and the available estimates of direct uses of forests in Palestine show that grazing/fodder, collection of medicinal plants and other fruits contribute significantly to the TEV of forests in Palestine

Figure 5: Summary of the estimated production values of Palestinian forests (1998)





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Perspective and crucial issues

Change in the current situation can be brought about in the long term by means of education that will engender a significant change in attitudes. However, the complex of pressures threatening the Palestinian forest ecosystems also demands an immediate response. The most rapid and significant change can be achieved by means of clear, comprehensive and effective legislation, which will be readily enforced to carry out the forest policy recommendations prepared by MOA.

Palestine has few institutions whose mission is to record and study its biodiversity. In most countries, national museums of natural history and herbaria assume this role. Few data has been collected in the field of forests and their value. Palestine has no formal biological survey, as many other countries do. Some studies have been done by Israeli scientists long time ago and are not accurate anymore. The MOA, Forestry Department, and few Palestinian NGOs have been working on preliminary studies on plants in general and woody plants in particular. However, no comprehensive studies or systematic research of forests and forest species have been conducted (Efraim Orni, 1978).

Although, generally speaking, there is a growing awareness in Palestine of the need to conserve natural resources, the formal institutions for studying, recording, and monitoring forests is almost lacking. It is imperative that a biological survey is necessary in order to monitor changes in forests and forest ecosystems. However, national and international funding for these activities are crucial and national guidance is required in order to ensure the continued monitoring of the country's natural resources.

Efficient planning for new forests and sound management of existing ones both require detailed surveying and mapping relevant areas. Appropriate development organizations should encourage research in ethno-biology to identify plant and animal species used by local people living in surrounding forests. The specialized knowledge that local people have accumulated about economically useful plant and animal species and about how the ecosystem functions (including the likely effect of certain human disturbances) can be of great use to modern society. Such a research would prevent them from being irretrievably lost (Ledec and Goodlands, 1988).



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