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Dedication

This research is dedicated

..........To my country

........My family

....My friends

Iman AL-Hirsh

6-6-2016

Viterbo – Italy

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Introduction

Chapter one :

1.1 Forests in the West Bank

Palestine, as part of the Eastern Mediterranean region, constitutes one of the rich eological region. 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. This location is also 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. 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 vegetation of Palestine comprises a considerable number of different plant formations ranging from dense forests to thin patches of desert herbs passing through different forms of plant communities**:**

1. Maquis (areas containing small trees and shrubs) and Forests: Located in the mountains of Judea, the Carmel and Galilee, these were the main woodlands. In most of the area today, the wild trees have been replaced by cultivated plants and domesticated trees, such as the olive and almond, or have been reforested with the Aleppo pine (*Pinus halepensis*). Where cultivated land have been abandoned, low herbaceous Mediterranean semi-shrubs grow.

2. Oak Woodlands: On the volcanic rock of the occupied Golan Heights, maquis dominated by the common oak (*Quercus robur*) grows in areas higher than 500 meters above sea level. Botanists believe that the woodland ranges here have decreased substantially during the past century.

3. Winter Deciduous (Montane) Forests*:* On Mount Hermon, between 1,300 and 1,800 meters above sea level, winter deciduous trees and shrubs that can withstand the cold and wind flourish.

4. Mount Tabor Oak (*Quercus ithaburensis*) Woodlands: This Mediterranean tree grows in Palestine's drier and warmer coastal areas, although much of these woodlands have been converted into olive groves.

5. Carob and Terebinth Woodlands: These forests cover the limestone hills at the foot of the central mountain range.

6. Lotus and Herbaceous Vegetation: These shrubs are scattered over the hilly south-eastern Galilee, making it look like a park without trees.

7. Savanna Mediterranean: In areas too warm and too dry for Mediterranean trees, the quasi-tropical jujube and spiny trees of Sudanese origin grow.

8. Semi-Steppe: Where Palestine's Mediterranean region meets the desert, the vegetation changes to semi-shrubs.

9. Cushion-Plants: Mount Hermon plants that grow beyond 1,900 meters above sea level must survive three to five months covered by snow each year and another four to five months of drought. The dominant vegetation here is small, spiny, rounded, dense shrubs known as cushion-plants.

10. Steppe: Semi-shrubs cover the slopes and hills of areas of the country that receive 80 to 250 mm of rain a year. This vegetation formation is often referred to as steppe.

11. Atlantic Terebinth Steppe: On rocky terrain higher than 800 meters a.s.l., the Atlantic terebinth (*Pistacia atlantica*) grows.

12. Desert: Steppe vegetation gradually gives way to Saharo-Arabian plant species as the climate becomes drier.

13. Sand: Each of Palestine's three sandy areas has a different climate and sand of different origin. Each, therefore, has different kinds of vegetation.

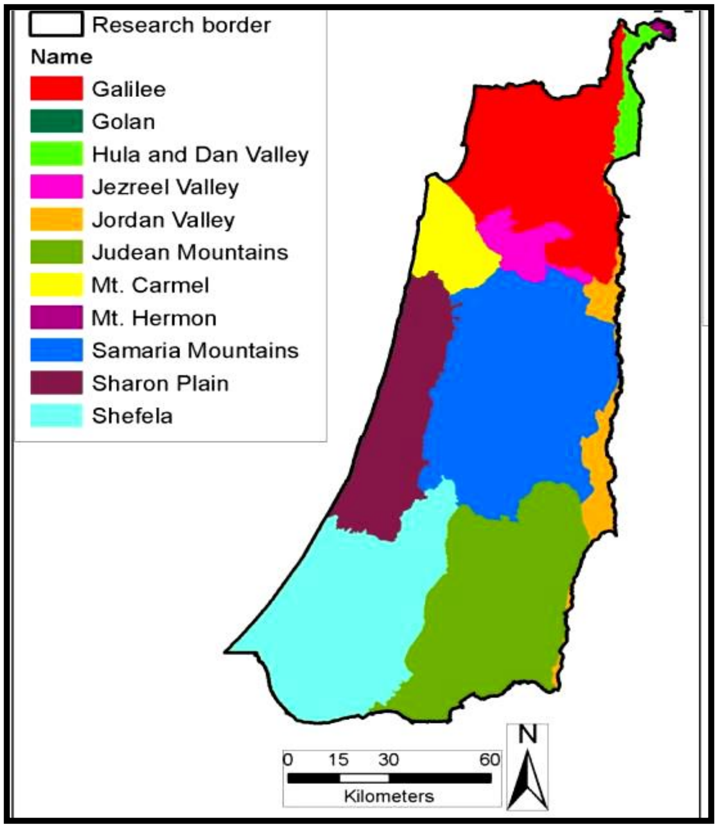
14. Oases: The warmest parts of Palestine are the Araba (Arava), the Dead Sea and the Jordan valley. Run-off and underground water accumulate here, enabling trees of Sudanese origin to grow in the oases, and salt-resistant date palms (*Phoenix dactylifera*) to flourish around desert springs.

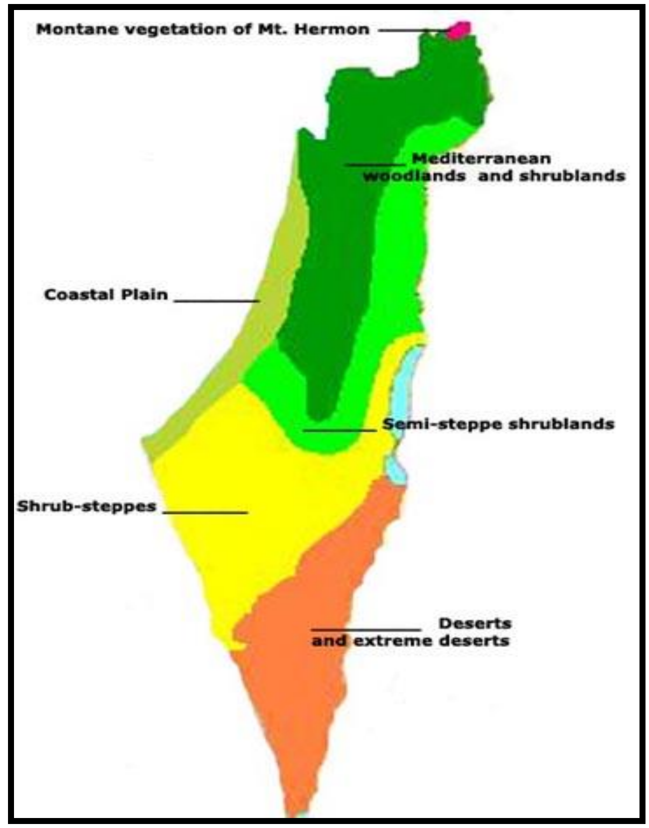
15. Desert Savanna: In the Rift Valley, rainfall gradually increases northward from an annual 30 mm around Aila (Eilat) to 150 mm north of Areeha (Jericho). Sudanese trees with long roots take advantage of the high water table in this area of poor rainfall; making parts of it resemble the East African savannas.

16. Araba (Arava) Woodland: The deep sands of the Wadi Araba (Arava Valley) are covered with sparse woodland of trees growing up to 4 meters in height.

17. Swamps and Reed Thickets: Water-logged soils on river banks support dense vegetation.

18. Wet Saline: Salty water moistens the soil throughout the year along the Jordan, the Dead Sea, the Wadi Araba (Arava valley) and on the Mediterranean shore near Akka





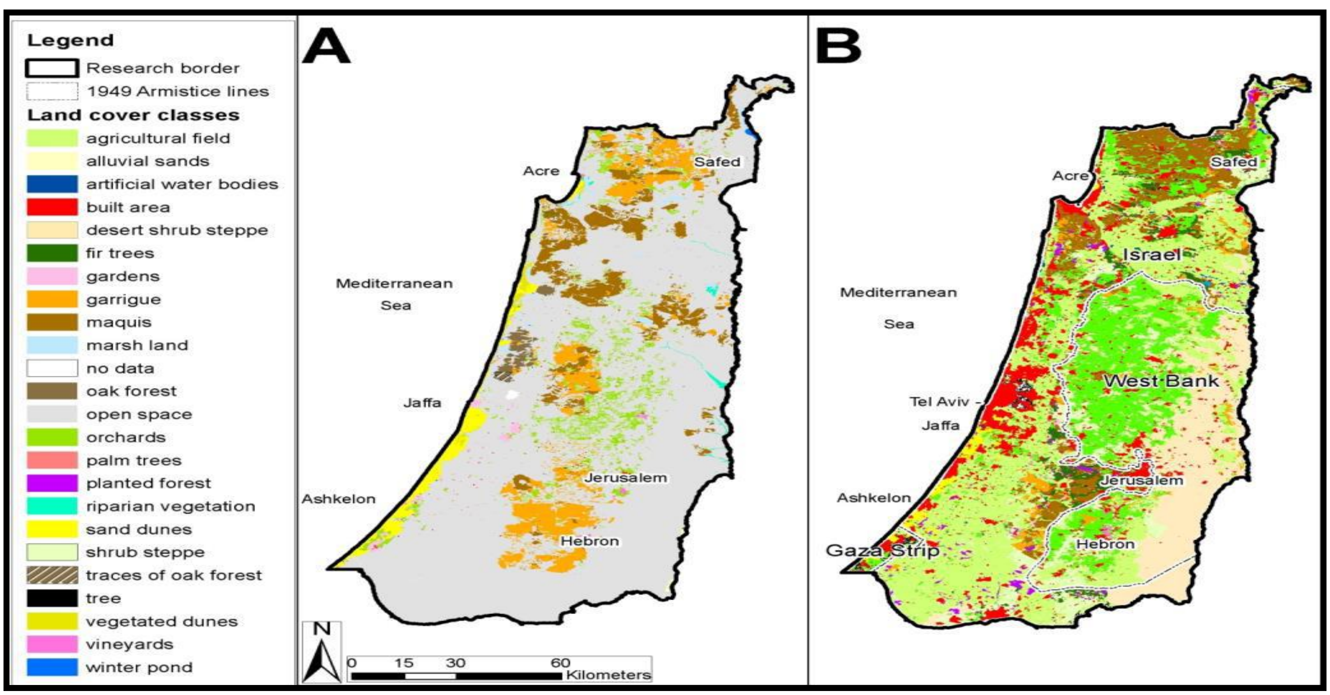


Figure (1.1) Type of Palestine vegetation cover during the period 1800 and 2011 in figures A and B respectively.(Schaffer and Levin ., 2014)

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).

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 (Roubina Ghattas et al, 2007)

The Palestinian Territories can be divided into five agro-ecological zones as indicated below

Jordan valley The area is wide about 413 km^2, low lying (-375 to -200 m below sea level) region along the western bank of the Jordan river. A semi-tropical region with hot summers and warm winters. It is an arid region with an average annual rainfall of approximately 160 mm. The main agricultural activity in this area is irrigated vegetable production.

Eastern slopes: This area have a size of 594 km^2, extend the length of the eastern edge of the West Bank (-200 to 800 m). This semi-arid region is in the rain shadow of the central highlands with annual precipitation ranging from 200 mm in the south to 400 mm in the north. The main agricultural activity is animal grazing.

Semi-coastal region: This area is 470.5 Km^2 wide (the smallest of the West Bank's agro-ecological regions) and it is located in the north west corner of the West Bank (100 to 400 m a.s.l.). It is a productive agricultural area receiving 600 mm of annual precipitation. The main agricultural activities are field crop production and citrus trees.

Central highlands: This area of the West Bank is 3144.5 Km^2 wide extending from Jenin in the north to Hebron in the south (400 to 1000 m). It is the main catchment area for the West Bank aquifers with annual precipitation ranging from 500 to 800 mm. The main agricultural activity is fruit tree production (e.g. olive trees).

Coastal region: This small strip is 365 Km^2 wide and it is located along the coast of the Mediterranean Sea (0 to 100 m a.s.l.). Annual rainfall ranges from 200 mm in the south to 400 mm in the north. The main agricultural activities are irrigated vegetable and citrus tree production. Also horticulture production is prevalent.

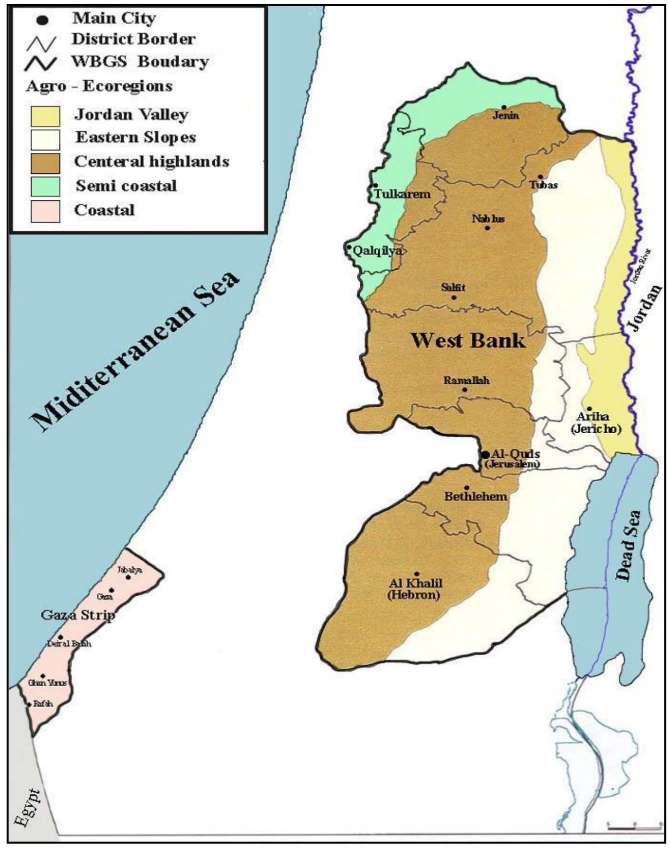


Figure 1:3. Palestine Geographical Location WestBank and Gaza Agro-ecological zones

1.2 Palestinian forest types according to the Quézel classification.

According to the Quézel classification, the Palestinian forests can be divided into the following types: **(i) Carob–lentisk *maquis* corresponding to thermophilic wild olive and pistachio scrubs.** This 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, on the slopes of Galilee and Nablus, and on 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 *Cistus villosus*, *C. salvifolius*, *Calycotome villosa* and *Phlomis viscose* are found. In the north, the association comprises Mediterranean shrubs such as *Olea europaea* and *Amygdalus communis*. On sand dunes, the association includes two leading species, *Ceratonia* and *Pistacia*, together with a series of shrubs, such as *Retama raetam, Artemisia monosperma* and *Lycium europeaum* (Zohary, 1962).

(ii) Pine forest corresponding to the Mediterranean conifer forests of Aleppo pine, brutia pine, stone pine and Phoenician juniper. This type of forest is dominated by Aleppo pine (*Pinus halepensis*) and is often accompanied by shrubs and trees of *maquis* and *garrigue*, such as *Quercus calliprinos*, *Pistacia lentiscus*, *P. palaestina*, *Arbutus andrachne*, *Juniperus oxycedrus*, *Cistus salvifolius*, *Salvia fruticosa*, *Calycotome villosa* and many other perennial and annual species. The Aleppo pine forest extends from the sea level in Lebanon to an altitude of more than 800 m a.s.l.. It is confined to 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 seedlings during the summer. Larger stands have been preserved 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. In addition, due to its high quality timber, it has been clear cut over large areas (Zohary, 1962).

(iii) Evergreen oak *maquis* and forest corresponding to sclerophyllous evergreen oak forests 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 *Laurus nobilis*, *Arbutus andrachne* and *Phillyrea media*; and, in addition, *Styrax officinalis*, *Rhamnus palaestina* and *Crataegus azarolus*. The most typical climbers of the *maquis* are *Clematis cirrhosa*, *Tamus communis* and *Lonicera etruca*. The *maquis* gives shelter to a large number of beautiful bulb and tuber plants such as the species of *Tulipa* (Liliaceae), *Allium* (Liliaceae), *Colchicum* (Liliaceae), *Crocus* (Iridaceae), *Orchis* (Orchidaceae), *Ophrys* (Orchidaceae) and shade-demanding ferns. 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 Lebanese hills in the north, up to the Judean Mountains (Jerusalem and Hebron) in the south. It is most characteristic of the Mediterranean *terra rossa*, but it also occurs on certain variants of rendzina (Zohary, 1962).

(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 broadleaved, deciduous forests. It reaches its southern limit of distribution and has different forms of association. It can be found together with a grass community dominated by *Desmostachya bipinnata*. However, this association has been almost totally destroyed by man and citriculture. On the other hand, a typical oak forest is that which is associated with and accompanied by *Styrax officinalis* and, under favourable ecological conditions, also by *P. palaestina*, *Crataegus azarolus*, *Phillyrea media*, *C. cirrhosa*, *Anemone coronaria*, *Cyclamen persicum* and *Arum palaestinum* (Zohary, 1966).

(v) Savannah forests (not included in Quézel classification). This type largely consists of thorny acacia species (such as *A. raddiana*), *Ziziphus spina-christi*, *Salvadora persica* and other tropical trees and shrubs which are distributed throughout the Jordan Valley, Dead Sea shore and in the southern Coastal Plain. *Z. spina-christi* is widely spread in the 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.

(vi) Riparian forests (not included in Quézel classification). Consisting mainly of various species of *Salix* spp. (such as *S. acmophylla*), *Tamarix* spp. (such as *T. jordanus*) and *Populus* spp. (such as *P. euphratica*), these predominate near rivers in warm areas. At the same time, forests of *Platanus* (such as *P. orientalis*), *Fraxinus* (such as *F. syriaca*) and *Ulmus* (such as *U. canescens*) occupy cold areas near water sources.

Forest typologies

Of the total forest area, around 79% comprises natural forest, 12% plantations and the remaining 9% is bare land with sparse vegetation. Most of the natural forest area is concentrated on the Eastern Slopes. It consists of a very open pseudo-savanna type with sparse large trees of *Ceratonia siliqua* and small shrubs such as *Pistacia lentiscus* and *Rhamnus palaestinus*. The dry areas of the eastern slopes contain species such as *Ziziphus lotus* and *Retama raetam*, while the dwarf shrubs *Sarcopoterium spinosum* are located between the central highlands area and grasses.

In the Central Highlands, natural forests are represented by Aleppo pine and evergreen oak *maquis*. The principle tree and shrub species include *Quercus caliprinos*, *C. siliqua*, *Pistacia palaestina* and *P. lentiscus.* The open *garrigue* and *batha* are mostly represented by *S. spinosum*, *Cistus villosus*, *Phlomis viscosa* and *Thymus capitatus*. These species also grow on the Semi Coast, where, additionally, species such as *Euphorbia perelis*, *Senecio vernalis*, *Thymelaea hirsutum* and *Lupinus palaestinus* can be found.

The Jordan Valley does not contain any officially designated forests. However, there is a large area of natural forests, partly protected as Israel declared them nature reserves. Along the River Jordan and the Dead Sea, there is a large area of riparian forest and wetland – considered military land since 1970 – with closed reed trees, such as *Tamarix jordanica*, and shrubs, such as *Atriplex* spp., *Lycium* spp. and *Nitraria retusa*.

The planted forests are mainly located in the Central Highlands. To a small extent, they can also be found in the Coastal Plain of Gaza where plantations were undertaken at a very low density with species including *Acacia* spp., *E. camaldulensis* and *Tamarix* spp. The main sand dune fixation species in Gaza are *Suaeda splendens*, *Salsola soda*, *Aster tripolium*, *Atriplex hasitatata*, *Ipomaea stolonifera*, *Salsola kali*, *Euphorbia peplis*, *Tamarix nilotica*, *Artemisia monosperma* and *Ammopila arenaria*. Most of these forests, though ‘naturalized’, are still classified as planted forests (Euroconsult/Iwaco, 1994).

Officially designated bare land with sparse vegetation is concentrated in the Central Highlands and Semi Coast. It should be stressed that actually most of the natural forest area in the Eastern Slopes is currently bare and consists of sparse vegetation (Maurizio et al., 2005).

Table 1:1. Type of Forest in West Bank and their Geographical location

Forest Type	Internal climate	Ecological topographic	Location special environment	Geographical Location	Area (Ha)
Dunes Forest	Eastern Mediterranean , Irani Turani	Coastal	moving coastal sand dunes	Beit Hanoon /Gaza	50
Dunes Forest	Eastern Mediterranean , Irani Turani	Coastal	moving coastal sand dunes	Khan Yunis/Gaza	100
Total Forest Dunes					**150**
planted pine forest (Artificial)	Eastern Mediterranean	Semicoastal	Semicoastal	Jenin / WestBank	546.3
planted pine forest(Artificial)	Eastern Mediterranean	Semicoastal	Semicoastal	Qalqilia/WestBank	15
Total of Planted pine Artificial Forest in the Semi coastal forests					561.3
Planted pine forest(Artificial)	Eastern Mediterranean	Mountinous Area	Western Slopes	Tulkarim / West Bank	108.8
Planted pine forest(Artificial)	Eastern Mediterranean	Mountinous Area	Western Slopes	Sulfit / WestBank	12
Planted pine forest(Artificial)	Eastern Mediterranean	Mountinous Area	Western Slopes	Ramallah / WestBank	15
Planted pine forest(Artificial)	Eastern Mediterranean	Mountinous Area	Western Slopes	Beithlehem / WestBank	50
Planted pine forest(Artificial)	Eastern Mediterranean	Mountinous Area	Western Slopes	Hebron / WestBank	538
Total of planted pine (Artificial) forest in the western slopes					723.8
Planted pine forest (Artificial)	Eastern Mediterranean	Mountainous Area	Highly mountain	Jenin /WestBank	10
Planted pine forest	Eastern Mediterranean	Mountinous Area	Highly Mountain	Nablus/WestBank	62.2
Planted Pine Forest	Eastern Mediterranean	Mountinous Area	Highly Mountain	Ramallah/West Bank	102.7
Planted pine forest	Eastern Mediterranean	Mountinous Area	Highly Mountain	Jerusalem /WestBank	110
Planted pine forest	Eastern Mediterranean	Mountinous Area	Highly Mountain	Beithlehem /WestBank	70.8
Planted pine forest	Eastern Mediterranean	Mountinous Area	Highly Mountain	Hebron/WestBank	147
Total of Planted Pine (Artificial) Forest in the Highly Mountain					**502.7**
Planted pine forest	Eastern Mediterranean	Mountainous Area	Eastern Slopes	Jenin /WestBank	258
Planted pine forest	Eastern Mediterranean	Mountainous Area	Eastern Slopes	Tubas /WestBank	140
Planted pine forest	Eastern Mediterranean	Mountainous Area	Eastern Slopes	Nablus /WestBank	124.4
Total planted pine forests in the Eastern Slopes					**522.4**
Total of planted Forest					**2310.2**

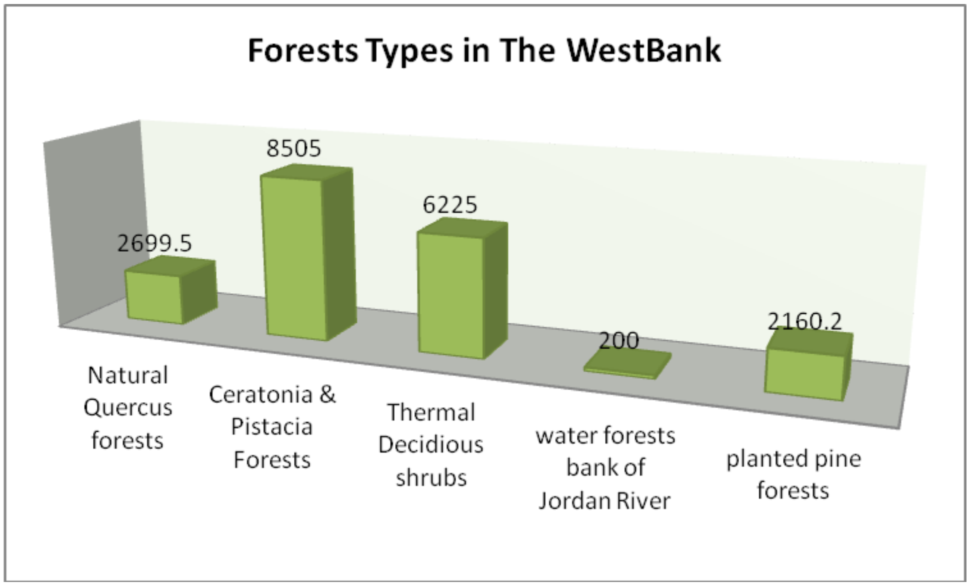


Figure 1.4 forest types in The WestBank

1.3 A forestation programs history in the West Bank

A forestation 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* spp. and *Pinus* spp. At the same period forest rangers were appointed to implement the law enforcement on the site and all over Palestine. In early 1930s nurseries were established to distribute seedlings to local governments and people as part of a Grand National a forestation scheme. In 1935 and at the British mandate period in Palestine only 90 hectares were afforested in Hebron and Nablus areas.

A forestation continued during the Jordanian Administration and after that by the Israeli occupation authorities. In 1971, the total area of the human-made forests had reached to 3,361.6 hectares, planted mostly with *Pinus*, *Cupressus*, *Eucalyptus,* and *Acacia* spp. Until 1971, the natural forests and nature reserves were distributed over different parts of the West Bank, occupying an area of 19,541 hectares, with the Jenin district featuring the largest area (18,637.1 hectares). The most prevalent trees were *Ceratonia siliqua, Pistacia palaestina*, *Rhamnus* spp.*, Styrax 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.*

As of 1971, Israel stopped all forestry activities and closed forestry nurseries in most districts of the West Bank. The only nursery left functioning was Wadi Al-Quf Nursery in the Hebron district, but its potential was reduced to only ten thousand tree seedlings per year. Since then, both types of natural and human-made forests were exposed too much 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. Large numbers of trees have been uprooted to clear areas for the construction of Israeli colonies. Photos below show the destruction of Abu Ghnaim Mountain to the south of Jerusalem district. Palestinians also deplete many forested areas through wood-cutting 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. They resulted in a vast reduction of the natural and human-made forested areas.

The Palestinian Ministry of Agriculture in 1995 estimated the area of the natural forest at 10,070 hectares and the human-made forest at 1,940 hectares (Breghieth, 1995). The difference in areas is referred to that the Ministry of Agriculture estimates are based on the 1971 forested areas and that they considered each forested area as forest whether it includes trees or not. Most of these forests are located on fertile soil types (Terra Rossas, Brown Rendzinas and Pale Rendzinas) and in areas, which enjoy favorable climatic conditions for agriculture.

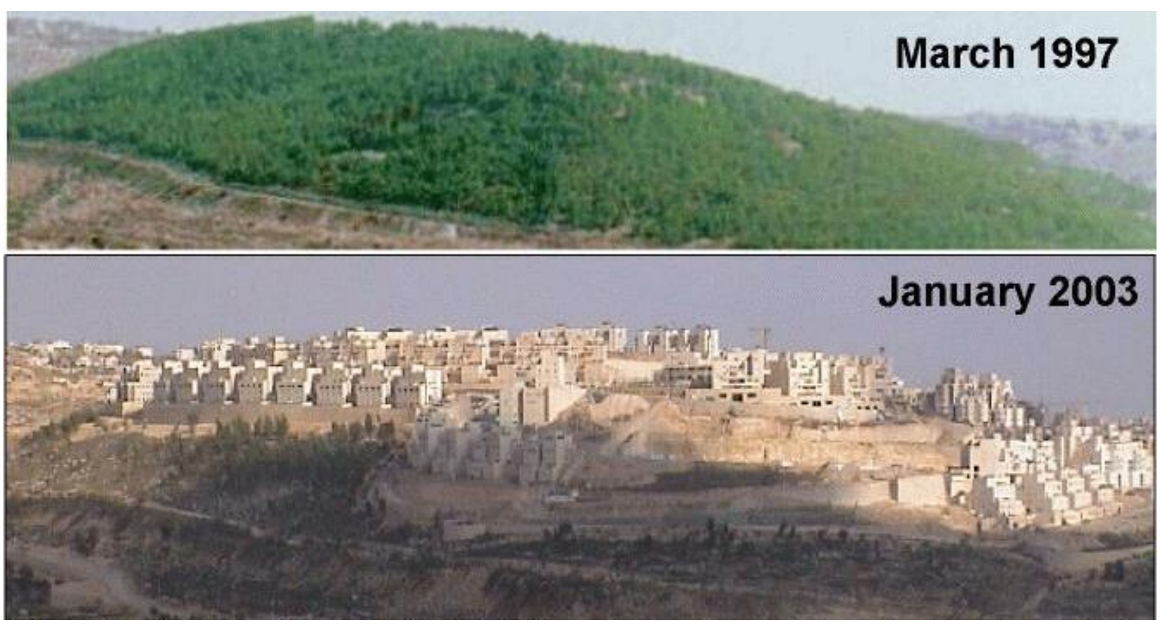


Figure 1:4. Abu Ghnaim Mountain Forests situation in 1997 and 2003.

Benefits of biodiversity

Sustainable use of biodiversity is considered a perquisite for sustainable social and economic development; it ensures the continuing provision of goods and services from ecosystems and their components. The Palestinian land has several diverse ecosystems, which have favored the country with rich cultural and natural resources.

An economic valuation of biodiversity provides one way of taking practical decisions on where conservation action is most needed, and a variety of conservation techniques that have to be developed both in situ and ex situ. The wildlife and the cultivated species of agriculture are directly contributing and supporting the main income of people in the West Bank and Gaza Strip.The economical value of several biological products could be categorized as follows:

Food plants

Different parts of useful plants are used by the Palestinians as direct food which includes: food cereals and pulses, root and tubers, oil, fruits and nuts, vegetables, herb, spices, drugs and medicinal plants. Some plants are used for their stems and leaves such as *Diplotaxis acris, Rumex roseum, Chenipodium spp., Eryngium creticum, Malva rotundifolia, Lactuca cretica, Cichorium punilum* and others. Some other plants are used for their fruits such as *Rubus sanctus, Crataegus* spp.*, Pyrus syriaca*, *Prunus ursina*, *Prosopis farcta, Ceratonia siliqua*, *Zizyphus spp.*, *Arbatus andrachne* and others. Other useful plants are used as raw material for industrial issues or as forages, fiber plants, and other miscellaneous purposes such as *Pistacia palestina*, *Cistus creticus* and *Pinus halepensis* that are used for producing gums and resins (ARIJ, 1997).

Medicinal plants

The West Bank and Gaza Strip are rich with plants that have different medicinal values, such as herbs, perfumes and dye plants. Medicinal plants were and are used by Palestinians according to traditional ways. Special people called "Al A'atarin" used to collecting medicinal plants from Bedouins and villagers who pick them in the wilderness and sell their useful parts to the public. Medicinal plants contain powerful natural chemical constituents and at the same time they are cheaper than those artificially synthesized. The products of these plants can be used in drugs, industrial food manufacturing, or other industries. The most popularly used medicinal plants in Palestine are: *Crocus* spp.*, Colchicium* spp.*, Cyclamen* spp.*, Lilium* spp.*, Scilla* spp.*, Rhus coriaria, Calotropis procera, Indula viscosa, Achillea santolina, Artemisia herba-alba, Matricaria chamomilla, Citrullus colocynthis, Avena sativa, Thymus bovei, Salvia fruticosa, Teucrium polium, Trigonella foenumgercum, Rosa canina***,** etc. On the other hand, some plants are used as perfumes and dyes such as *Achillea aleppica, Achillea santolina, Artemisia monosperma, Anchusa strigosa, Arnebi* *decumbens, Echuim* spp.*, Isatis lusitanica, Rubia tenuifolia, Reseda luteola*, etc. Unfortunately, the over-exploitation of medicinal plants is eroding genetic resources in Palestine.

Forest plants

Forests in Palestine produce timber, used mainly as an energy source (fuel). The major benefit of forests in Palestine is the microclimate they induce, the filtering of air pollutants generated from urban areas, the retention of water in the ground and the fixing the mobile sand, dunes and soils. Recreation and ecotourism can also transform forest areas into major sources of economic revenues. *Cupressus* spp.,*Quercus* spp., *Acacia* spp. and *Pinus* spp. and *Acacia cyanophylla, Eucalyptus* spp. and *Tamarix* spp. are the major forested economic plants in the West Bank and Gaza Strip respectively (ARIJ, GIS Unit).

The beauty of wild flora in the West Bank and Gaza Strip gives a significant ornamental importance to the area. Although ornamental plants are usually cultivated, they remain a significant part of trade in wild plants.

The major families used as ornamental plants are the Rananculaceae, Iridaceae, and Papaveraceae.

1.4 Forest and range resources in Palestine

Twenty seven percent of the total area of Palestine (6207 km^2) composed of forests and rangelands. Both areas differ and maintain diverse eco-systems, climate, topography and biological resources. The most dominant either cultivated or wild exiting trees are oak, pines, ceratonia, pistacia, cypress, wild olives, almonds and pears. Areas such as the Jordan Valley and Gaza Strip are covered with tropical forest trees such as *Ziziphus*, *Tamarix, Halexylon, Acacia* and others, which have special capability to tolerate temperatures and salinity and the ability to stabilize soils and sand dunes.

Records show that due to confiscation of Palestinian lands for Israeli settlements and over population in Palestine forest and rangeland usage in Palestine have changed over the last fifty years. There has been an increase in wood collection for wood usage in different industries. Local people were very much dependent on forest resources in Palestine, although in present times there are less resources and less people are using such resources for different livelihood aspects.

In recent years, for example, high pressure on plant collection for Oregano was seen, while medicinal plant collection is decreasing in the past several decades.

Table 1:3. Area of forests, Natural Reserves & Pastures in the West Bank Districts.

District	forest & woodland	Natural Reserves	Pastures
Jenin	33.2	62.9	54
Tubas	22	19.2	33
Tulkarm	1.2	0.5	18
Nablus	2.4	113	23
Qalqiliya	2.5	No Available Information	12
Sulfit	11.8	9.8	36
Ramallah and Al- Bireh	2.1	34.9	35
Jericho and Al-Aghwar	3.5	37	No Available Information
Jerusalem	2	202	12
Bethlehem	1.4	22	38
Hebron	9	13	360

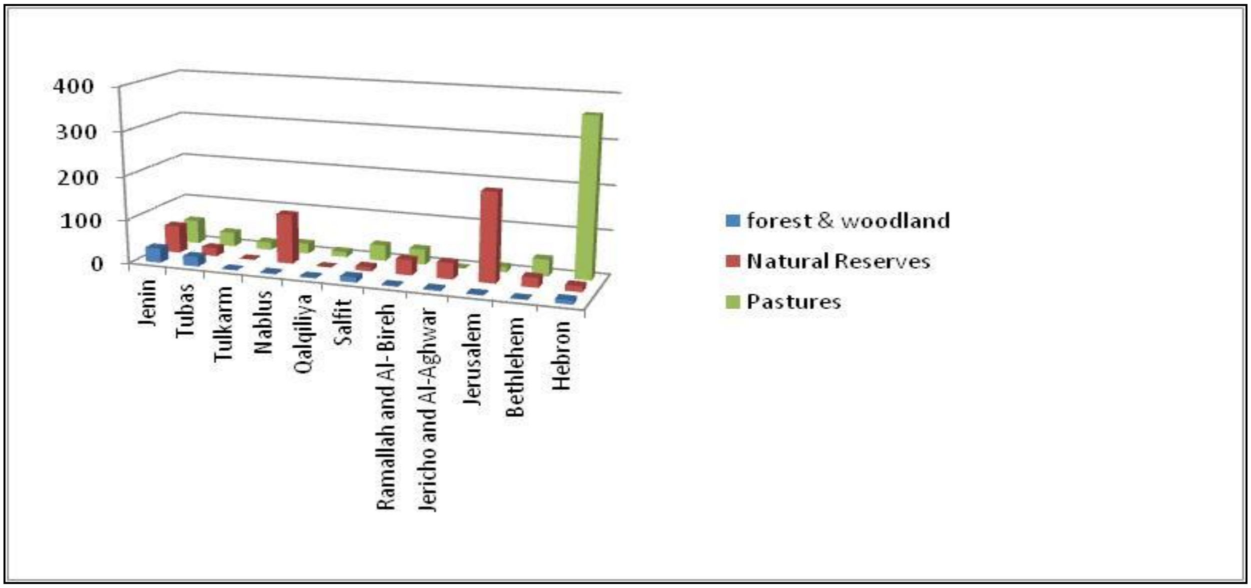


Figure 1:4. Forest, natural reserves and pastures Area in West Bank Districts.

Source: Palestinian Central Bureau of Statistics, 2009. Land Use Statistics in the Palestinian Territory, 2008.

1.5 Forests Functions

- The main usage of forest and rangeland products in Palestine can be summarized as follows:
- Fuel production from natural wood 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.

- Broom and other household production.
- Filters from *Eurocaria* and *Rebudia*.
- Fertilizers for farming and nurseries from forest tree leaves.
- As decorative plants in gardens and houses.
- Souvenirs and other touristic industries from oak, pistachio, pine, cypresses.
- In paints and glue.
- Gums and honey production.
- Tools in agriculture (genetic resources for fruit trees).
- Recreational purposes. Source: Palestinian Environmental Authority, 1999.

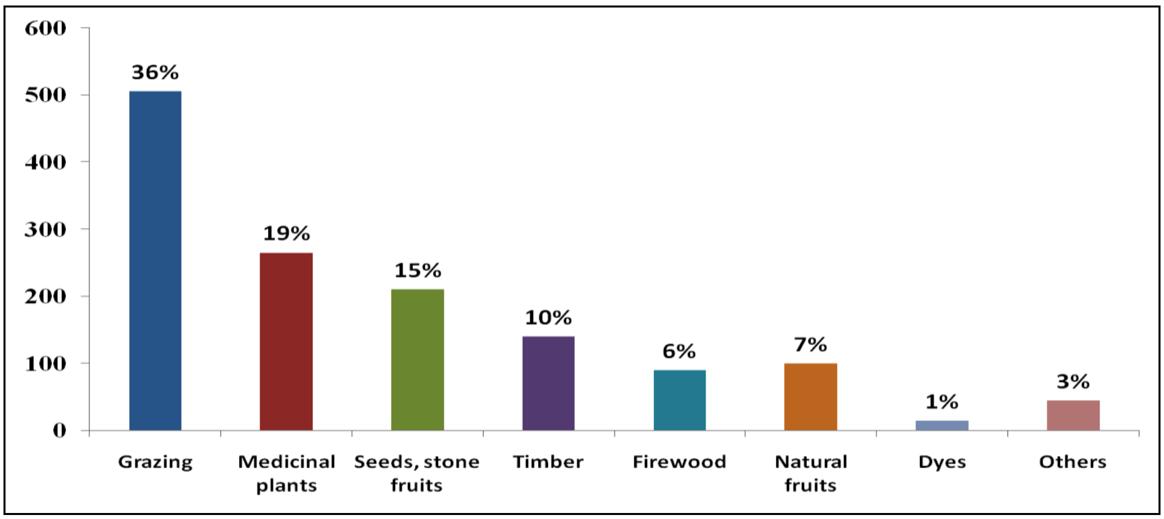


Figure 1: 5 Main components of the Total Economic Value of Palestinian forests (Merlo, 2005)

Threats and impacts:

- Lack of land use management
- Lack of management of forest and range resources.
- Lack of management of tourists' activities.
- Lack of systematic research and monitoring.
- Inadequate clear management vision towards forest resources usage.
- Cutting of natural forests and vegetation for fuel and other house hold appliances
- Soil erosion and loss of soil natural environmental condition such as desertification.
- Encroachment of urban and agriculture over natural forest areas.

- Introduction of exotic species of forest species animal species.
- Transportation schemes and road buildings, affecting forest and tree abundance and natural distribution.
- Liquid and solid pollution in Forests.
- Air and atmospheric pollution and dust lift up from transportation and mining activities.
- Water over pumping from forests wadis, springs and watersheds.
- Illegal hunting in forests for key species.
- Introduction of exotic plant and animal species.
- Disappearance of faunal species important for forest balance and ecology.
- Manmade fires.
- Lack of human and financial recourses, and Inadequate law enforcement and legislation.

1.6 Facts about Forest Changes in the WestBank between 1970-2007

The Table below show the changes in forest areas in all the West Bank district since 1971-2007 for the Natural, Planted and Bare forest.

Table 1:4. Types of forest area changes in different period in the West Bank Districts.

Forest Type	District	Area (Ha) 1971	Area (Ha) 1999	Area (Ha) 2007
Natural forest	Jenin	3,093	1,955	1919,1
	Tubas	15,730	15,632	14,730
	Qalqilia	150	0	No available data
	Sulfit	651	631	617.6
	Ramallah	60	65	27.8
	Hebron	63	63	65
Planted forest	Jenin	861	680	814.3
	Tulkarim	109	109	108.8
	Tubas	170	165	140
	Nablus	334	239	186.6
	Qalqilia	130	68	15
	sulfit	12	12	12
	Ramallah	408	163	117.7
	Jerusalem	279	199	1100
	Hebron	972	807	685
	Bethlehem	259	149	120.8
	Gaza	4200	200	150
Bare land with sparse vegetation				
	Jenin	1203	686	595.8
	Tulkarm	10	10	10
	Tubas	600	590	109.2
	Qalqilia	209	185	28.7
	Sulfit	540	540	479.5
	Hebron	30	30	80

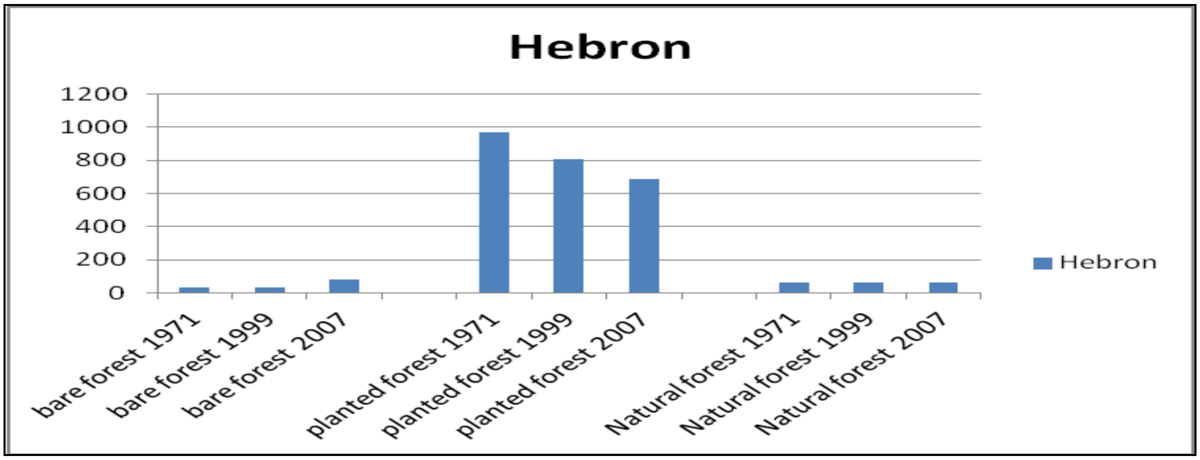


Figure 1:6. Forest types changes in different periods in Hebron District.

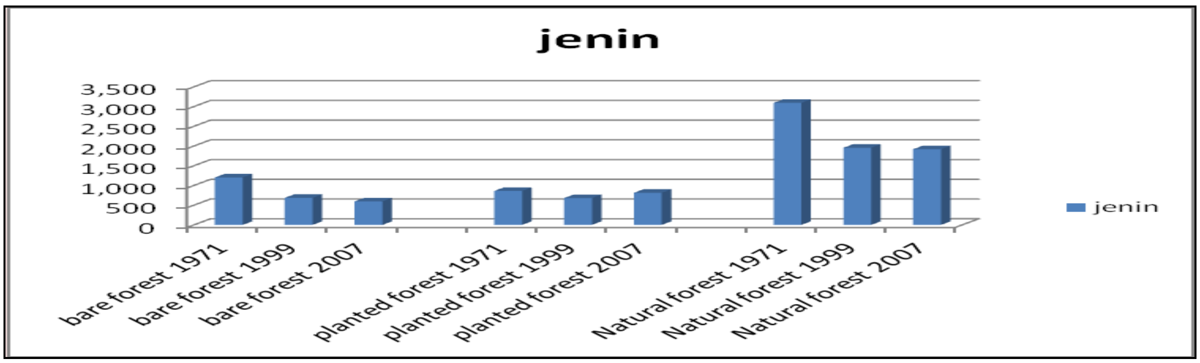


Figure 1:7. Forest types changes in different periods in Jenin District.

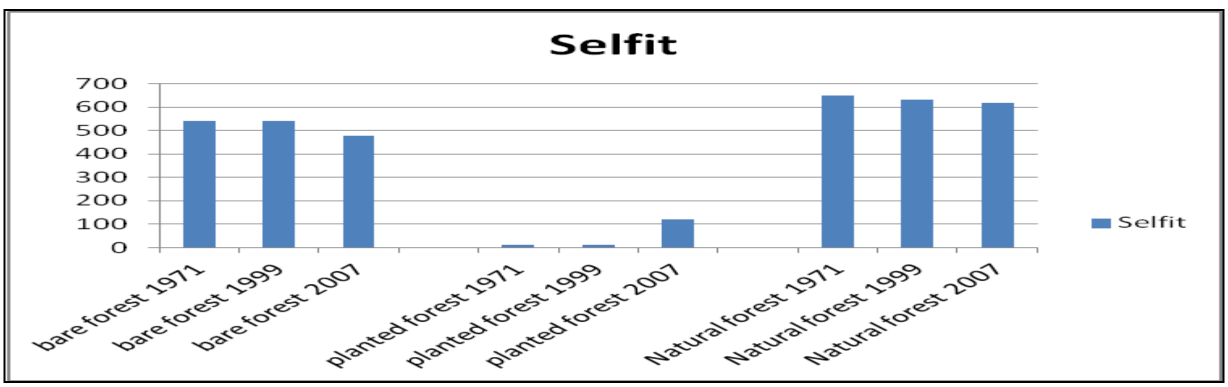


Figure 1:8 Forest types changes in different periods in Sulfit District.

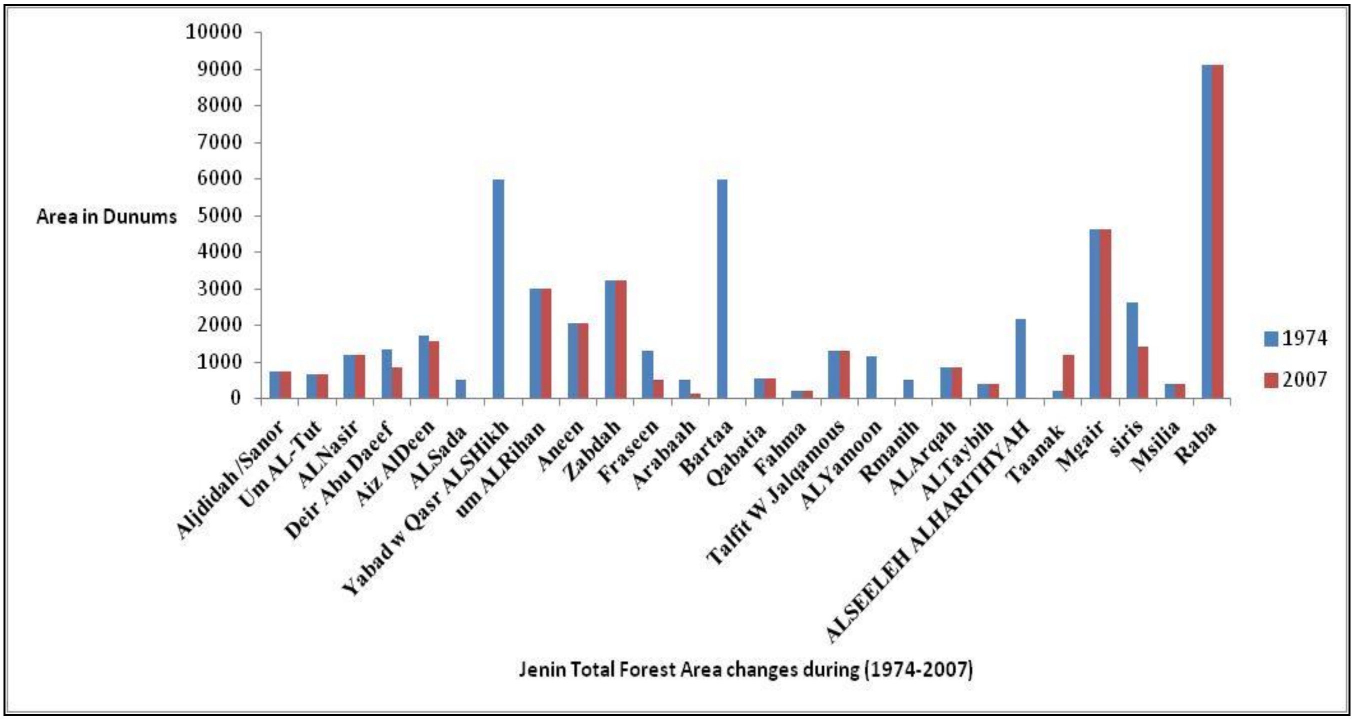


Figure 1:9 Total forest area changes in Jenin District during the period 1974-2007.

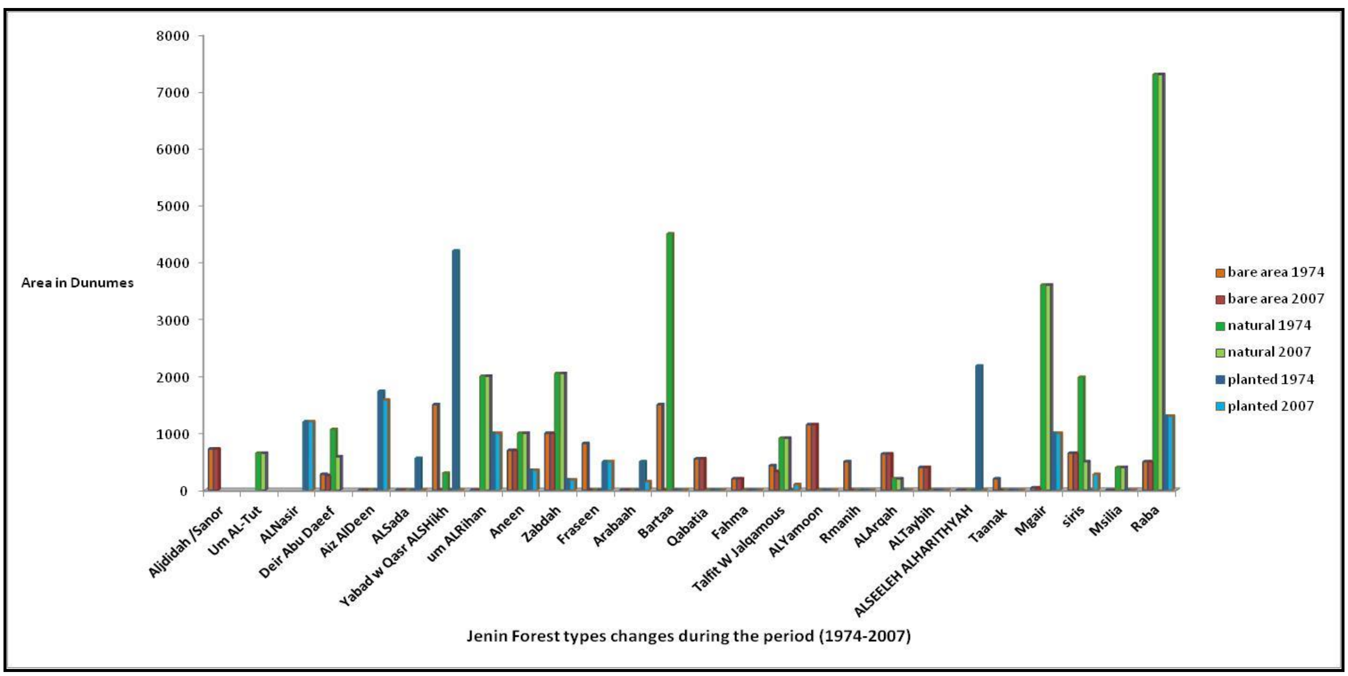


Figure 1:10 Forest Types changes during the period 1974-2007 in Jenin District.

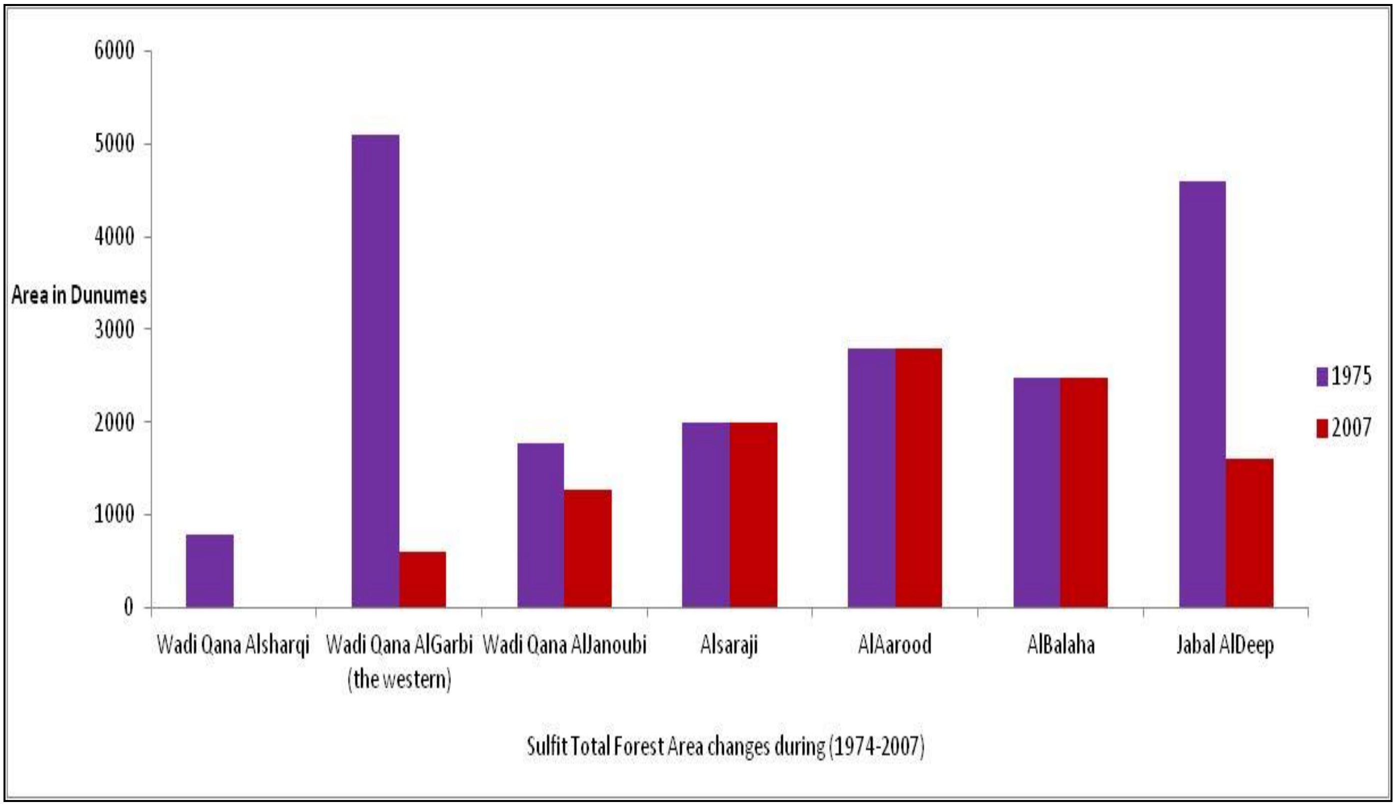


Figure 1: 11. Total forest area changes in Sulfit District during the period 1974-2007.

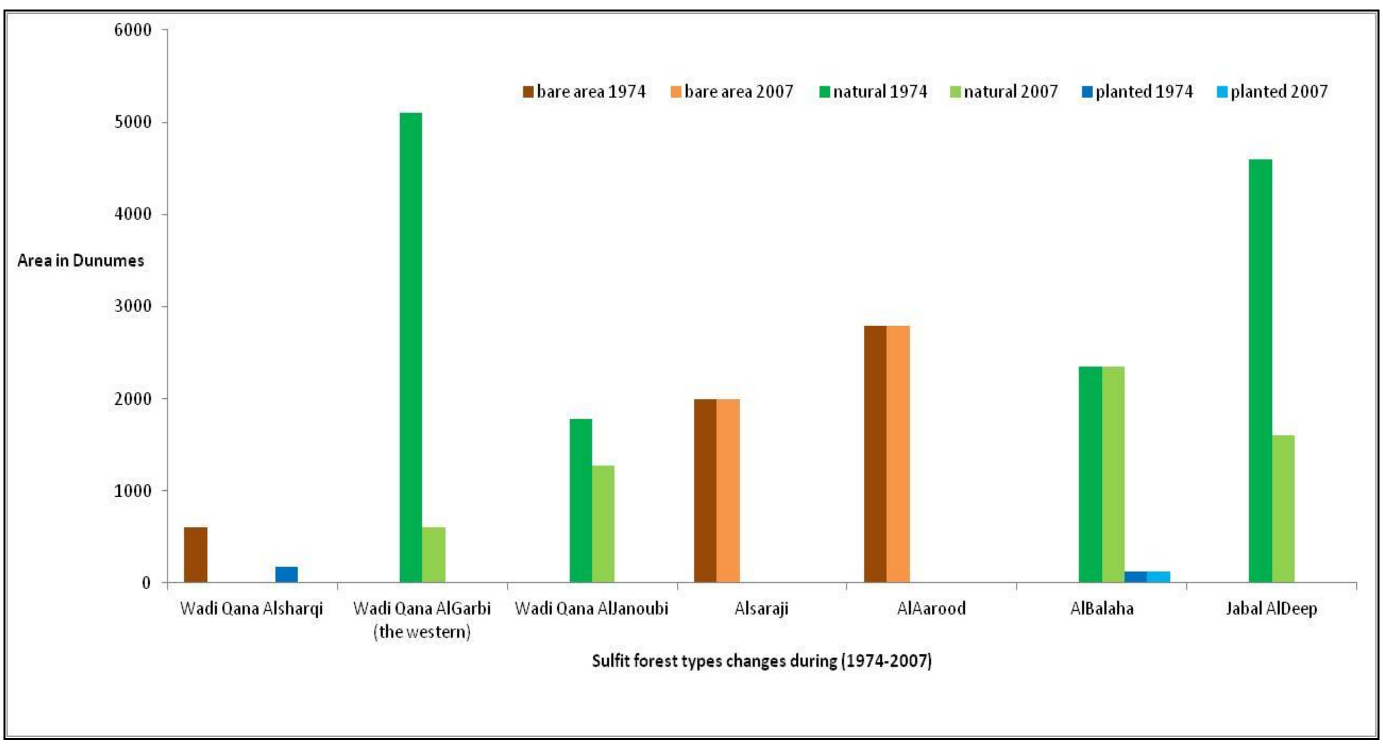


Figure 1: 12. Forest Types changes during the period 1974-2007 in Sulfit District.

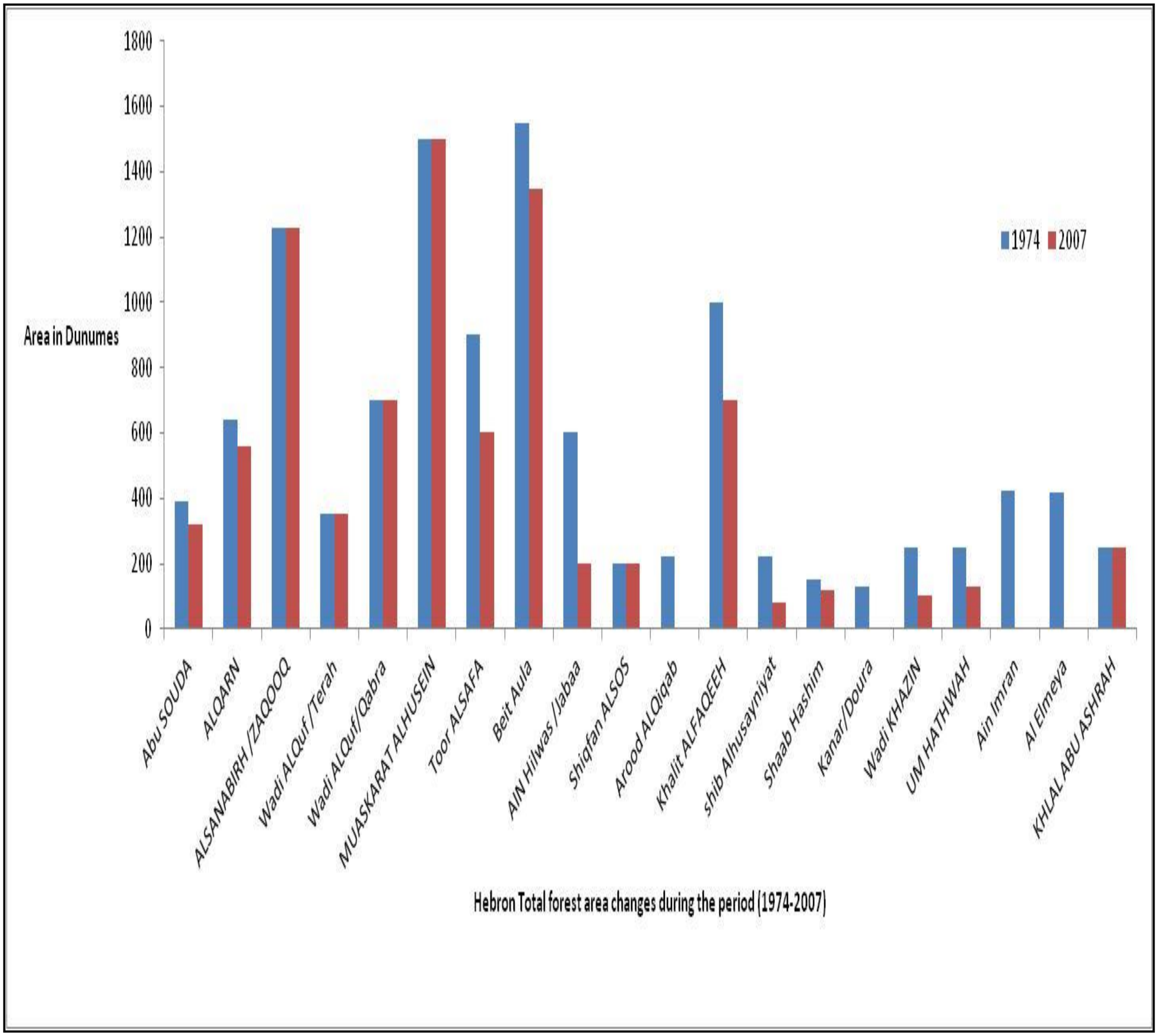


Figure 1:13 Total forest area changes in Hebron during the period 1974-2007.

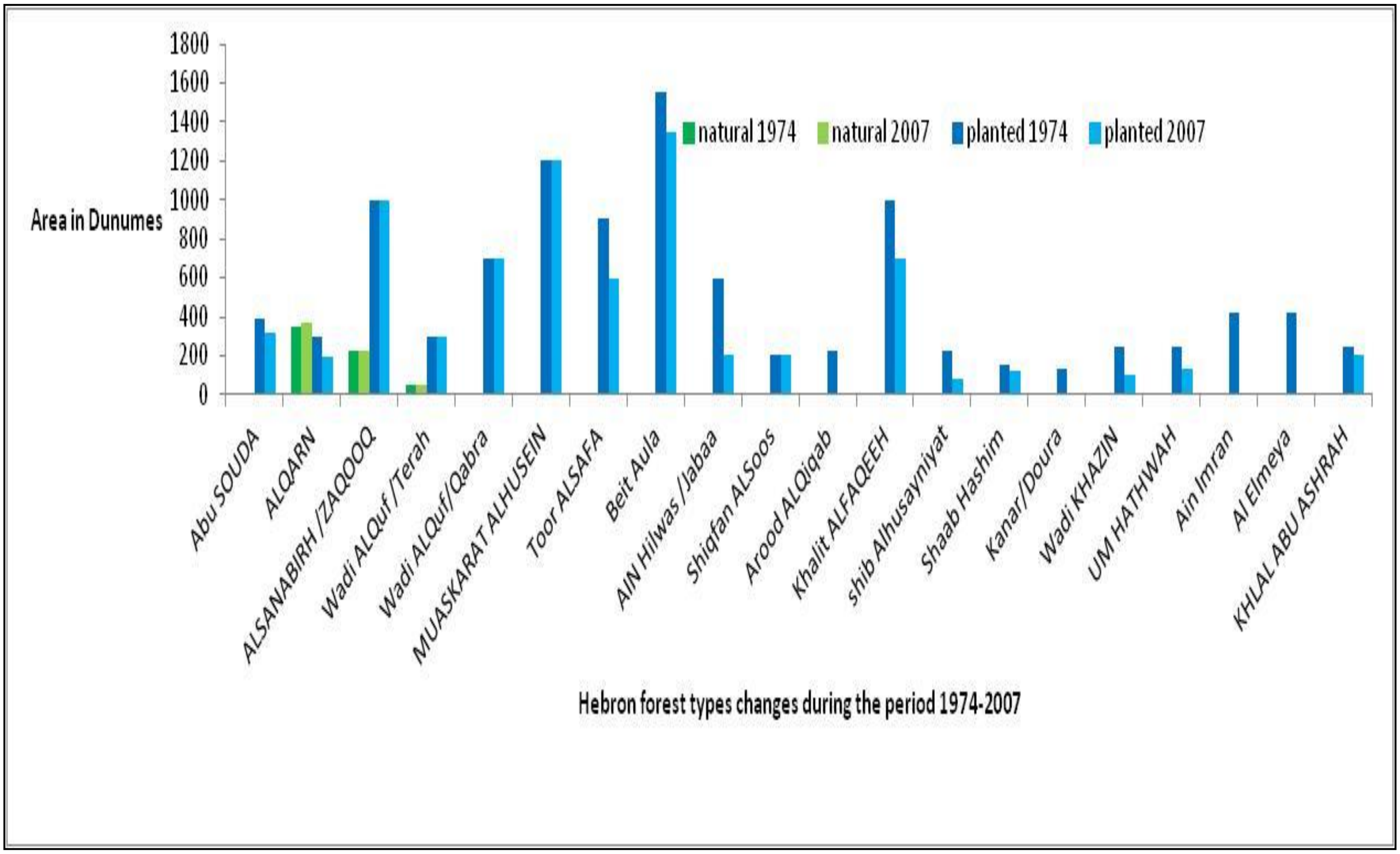


Figure 1:14. Forest types changes during the period 1974-2007 in Hebron District.

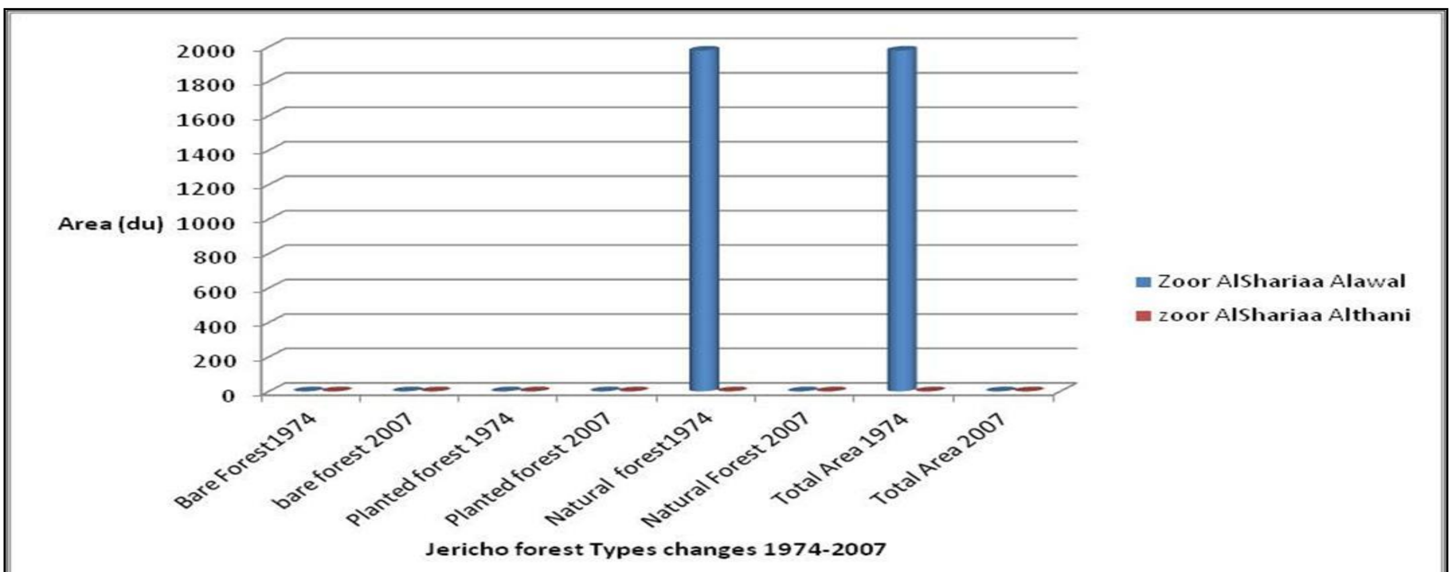


Figure 1:15. Total forest area changes in Jericho District during the period 1974-2007.

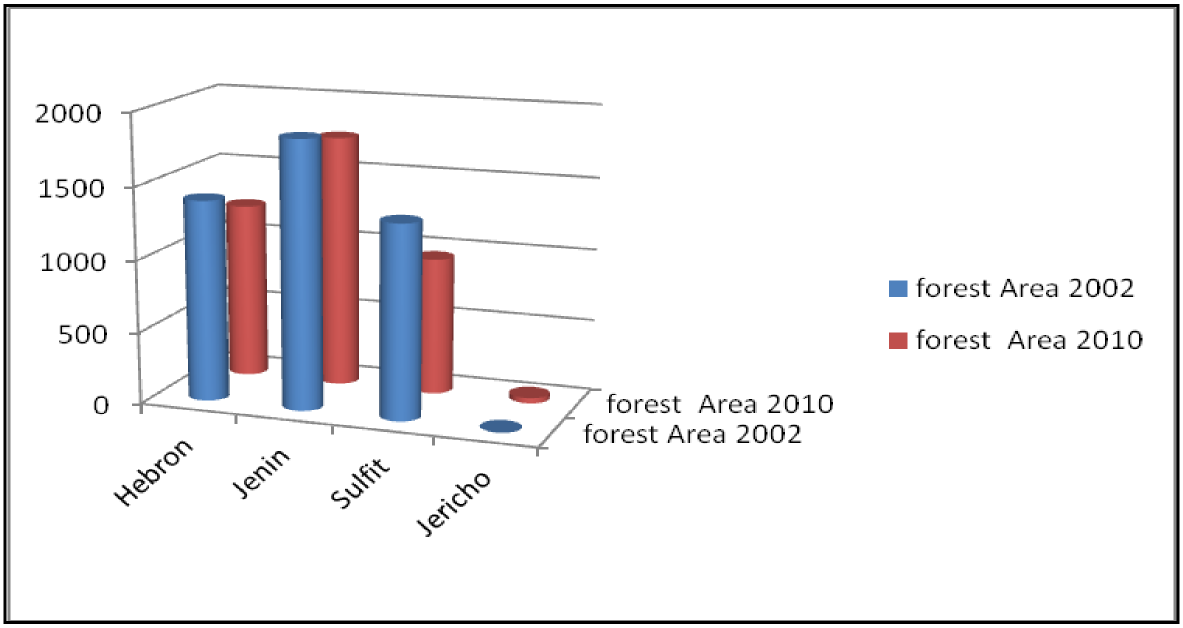


Figure 1:16. Forest area changes during 2002-2010.

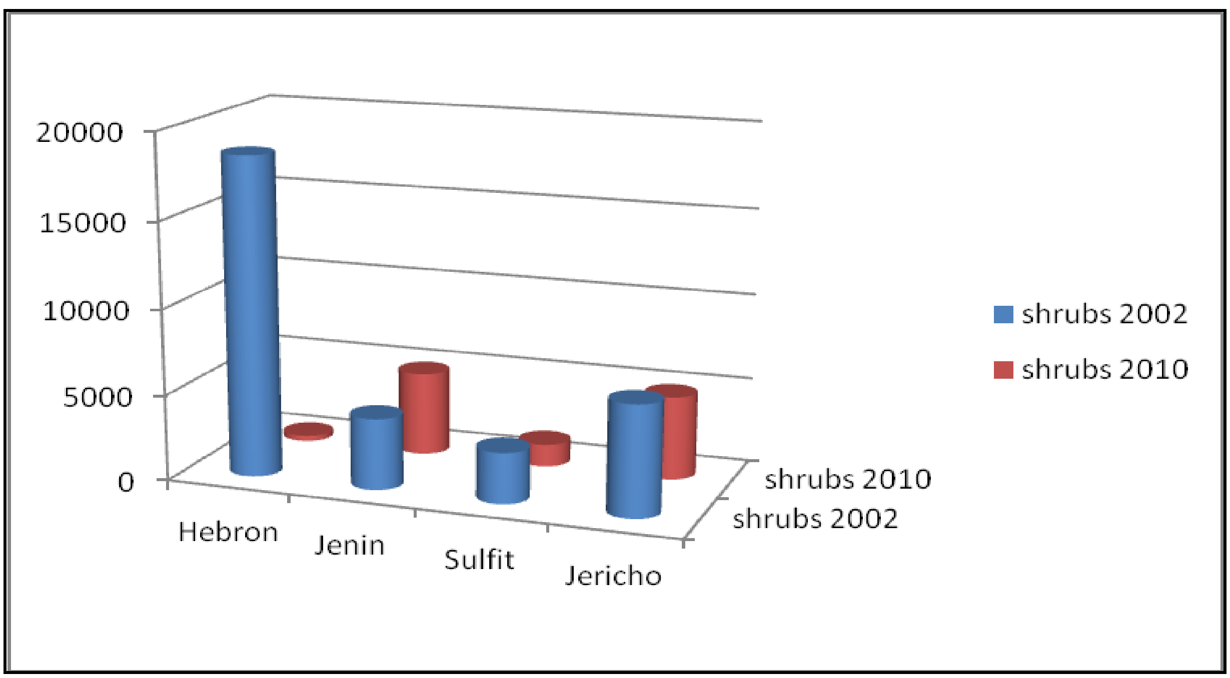


Figure 1:17. Shrubs area changes during 2002-2010.

Chapter Two : Habitat fragmentation and ecological corridor for conservation

2. Habitat destruction is the alteration of natural habitats to the point that it is rendered unsuitable to support sensitive species dependent upon it as their home territory. Modifying habitats for agriculture is the chief cause of such habitat loss. Other causes of habitat destruction include Surface mining, deforestation, slash and-burn practices and urban development.

Habitat destruction is presently ranked as the most significant cause of species extinction worldwide. Additional causes of habitat destruction include acidrain, water pollution, introduction of alien species, over grazing andoverfishing . A closely related concept is that of habitat fragmentation, where a habitat is separated into fragments that lack effect ecological connectivity, reducing the viability of some of the sensitive species . The fundamental driver of habitat destruction has been the un prevented human population explosion, which has been a unique event of a single species dominating natural systems of the Earth within the short time span of 10,000 years. The waves of habitat destruction are closely correlated with the numerical expansion of the human population as well as settlement incursions and change in lifestyle.

Habitat fragmentation usually occurs because of human activities such as new roads, parking lots and housing developments. Organisms need their specific habitat for survival, and fragmentation is a leading threat to many terrestrial animals. Not only are these animals separated from the resources they depend on, but they now have to travel across unsuitable areas, such as roads, to reach those resources.

Habitat fragmentation from human activities is not limited to urban areas. Logging is a major cause of habitat fragmentation in forests. Logging creates clear-cut, open ground areas that were once protected by the cover of trees. Logging roads that are built for the logging trucks to travel on can also be cut through forests, disrupting the habitat. Habitats may also become fragmented by natural processes. Rivers serve as natural pathways for both terrestrial and aquatic animals. If the river floods, it may make passage across it by terrestrial animals impossible. On the other hand, aquatic animals that depend on the river to move between two different water bodies will not be able to travel from one place to another if the river dries up.

Fragmented habitats may be subject to the edge effect. The edges of habitats are important parts of the landscape and are so unique that they have their own sets of physical conditions and communities of organisms. When habitats become fragmented, their edges often become more abrupt and transition less smoothly than they would naturally. Edges usually have less diversity and are dominated by a small number of species specially adapted to those areas. When more edges are created, the species inhabiting edges expand into areas that they wouldn't normally be found. This creates new competition for the species native,linked to the originary fragmented habitats, and this can have detrimental effects on those original species. Also, since habitat fragmentation breaks the original habitat into smaller, isolated patches, movement between these patches can become dangerous for dispersing individuals. This is especially true if animals now have to cross something like a busy road. To make passage safer, wildlife corridors should be created.

Wildlife corridors are a thin strip of habitat linking larger patches of wild habitat. They are like roads for animals, providing a safe way to get from one place to another. Wildlife corridors are often constructed as 'land bridges' across busy roads, or tunnels underground. Nevertheless, this is only a type of habitat connection (Bennett, 1997). Fragmentation and transformation of the natural landscape, creating thousands of patches of habitat, while some patches can have significant social value, such as green buffers or small urban parks, the majority of them have lost many of its ecological functions. On the other hand, the impacts produced by the combined effect of the sprawl of urban, industrial and transports systems, i.e. air or light pollution and noise, are such that they are negatively impacting almost all natural systems (Mallarach, 2000).

2.1 Main Biodiversity indicators for sustainable development in the OPT

Ecosystem Habitat : Indicators of pressure / threatening processes

- Habitat alteration and land conversion from its natural state :
  1. i. Deforestation: 59% since 1970 (MOA,1999),
  2. ii. Uprooted Trees: 794162 trees since 10 years (ARIJ GIS,2006) .
  3. iii. Palestinian built up area: increased by 21.3 % in Westbank (last 5 years) (ARIJ GIS ,2006) and 41.9% in Gaza strip (Issac.et al., 2006).
  4. iv. Israeli colonies area increased by 16.5% (last 5 years) (ARIJ GIS,2006).

- **Aquatic habitat destruction :**
  - I. Over fishing: 33,8 % rare fish of total fish species in Gaza 8.5 % are very rare fish of total fish species in Gaza.
  - II. Pollution: 70-80% of the domestic wastewater produced in Gaza reaches the environment untreated and discharged into the Mediterrean sea.

- Indicators of State / loss of Biodiversity

- i. Total vegetation cover : Total natural vegetation area forms 25.88% of total West Bank and Gaza Strip area (ARIJ GIS, 2006).
- ii. Total forested area : Total forest area forms 1.42% of total West Bank area (ARIJ GIS, 2006).
- iii. Protected areas : Total nature reserves area form 12.8% in the West Bank and Gaza strip (ARIJ, 2006)

Indicators of Response /Biodiversity conservation and management

- i. Afforested areas : Total afforested areas forms 4.1% in West Bank and Gaza strip.
- ii. Forested conservation : No conservation programs.
- iii. Marine protected areas : Three natural reserves are located in the coastal area of Gaza strip including with a total area estimated by 30 km^2

Indicators of State/loss of Biodiversity

Species : Extinct, endangered and vulnerable species and ecological communities

Rare species: 303 species (14.7 of total species).

Very rare species: 67 species (3.23% of total species).

Endemic species: 102 species (4.9% of total species).

Endangered endemic species: 47.1 % low frequent species

11.8 % rare species, 5 % very rare species.

Indicators of Response/Biodiversity conservation and management

I identification procedures: No detailed procedures for identifying endangered, rare and threatened species were developed .

Existing strategies : Existing strategies for in situ/ex situ conservation of genetic variation are mentioned in BSAPP(Biodiversity Strategy and action Plan for Palestine , 1999).

Biodiversity is often reduced dramatically by Land Use/Land Cover Changes (LULCC). When land is transformed from a primary forest to a farmland, the loss of forest species within deforested areas is immediate and almost complete. Even when unaccompanied by apparent changes in land cover, similar effects are observed whenever relatively undisturbed lands are transformed to more intensive uses, including livestock grazing, selective tree harvest and even fire prevention. The habitat suitability of forests and other ecosystems surrounding those under intensive use are also impacted by the fragmenting of existing habitat into smaller pieces (habitat fragmentation), which exposes forest edges to external influences and decreases core habitat area. Smaller habitat areas generally support fewer species (island biogeography; Mac Arthur and Wilson, 1967; Diamond, 1975), and for species requiring undisturbed core habitat, fragmentation can cause local and even general extinction. Research also demonstrates that species invasions by non-native plants, animals and diseases may occur more readily in areas exposed by LULCC, especially in proximity to human settlements. For example land cover in Israel underwent great changes between the late 19th century and the present. The most dominant land cover classes in the 1870s were 'open space' (77.8%) followed by 'garrigue' (6.5%) and 'maquis' (6.2%). On the other hand, the most dominant land cover classes at the present were 'agricultural fields' (30%) followed by 'orchards' (17.4%), 'desert shrub steppe' (12.2%) and 'built-up areas' (12%). Some land cover classes shown on the PEF 1870s map did not exist in the present land cover map, such as 'open spaces' (referring to land cover which was not defined on the PEF map) and 'traces of forest' (relating to coastal forests cut down in the 19th century). Conversely, some present-day human-related land cover classes did not exist in the past, such as 'artificial water bodies' and 'planted forest'. Relative to the past land cover classes, the largest decrease in area was in 'marsh land'(-93.4%), 'winter pond' (-70.4%), 'gardens' (-66.9%), 'garrigue (-59.2%) and 'riparian vegetation (-58%) and the classes showing the largest increase from their past area were 'fir trees' (+11710.7%), 'built-up area' (+7165.7%), 'orchards' (+329.7%) and 'vineyards'(+294.1%).

Table 1:3 Land cover classes changes during the 1881 and 2011

Land cover classes	PEF map (1881)			Present map (2011)		PEF area change in land cover classes relative to the past	
	Percent of total study area (%)	Percent of total study area not including 'open space' class (%)	Area in km²	Percent of total study area (%)	Area in km²	Percent differences in (%)	Sum differences in km²
Agricultural field	N/A	N/A	N/A	30	4409.7	N/A	N/A
Alluvial sands	0.18	0.79	25.9	N/A	N/A	N/A	N/A
Artificial water bodies	N/A	N/A	N/A	0.54	79.1	N/A	N/A
Built area	0.16	0.74	24.2	12	1758.3	+7165.7	+1734.1
Desert shrub steppe	N/A	N/A	N/A	12.2	1793.6	N/A	N/A
Fir trees	0.02	0.08	2.8	2.2	330.7	+11710.7	+327.9
Gardens	0.45	2	66.2	0.15	21.9	-66.9	-44.3
Garrigue	6.5	29.4	960.7	2.7	391.2	-59.2	-569.6
Maquis	6.2	27.8	909.8	7.5	1106.7	+21.6	+196.9
Marsh land	0.57	2.6	83.6	0.04	5.5	-93.4	-78.0
No data	N/A	N/A	N/A	1	209.9	N/A	N/A
Oak forest	0.74	3.3	109.1	N/A	N/A	N/A	N/A
Open space	77.8	0.0	11446.9	N/A	N/A	N/A	N/A
Orchards	4.1	18.3	596.9	17.4	2564.9	+329.7	+1968.0
Palm trees	0.03	0.12	3.9	N/A	N/A	N/A	N/A
Planted forest	N/A	N/A	N/A	1.8	264.4	N/A	N/A
Riparian vegetation	0.43	1.9	63.6	0.18	26.7	-58	-36.9
Sand dunes	2.1	9.6	314	2	234.1	-25.4	-79.9
Shrub steppe	N/A	N/A	N/A	9.4	1386	N/A	N/A
Traces of oak forest	0.19	0.83	27.2	N/A	N/A	N/A	N/A
Tree	0.01	0.06	1.9	N/A	N/A	N/A	N/A
Vegetated dunes	0.29	1.3	42.5	0.2	28.9	-32	-13.6
Vineyards	0.16	0.73	23.8	0.64	93.8	+294.1	+70.0
Winter pond	0.10	0.43	14.2	0.03	4.2	-70.4	-10.0

(Schaffer and Levin., 2014)

The Figures below represent the Land use changes during the Year 2002, 2010 respectively in four District of the West Bank (Sulfit, Hebron, Jenin, Jericho).

These district were chosen because our study areas in this research included in these Districts (more information will be found about the study areas in the next chapter).

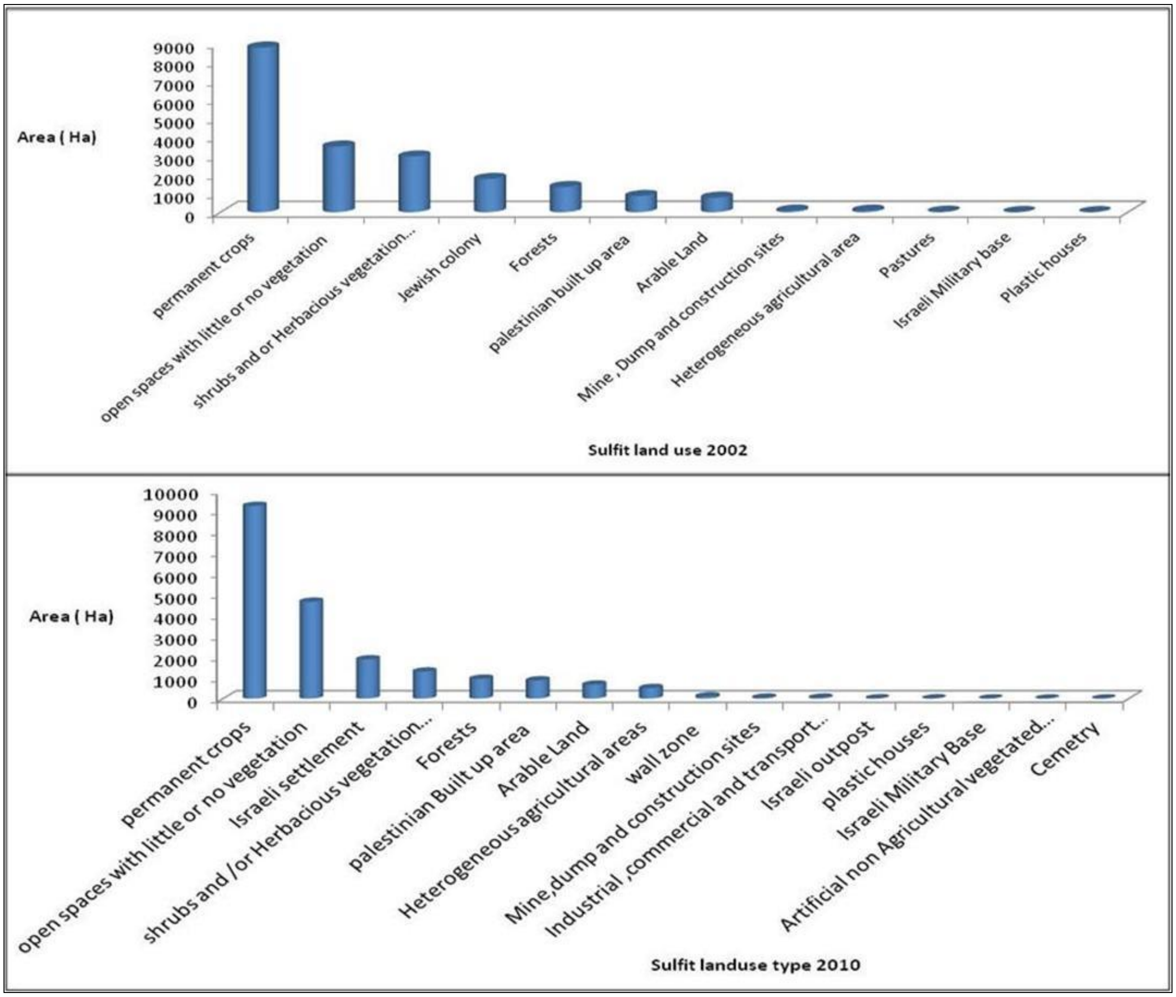


Figure (2.1) Landuse type in Sulfit During the year (2002,2010)

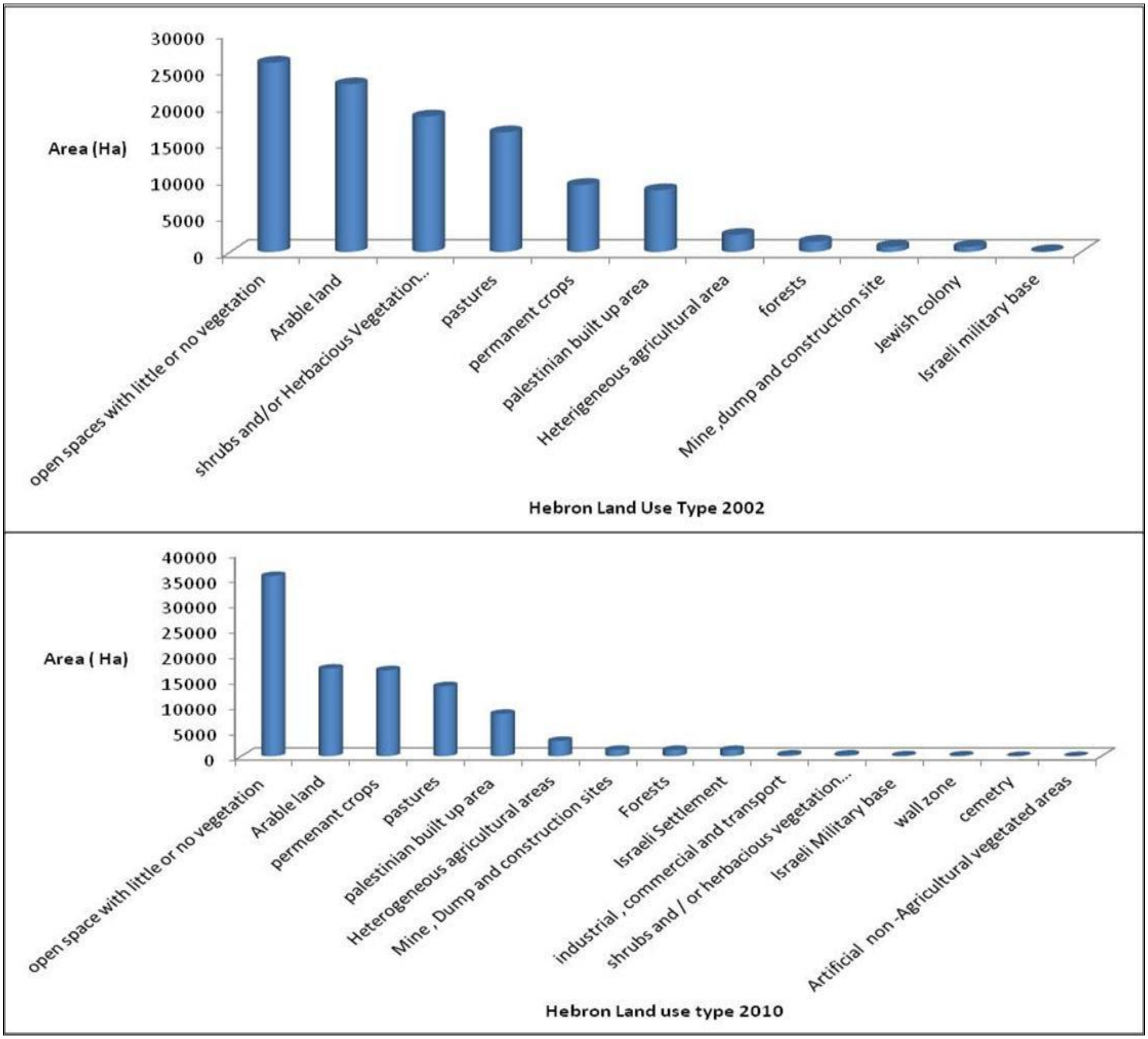


Figure (2:2) Land use type in Hebron (2002 ,2010).

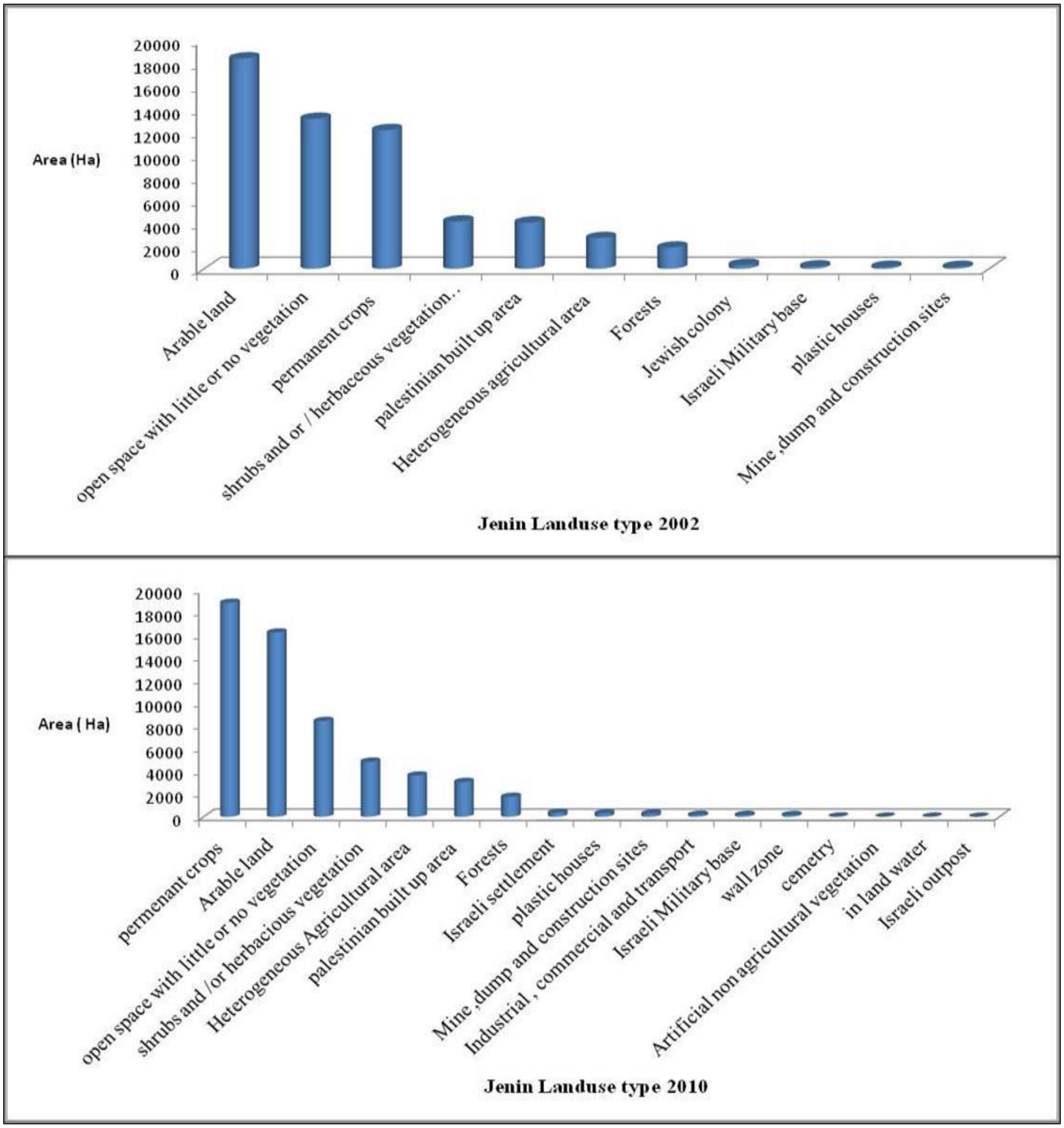
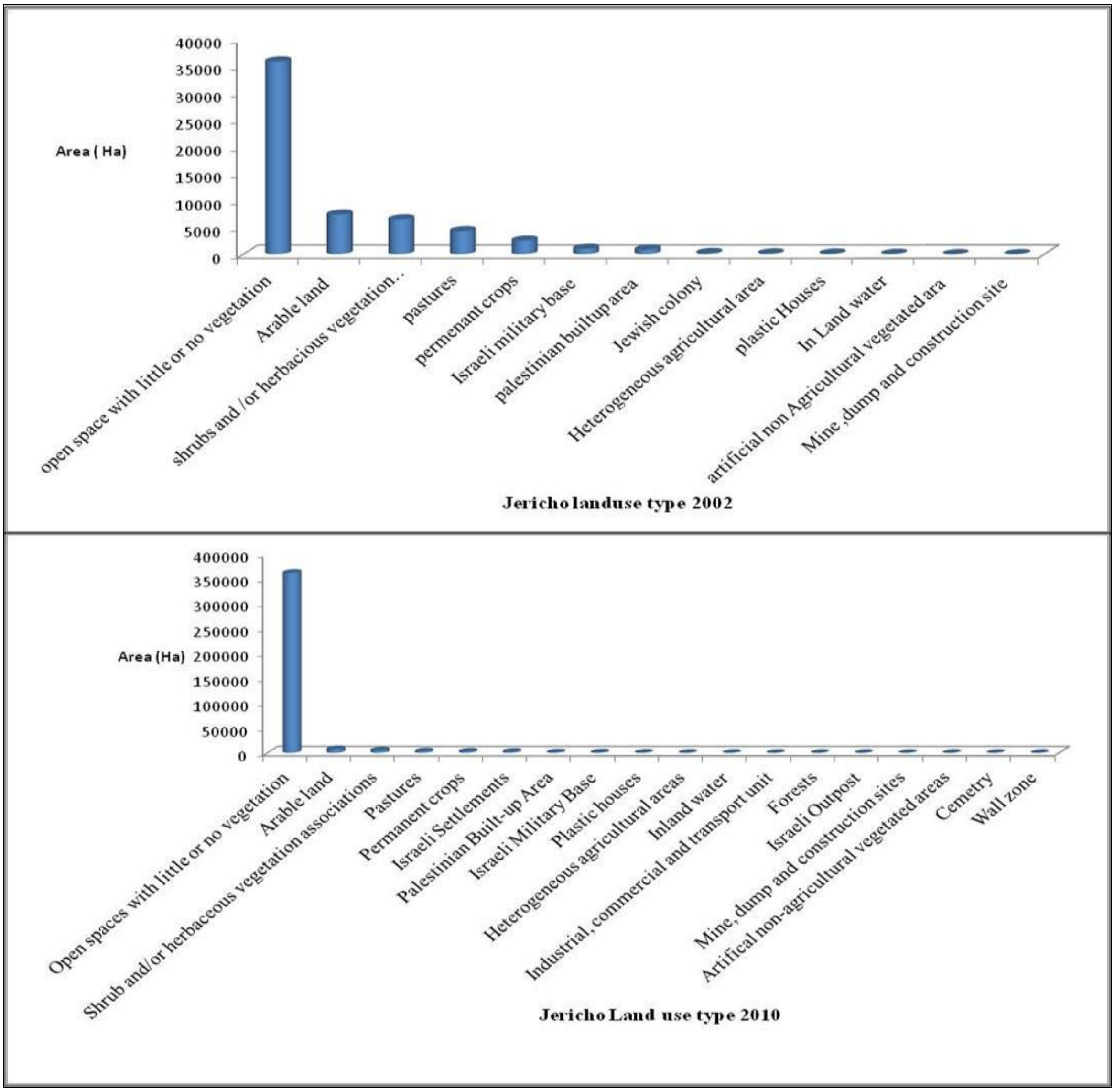


Figure 2:3 . Land use type changes in Jenin in (2002, 2010)



(Figure 2:4 Land use type in Jericho 2002 , 2010)

2.3 Palestine habitat situation

The Palestinian population all over the World account today for more than 9 million Palestinians distributed in the Palestinian Territories, Israel, the Arab World and other foreign countries. According to Palestinian Central Bureau of Statistics (PCBS) projections for the year 2004, the Palestinian population living in the Palestinian Territories is 3,827,914 of whom 2,421,491 (63.3%) live in the West Bank and 1,406,423 (36.7%) live in the Gaza Strip. There are approximately 661 Palestinian built-up areas in the West Bank spread over an area of 354,870 dunums (ARIJ database, 2002).

The Israeli territorial strategies of unrealistically limiting border expansion of cities and villages has overloaded infrastructure and increased population density in the built-up areas. It has also translated to the random, unplanned, and unlicensed construction of houses and urban sprawl. Furthermore, it has contributed to rural-urban migration by people who are unable to find housing in the rural areas" (MOPIC 1998:51). The living conditions in the West Bank are according to MOPIC degrading due to population growth and unsatisfactory urban development. Many elements contributed in shaping the patterns of Palestinian urban areas in the West Bank. The topography, the shape of the transportation routes, the surrounding agricultural and hinterlands and other resources, location, the physical structure, planning and control, were among many other elements that contributed to the development and the shaping of the urban patterns. Some Palestinian cities have strategic locations within the West Bank such as Hebron, Ramallah, and Jerusalem. Their urban pattern was shaped as result to their location at the main nodes from which the main and regional roads radiate to connect the West Bank, and the function they perform in relation to their surrounding or other urban centers. In other cities the urban pattern was shaped as a result of their location on areas that have natural resource potentials, water or agriculture such as the cities of Jericho and Qalqiliya. While in cities as Tulkarm, the urban pattern was shaped as a result to their location near the border line, their potential derived from their function as market areas and as nodes of connection with other regions inside the West Bank.

Israeli colonization

The jagged division of the West Bank into areas A, B, C, H1 and H2, according to the different Palestinian-Israeli peace accords has partitioned the territory into isolated cantons, which are physically separated from each other. Israeli colonies, outposts, bypass roads and lately the

Segregation Wall have been built on Palestinian lands, separating the Palestinian communities from each other and from their lands. Confiscation of approximately 52% of the West Bank land under various pretexts has imposed enormous limitations on Palestinian built-up areas. Significantly, the Israeli colonization has raised the population density in Palestinian built up areas. Population densities have become even higher if one takes into consideration the segregation imposed by the Oslo Accord. Area A has a population density of 969 people/km^2, in Area B the population density reaches 1,118 people/km^2, whereas in the East Jerusalem the population density exceeds 4,000 people/km^2. The situation in the Gaza Strip is much worse, where population density reaches more than 3,600 people/km^2 (PCBS, 1997). In contrast the population density in Israel averages 261 people/km^2 (ICBS, 1997). Since the Israeli occupation of the West Bank in 1967, the Israeli land policy in the Palestinian Territories focused on land expropriation for the construction of Israeli colonies on Palestinian lands. The scope and type of land affected by Israeli colonization of the Palestinian territory is determined by the unique geopolitical ambitions of Israel to the Palestinian Territories. Two primary goals guided the expropriation of Palestinian land for the colonization project: expansion and separation from the Palestinian population. Land is therefore chosen for expropriation on hilltops overlooking and surrounding Palestinian built-up areas, areas that block the merging of Palestinian built-up areas while facilitating the merging of colonies, areas that may be easily annexed to Israeli proper in the future, or that secure economic resources, militarily advantage or negotiating leverage. During the years of occupation Israel managed to control 60% of the West Bank, over 30% of the West Bank area is confiscated and expropriated for exclusive Israeli use.

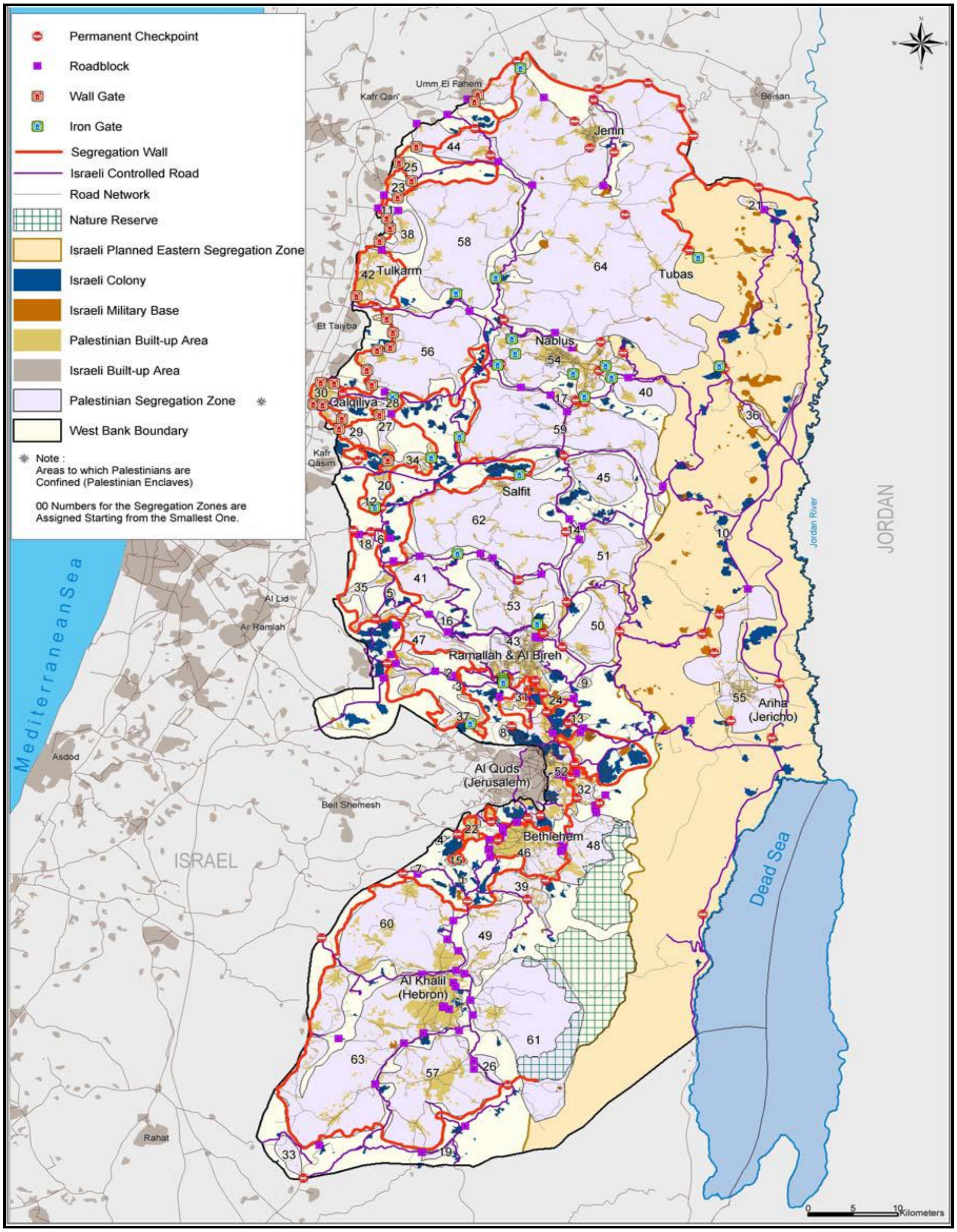


Figure 2:5. Map reflect the real situation of the West Bank and its fragmentation by different factors.

Biological diversity is highly dependent on the quality, quantity, and spatial cohesion of natural areas. Fragmentation of natural habitats severely affects the abundance of species. A solution to this problem is the development of ecological networks, linking core areas of nature by means of corridors and small habitat patches. If wildlife is spread over a large area in small numbers, and if the remaining areas are too small, sooner or later, wildlife species will disappear. Fragmentation severely affects the abundance of species. To allow for repopulating or restocking of small areas and habitats, the areas need to be connected to the remaining core areas for wildlife in the surrounding (Jongman et al. 2011; Snep and Ottburg 2008). For birds, this means that the distance from source areas to their habitat is less than the normal distance they might cover when flying. For non-flying animals it might mean that a physical connection is required that functions as a corridor (e.g., woodlands, streams, rivers, natural grasslands, and so forth; Grift et al. 2013; Van der Sluis et al. 2004). An answer to this problem is the strengthening of an ecological network, linking nature areas by means of corridors and small habitat patches (Opermanis et al. 2012; Van der Sluis et al. 2004; Van der Sluis et al. 2003; Vos et al. 2001). An ecological network consists of habitat patches for a population of a particular species that exchanges individuals by dispersal. Management of land in support of biodiversity covers a wide range of policies and practices. The most basic of these is to set-aside existing biodiversity habitats as conservation reserves from which humans are excluded. Another is the establishment of preserves and parks in which local human populations and tourists participate in the less harmful economic use and preservation of biodiversity lands. More recently, efforts are being made to restore biodiversity habitats on lands stripped of their original habitat, and to manage existing agricultural and urban landscapes to enhance their suitability as habitat by practices including the planting of native plants and the restoration of habitat patches within intensively managed landscapes. Another new land use practice is the establishment of corridors of habitat between existing patches of habitat distributed across landscapes, creating larger effective habitats by connecting smaller patches together and enhancing species migrations. This will be an especially important practice in response to future changes in climate that will cause the habitat ranges of many species to migrate, mostly northward, requiring species migration through managed areas.

Protection of productive agricultural land has become a major priority in many regions of the world. Land degradation by overgrazing and intensive agriculture on marginal lands is a major driver of land loss; a number of national and international programs have responded with land reforms and incentive programs to avoid this outcome. In rapidly industrializing nations with dense populations such as China, and in the past, Korea, Japan and Western European nations, demand for land for industry and residential use is driving the transformation of some of the most productive agricultural land in the world out of production. Policy efforts to avoid this loss of production are also in place, but their effectiveness in the face of economic demand is often limited. Another threat is the wide adoption of automobile transportation in some developed nations, which has transformed large areas of agricultural land to relatively low density residential uses around cities and along highways (urban sprawl). “Smart growth” and other programs have been developed in these areas to encourage more efficient and desirable land use and to protect agricultural land. The examples above demonstrate the variety of solutions to environmental harm by LULCC that are in progress. The effectiveness of these and other regional and national efforts to reduce the negative impacts of LULCC remain to be seen. The need for greater efforts and new methods to monitor and mediate the negative consequences of LULCC remains acute, if we are to sustain current and future human populations under desirable conditions.

Figure (2.6) a. Habitat fragmentation by Roads b. Fragmentation reduce Biodiversity

Connectivity can be synthesized as the degree in which landscape facilitates or impedes species movements and other ecological flows (Rubio and Saura, 2012; Taylor et al. 1993), and is one of the key factors maintaining the ecological functions of forests (Liuet al. 2014a). When forests are fragmented, the pattern of spatially structured habitats is modified and the movement of dispersing individuals may be constrained, hampering biodiversity conservation (Laita et al. 2010; Saura and Torné, 2009). This is in fact the case for many forest and ground-dwelling species (Pascual-Hortal and Saura, 2006, 2008), whose habitat availability has been severely altered due primarily to human actions. Indeed, mosaics of landscape patches can have a natural origin, but are mainly caused by anthropogenic activities, such as plantation forestry, agricultural intensification, road network, or urbanization (Di Giulio et al. 2009; Fu et al. 2010; Li et al. 2010; Liu et al. 2008, 2011, 2014b; Szabó et al.2012; Yu et al. 2012). In highly populated areas, landscape fragmentation limits species survival to the existence of connectivity between spatially separated populations (Fischer and Lindenmayer, 2007; Kramer-Schadt et al. 2004). Deforestation is one of the activities inflicted by humans which has the most influenced landscape fragmentation (e.g. Fearnside, 2005; Harper et al. 2007; Skole and Tucker, 1993). Clearance has sometimes been aimed at the substitution of native tree species with fast growing ones, often exotic. These new species contribute significantly to the economic growth of many regions as a result of the derived benefits of timber exploitation and the functions that they provide as forest habitats (see e.g. Brockerhoff et al. 2003, 2005; Carnus et al. 2006; Humphrey et al. 2000). However, they may also induce substantial changes in natural ecosystems and habitat structure (Calvi˜no-Cancela et al. 2012; Fabiao et al. 2002; Poore and Fries, 1985) and it is usually true that natural forests offer better quality habitats for native forest species than plantation ones (Brockerhoff et al. 2008). Plantation forests can enhance indigenous biodiversity by improving connectivity between natural forest remnants (Brockerhoff et al. 2008). In fact, some plantation forests can be assimilated to natural ones when their management is sustainable, and is allowed to acquire “old-growth” conditions (Humphrey, 2005). On the other hand, when plantation forestry is very intensive, with short rotations and high timber productivity performance, plantation patches with a key role in network connectivity are eventually transformed into autochthonous vegetation forest. Thus, previously existing plantations can benefit the restoration of natural forests, accelerating natural recovery by modifying physical and biological conditions positively (Lambet al. 2005 and references therein). These management action shows ever, need to be contemplated in the global perspective of the modified landscapes where they are planned and not as isolated actions, since specific topographical or man-made features may modify their results substantially. Large highways or high speed railway infrastructures, for instance, may pose important barriers to connectivity notwithstanding the effect of plantation patches, and their effect should be included in the connectivity analyses before a reforestation strategy is approved or put in motion. Indeed, these infrastructures are a major element in the fragmentation of natural habitats, and pose particular problems to forest dwelling fauna species which often encounter in surmount-able barriers in particularly broad or busy highways (Forman and Alexander, 1998; Liu et al. 2014b; Spellerberg, 1998). Forest patches are often severely segregated by roads limiting connectivity between forest-dwelling species. Their impacts can be intensified by the flow of traffic (Langevelde et al. 2009), especially in border areas (Forman and Deblinger, 2000), where noise, pollution, luminosity, waste, etc. are more intense (Formanet al. 2002). On the other hand, roads have also been found to attract specific faunal species (Dean and Milton, 2003; Dodd et al. 2007), some being able to disperse through landscapes with major roads or highways (Blanco et al. 2005; Waller and Servheen, 2005).The impact of these infrastructures will also vary depending on the sensitivity of the affected habitats and landscapes, and the tolerance and adaptability of distinct animal and plant species living in the area (Forman et al. 2002; Geneletti, 2006; Rytwinski andFahrig, 2013). For instance, the dispersal ability of organisms across changing landscapes, which is a fundamental issue for long-term biodiversity conservation (Fahrig, 2007), is a clear limiting factor when considering species abilities to move between preferred habitat patches, or surmount specific obstacles such as roads or highways. Reforestation schemes aimed at guaranteeing connectivity between forested areas must take all these factors into account and specifically analyze the implications that the presence of a particular barrier, such as a prominent highway or railway, may have for achieving the planned connectivity objectives. An ecological corridor is a unique strip of land in possession of particular features (different to those of its surroundings) that forms a link between areas sufficiently large to enable the existence of various kinds of wildlife in their natural habitats which are otherwise disconnected. Ecological corridors connect nature reserves with areas of ecological importance, enabling species to move between them. These definitions were first established in connection with the landscapes of England and other western European countries. With time the concept of ecological corridors has developed and expanded and today ecological corridors include agricultural lands and natural open spaces that connect nature reserves. In Israel ecological corridors have great significance.

At first, the concept of nature preservation in Israel stemmed from a desire to protect areas of interest and uniqueness in terms of botany, zoology, aquatic life and other aspects and the locations of nature reserves in Israel were determined accordingly. In the early years of the state, nature reserves were also surrounded by nature; they were sufficiently distant from population centers and infrastructure to ensure their protection from nuisances and danger. Over the course of time the population of the country grew and the developed and built-up areas have expanded. Developed lands have inched closer to the borders of nature reserves, becoming a threat to these small sealed-off islands of nature that are surrounded on all sides by residential and industrial zones. Likewise, agricultural plots, cultivated with intensive fertilizer and insecticide use have also damaged the natural conditions. In this way nature reserves became small, fragmented and isolated islands. This situation has a direct negative effect on the renewal of species: when there is no contact between populations in various areas and no procreation between them, there can be no transfer of genetic material. This results in a decrease in genetic variety; the species atrophy and become increasingly susceptible to threats and outside dangers (Meffe and Carrol, 1997). The limited dimensions of nature reserves in Israel, which allow for the existence of only small populations, worsen this problem - a small, isolated population has no future in the long term and is doomed to extinction. Therefore, protection of open spaces surrounding typical natural areas – both nature reserves and others - is of the utmost importance. These include agricultural lands defined as ecological corridors. The idea of creating a system of ecological corridors in Israel was first developed by the Nature and Parks Authority (Shkedi and Sadot, 2000). These corridors will connect "statutory protected areas and the open areas between them" in order to support preservation of nature in Israel. The designated aim is to preserve, as much as possible, the spaces within the area of the corridor and to ensure that development takes place outside of the corridor. The concept of ecological corridors that has developed in Israel refers to large strips of land, including mainly natural undeveloped areas, in which the nature reserves are concentrated, connected by strips of man-planted forests and agricultural plots, which enable movement (of animals and seeds) between these natural areas. The map of suggested ecological corridors demonstrates that the lands included within the system of corridors are mainly open spaces connecting nature reserves and national parks included in National Outline Plan 8 for Nature Reserves, man-planted forests and natural groves of various kinds included in National Outline Plan 22 for Forests and Forestation, in addition to open spaces that are not protected. It contains hardly any large or continuous sections of agricultural land. Indeed, the flat plains on which agricultural lands are located, among them the Jezreel Valley, the Zebulun Valley, the Sharon and the coastal plain, the Pleset coastal region (including Ashkelon and Ashdod) and the north western Negev and the Beer Sheva Valley, for the most part have been excluded from the arrangement of ecological corridors. This separation between ecological corridors and agricultural lands, and the latent potential of the latter within the arrangement of ecological corridors, raises the possibility that the time has come to construct a system of links between them. This opinion is based on the concept that agricultural lands can form a central link in the chain of ecological corridors in Israel. In fact, this constitutes a return to one of the principal ideas that led to the development of the concept of ecological corridors - they are strips of agricultural land including natural elements, for example hedgerows, which serve as a passage and shelter for animals and vegetation.

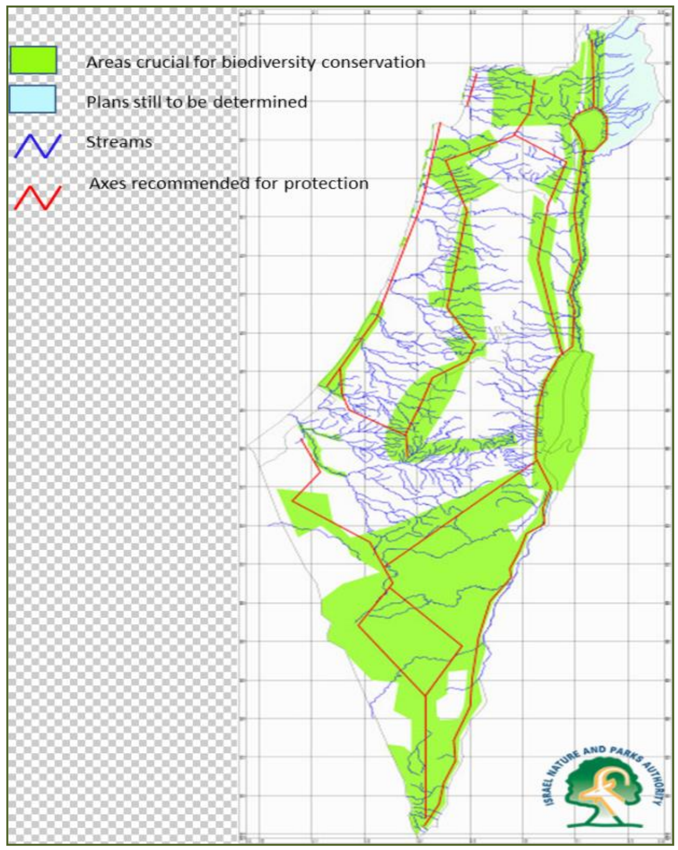


Figure 2.7Areas crucial for Biodiversity Conservation

It is important to remember that an ecological corridor should possess different qualities to its close surroundings, and that materials and information that flow between natural areas should be concentrated within it (a case study of Tsevaim –Gilboa-Harod,Israel).Based on comprehensive surveys of open spaces in Israel, four major axes were recommended for protection as ecological corridors, preferably within the framework of biosphere reserves:

1. The Syrian-African Rift Valley, a unique biological and geo morphological unit that should be preserved, preferably in cooperation with the Kingdom of Jordan
2. The Mediterranean desert corridor which connects three biogeographical zones in Israel:Mediterranean, Irano-Turanean and Saharo-Arabian
3. A broken axis along the Mediterranean Sea to conserve the ecosystems which were identified as both rare and threatened (aquatic and sand).
4. A desert axis to preserve the Negev desert.

It was originally suggested that corridors of natural habitat that connect nature reserves may enhance the conservation value of reserves by decreasing rates of extinction and by increasing rates of re colonization. More recently, the term "corridor" has been used to describe a number of additional phenomena:

Corridors that *function* as conduits, barriers and habitat.

Corridors that *connect* various habitats: they may connect like habitats and permit the movement of organisms between habitat patches (often reserves), or they may connect unlike habitats and permit the transfer of organisms from one habitat type to another. They may permit seasonal and migratory movements between habitats where resources are available at different times of the year or they may allow gradual population migration along environmental gradients in response to environmental change. They may connect different biota and permit the long-term exchange of species between biogeographical regions.

Corridors that *contain* various habitats that permit organisms to pass along them (transit corridors) or live in them (inhabited corridors).

Linear habitats (e.g., riparian habitats) are also described as corridors, but these do not necessarily act as conduits or barriers. Examples of most of these are known. A particular corridor system may function in different ways for different organisms. In the late 1970s it was predicted that corridors would have important genetic and demographic consequences for populations inhabiting fragmented landscapes. A few experimental tests and many corroborative examples now confirm this view, although information on gene flow through corridors is still limited. Corridors that connect small reserves by strips of continuous breeding habitat are likely to be particularly beneficial to wildlife. Migratory corridors that permit animals to use seasonally available resources are also important. On the basis of theory and empirical examples, there is no doubt that corridors can work, and that corridors can be useful in conservation planning. However, some corridor types have undesirable effects in some situations, so each corridor proposal must be assessed independently. Decisions must be made by balancing the potential advantages and disadvantages in each case. The term has been used in many different ways in the ecological and landscape literature, and Different corridors can be expected to have different functions (Forman and Godron 1986). This section classifies different uses of the term and considers evidence appropriate to each type of corridor, using the three-part classification mentioned above. A given reserve and corridor system may function in several ways, and fall into several of the categories listed below. In many cases, the classification of a particular corridor is organism-specific: one connected reserve system may perform quite different functions for populations of different species.

Figure(2.8) A corridor planting designed to assist Koalas to move across a property at Mt Barney

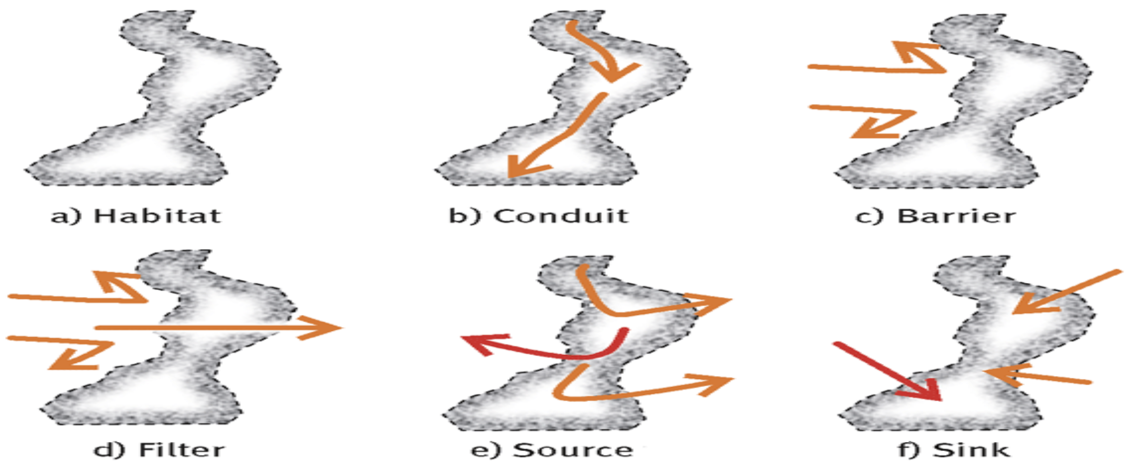


Figure 2.8 Corridors can play 6 possible roles (Benntte .,2003)

2.4 Effectiveness of corridors

The three key factors that influence the effectiveness of corridors for certain types of wildlife are connectivity, composition and configuration. Before planning a corridor, consider what species you are trying to assist.

1. Connectivity – can be achieved by corridors or stepping stones. Research indicates that the space between stepping stones or corridors should not extend for more than about 1 km before connecting to another patch of vegetation that is at least 1 ha in size.

2. Composition – or structure of the vegetation is an important consideration as it can influence which species of wildlife can use the corridor. The more structural variety provided (e.g. trees, shrubs, fallen branches, leaf litter, groundcover and rocks) ensures that a greater diversity of wildlife species will be able to use the corridor.

3. Configuration – the size, shape and location of patches in relation to one another is important. Minimizing edges and maximizing core areas of vegetation increases habitat for wildlife. Compact patches of vegetation (i.e. square or circular in shape) have fewer edges compared to long narrow strips.

Predation and competition

The presence of predators or competitors in a corridor may hamper movement or increase the rate of wildlife mortality. Movement of introduced predators such as foxes and feral cats is often aided through the clearing and opening up of native vegetation that occurs when infrastructure such as roads and tracks are constructed in vegetated areas. Some aggressive native fauna species such as Noisy Miners have readily adapted to disturbed environments. They can often dominate road reserves and narrow corridors of vegetation and out-compete other native species.

Diamond (1975a) and Wilson and Willis (1975) recommended that reserves should be linked together by strips of habitat that act as ecological corridors between reserves. In reserve planning, corridors were predicted to have five major benefits.

- Increase the effective area of reserves by making one larger reserve out of several smaller ones, and thereby decrease the probability of extinction of species requiring large areas.
- Permit an increased rate of re colonization of one reserve from others following local extinction in one of the reserves. With a corridor, re colonization may sometimes be instantaneous.
- Provide a "rescue effect", whereby continuing migration from one reserve (the source) to another (the recipient) may prevent particular species from becoming extinct when they are at low ebb in the recipient reserve. (Brown and Kodric-Brown 1977) they also included instantaneous re colonization under the term "rescue effect", grouping instantaneous re colonization with prevention of extinction because it is often hard to distinguish between the two. I restrict use of the term "rescue effect" to the prevention of extinctions.) Corridors permit seasonal movements of animals between temporarily available resources.
- Permit gene flow between reserves.
- These effects are expected to be beneficial because they increase colonization rates and decrease extinction rates, according to biogeographically models, increase the equilibrium number of species on reserves (Simberloff and Cox 1987). The effects apply equally to single species: they are predicted to increase the likelihood that a reserve system will maintain MVPs of key species. The attributes above (partly except the first one) emphasize one function – which corridors act as conduits for organisms between otherwise separate areas. However, corridors can be expected to perform three general functions (Forman and Godron 1986). They may act as conduits: organisms

may pass through the corridor from one habitat patch to another (e.g., a forest bird may pass from one forest patch to another via a forested corridor). They may act as barriers to organisms that live in the matrix through which the corridor passes (e.g., hedges act as barriers to livestock in agricultural landscapes). They may provide habitats in their own right. Woodland corridors connecting patches of endangered plants not only increase dispersal of seeds from one patch to another, but also create wind conditions that can spread the seeds for much longer distances. The idea for the study emerged from modern animal conservation practices, where landscape connectivity - the degree to which landscapes facilitate movement - is being used to counteract the impacts of habitat loss and fragmentation on animal movement. The experimental efforts provided a novel dataset of observations of seed movement and wind in patch-corridors landscapes. However, the researchers understood that reality is always much more detailed than can be observed. Therefore, to comprehend the fine details of the relationships between the forest gap structures and the wind, the scientists leveraged the physical model to generate a virtual and complete environment, where every detail of the wind and seeds movement and the forest structure are known. "Result was found that corridors could affect the wind direction and align the wind flow with the corridor, that they accelerate the wind and provide preferable conditions for ejection above the canopy, where long distance dispersal could occur", stated Gil Bohrer.

2.5 Corridor Design Guidelines

Far too few real examples of corridors have been studied to be able to give definite recommendations for the design of corridors. These guidelines are tentative, based on limited current knowledge, and should be used only with caution and with regard to specific local conditions, as with Diamond's (1975a) and Wilson and Willis' (1975) reserve design guidelines. These corridors are intended to function both as conduits and as habitat for habitat-interior species. Habitat in the corridor should be similar to, or the same as, habitat in the patches that are being connected. When several habitat types exist, corridors should be wide enough to encompass each habitat type in each segment of the corridor, as far as possible. When the spatial distributions of habitats and species populations are patchy, and the positions of patches change over time, corridors must be sufficiently wide to enable natural patch dynamics to take place in them. Corridors should usually be wider than the mean inter-patch distance. Corridors should be sufficiently wide that they are not entirely edge. In forest, edge effects are commonly found for up to 500 m. Habitat breaks across corridors (e.g., roads) should be minimized or eliminated since they may constitute a habitat barrier of two edge widths (plus the width of the break) across the corridor, and impair its function. Habitat modification (e.g., selective logging) that creates many edges should be minimized or eliminated as these activities may impair corridor functions for habitat-interior species. The longer a corridor, the wider it should be in order to ensure that the corridor is continuously populated, and that organism can pass from one end to the other. In long corridors, the core width should usually be at least several times wider than the combined width of the two edges. For example, if one edge effect is 500 m, then the corridor should be at least 3 km wide –two edges plus at least 2 km of core. (If some sections of corridor are narrow or disrupted, adjacent sections should be wider than this).Corridor habitat is often partially modified at the time of corridor designation, and habitat restoration may be needed. Damaged habitat that can be restored in the long-term may be adequate for corridor designation since most corridor benefits are expected to occur in the long-term. When these design criteria cannot be met, less complete designs may still fulfill useful corridor functions, but their benefits are less predictable. Existing, connecting strips should not be abandoned if they do not meet all of these design criteria.

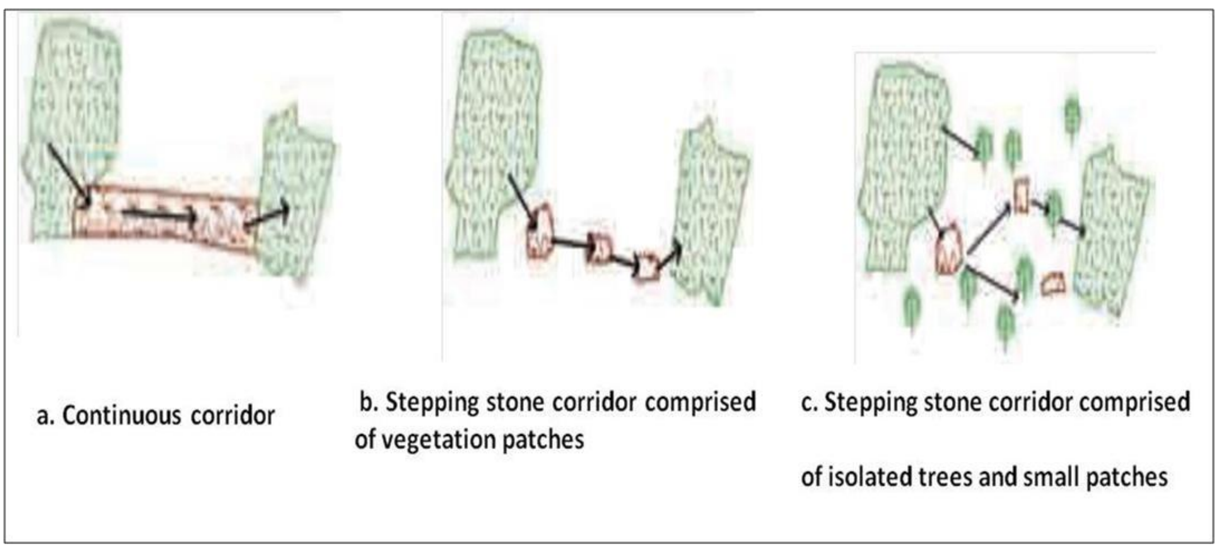


Figure 2.8 corridor different types

Some wildlife species have difficulty living in or moving through a developed landscape. They require a continuous link of suitable habitat between two vegetation patches in order to safely move across the landscape. Examples of animals that require continuous corridors include small mammals, small reptiles, some ground-dwelling birds and non-flying invertebrates.

‘Stepping stones’ of suitable habitat may be sufficient to allow some wildlife to move through a relatively developed landscape. Examples of animals that can use this type of corridor include highly mobile birds such as cuckoos, fruit pigeons and lorikeets, flying foxes and flying insects. A mosaic of natural and modified vegetation (such as scattered trees in paddocks) may be sufficient for some wildlife species to move through an area. These species are tolerant of land uses in the surrounding environment. Examples of animals that can use isolated trees as stepping stones include some kangaroos, wallabies and common open-paddock birds such as magpies.

Palestine habitat is really face a great challenges to alteration and fragmentation related to the factors discussed before , the fact now is that About 4% of the West Bank and Gaza is forested (1999 data), or about 23,000 ha of a total land area of 602,000 ha. Deforestation is currently an issue in the occupied Territory .Between 1971 and 1999, it is estimated that some 24% of forest cover have been lost, i.e. around 6,900 of the 30,000 ha. In the 1971 – 1999 period , around 250 ha of forests were lost each year on average, or 0.82% of the forested area. Deforestation in the West Bank and Gaza stands currently at 0.82% (1999 data). If deforestation continued at the rate observed in 1971 - 1999, the total amount of forest lost by 2020 would be 5,186 hectares, i.e. a decrease of 22.4% of the current forest size. If the target of halting forest loss is met instead, a possible path would be for the rate of deforestation to gradually and continuously fall until it stops completely in 2020. Although some forest will be inevitably lost in the next decade, its size will decrease at a lower rate than the current one, i.e. at 0.2% per year, and finally stabilize in 2020. In the OPt, this would imply that, under the target scenario, forest cover will decrease to 22,186 hectares and remain at this level as from 2020. This would represent a loss of about 4.2% of forest land by 2020, but will still result in the avoided loss of 18.2% of forest land if deforestation were to continue at the current level. Compared to the baseline scenario, this would save 4,213 hectares of forest in the next decades, so there is a lot of strategies that should be applied for achieving habitat conservation which will lead for biodiversity conservation.

2.6 Aims

General Aim: Biodiversity conservation for Palestine landscape by using different strategies starting from patch scale site level to reach the landscape level **.**

Specific Aims : Threat analysis approach works at site (patch) scale more than at landscape one through

- Analyze the patterns and regimes of threats in the different selected sites of our project (different habitat types of conservation concern (wadi ALQuf, BaniNaim , Siris , Um ALTut , Shobash ,Wadi Qana , Khirbit Quis , Ein ALFashkha)
- Threat Analysis (Salafsky et al.,2008) of different threats in different habitat types using a standard taxonomy and so naming, classifying, rating and ranking all threats in all habitat types.
- Quantify landscape structure is prerequisite to the study of landscape function and change. For this reason, much emphasis has been placed on developing methods to quantify landscape structure
- Fragmentation / corridor approach- This approach consistent in a second phase. when a check list of animal species that use the patches as habitats or corridors and that are fragmentation-sensitive. This approach is at landscape level.

2.7 Hypothesis :

Since the convention on Biodiversity was agreed upon Rio in 1992, conservation of biological diversity has attracted the attention of the international community and policy makers in diverse ways. Focus has since been shifted from protection of individual reserve to management of entire landscape. This is because failure to consider biodiversity at a larger scale (ecosystem level) results in risk of negative impacts on important life-support functions, risk of overlooking ecosystem services and failure to understand variation in time and space.

Biological diversity is highly dependent on the quality, quantity, and spatial cohesion of natural areas. Fragmentation of natural habitats severely affects the abundance of species. A solution to this problem is the development of ecological networks, linking core areas of nature by means of corridors and small habitat patches.Landscape ecology is largely founded on the idea that the patterning of landscape elements (patches) strongly influences ecological characteristics; the ability to quantify landscape structure is prerequisite to the study of landscape function and change. For this reason, much emphasis has been placed on developing methods to quantify landscape structure.In landscape analysis, indices of shape, richness and diversity provide additional evaluation of spatial distribution of land cover within a particular landscape. Landscape analysis also provides outlines of the degree of disturbance and biodiversity change within a period of time (Roy and Joshi, 2002). Habitat fragmentation has a major impact on the regional survival of plant species and is one of the most important causes of worldwide loss of biodiversity (Vitousek et al., 1997). The threat posed by forest loss and fragmentations to local biodiversity has been popularized for nearly two decades (Harris and Miller, 1984). Although spatial heterogeneity is a natural phenomenon, human activities are altering natural landscape by changing the abundance and spatial pattern of habitat. The two most significant effects of forest fragmentation are a decrease in population size and reduction of diversity (Zuidema et al., 1996). "Habitat fragmentation is a process at landscape scale, while human-induced threats develop at site (local) scale: therefore, conceptual tools and approaches are different. More particularly, the patch analysis and the analysis on land use changes may be useful tools acting at landscape (regional) level useful to define the level of habitat fragmentation/transformation (Fahrig,; Lindenmayer and Nix) differently, at site (single local patch) level many human-induced processes (threats) may act affecting local biodiversity and ecological processes: at this local scale may be important utilize the tools and approaches developed inside the arena of threat analysis (Salafsky et al.,2008).The concepts of ecological corridors and ecological networks have been used as possible conservation responses acting against the effect of habitat fragmentation at landscape scale; differently, at local scale project management have developed single different actions aimed to respond to single specific human-induced threats.

2.8 Work Flow:

From2013to 2015, all possible information and data on the direct and indirect human –induced threats to biodiversity targets were collected for each of the eight selected sites (Target refers to those biological /ecological entities that appeared to suffer a reduction in population abundance or experienced stress related to a key ecological attribute due to specific threats, Salafsky et al .2003). This assessment resulted in the production of a list of direct and indirect threats to the eight sites (threat taxonomy) .List items were based on the original threat Check –list developed by Salafsky et al. 2003 and the more recent IUCN-CMP (2006) list.

↓

Quantifying landscape metrics by using Patch analyst Extension for Arcview version 3.2 and patch analysis at class and landscape level for (Hebron , Jenin , Sulfit , Jericho) where the selected site are located depending on landuse maps for these districts .

↓

Evaluation for Cultivation possibility by Design maps for the target species of plants for planning ecological corridor (*Ceratonia siliqua, Pistacia palaestina, Quercus calliprinos, Rhus coriaria, Amygdalus communis*) in Hebron, Jenin, Sulfit, Jericho depending on landuse classes GIS Shapefile map

↓

An Analysis of the necessity for Ecological corridors is very urgent step to do for Palestinian landscape conservation and life line in Ramat Hanadiv as a case study in Israel is a very good example to follow in the future.

Chapter 3

3. Material and Methodology

The work in this research divided into three Parts, work start from patch (small sites) level to the landscape level for the target cities of our project.

Phase one: Threat analysis approach related to the selected sites

Phase Two: Quantifying the landscape metrics for Hebron, Jenin, Sulfit, Jericho

Phase Three: Cultivation possibilities for the five target species in Hebron, Jenin, Sulfit, and Jericho.

3.1 Study Area:

We studied 8 sites of high ecological interest located in West Bank, Palestine (31°21` - 32°33` Lat; 34°52` - 35°32` Long; Tab.(3. 1); Fig (3.1).

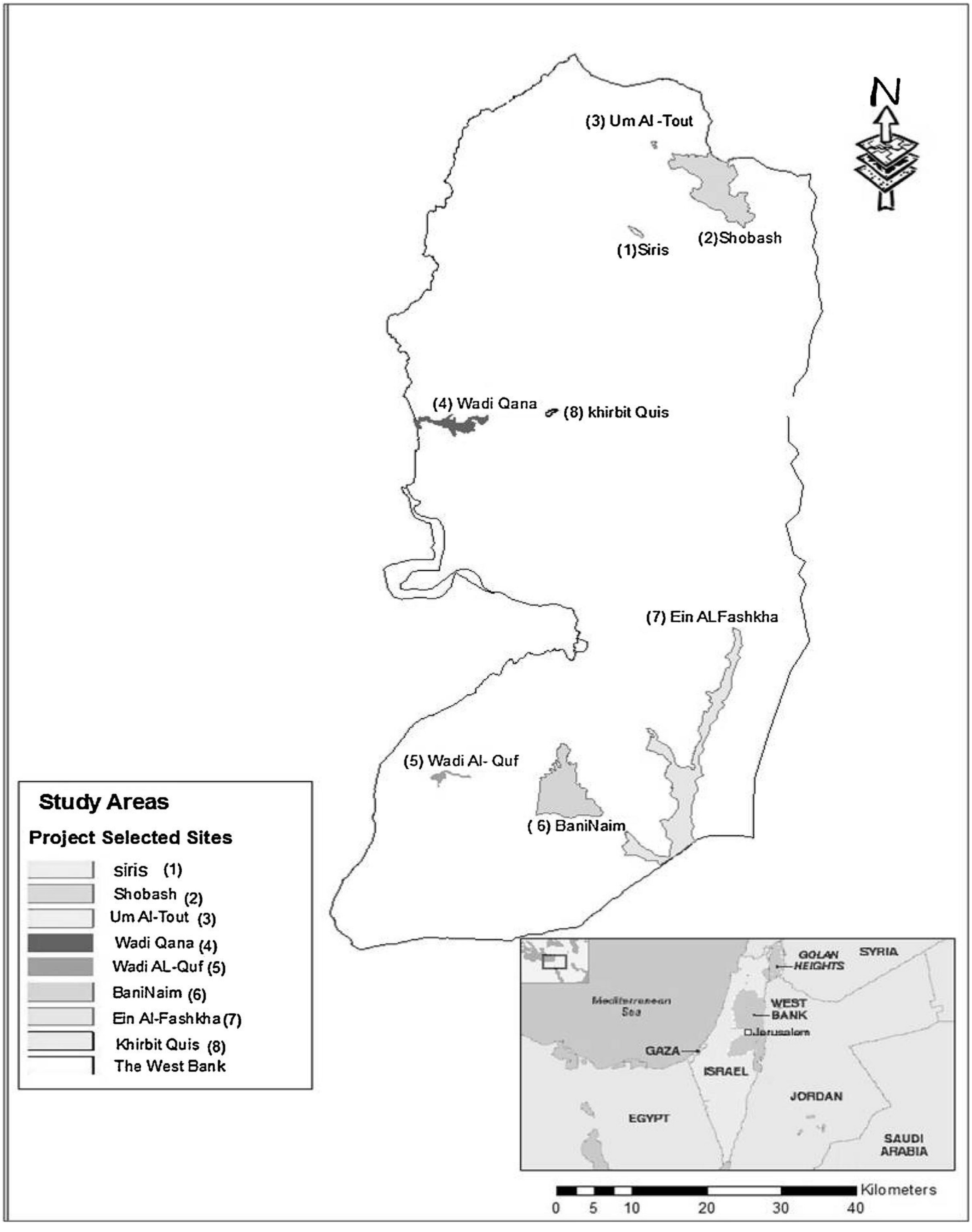


Figure (3.1) Map for the Study Area in the WestBank , the location of ecological selected sites is shown With the geographical location of Palestine in the bottom (AlHirsh, Battisti and Schirone ., 2016)

Table (3:1) Description of the ecological selected sites in the West Bank

Site	Area (km^2) and population density (in./km^2)	Elevation (m a.s.l.)	Coordinates (Latitude, Longitude)	Description and main biodiversity targets	Sources
Ein Al Fashkha Region (Jericho district)	25; No Available data	-390 (depressed area)	31 42`N 35 28`E	This is a protected wetland area on the shores of the Dead Sea near the city of Jericho. It contains large quantities of fresh water and brackish springs. The oasis of Al Fashkha is one of the few areas in Palestine containing a wide variety of wetland plants. The oasis contains artificial pools, some created prior to 1976. In addition, there are natural pools and springs containing fresh water, that provide habitat for a wide variety of fish species. The plants in this region belong to the semi-tropical climate and include dates, palms and plants of African origin. Halophytes are abundant; many wild herbivores are present (*Capra ibex nubiana,* G*azella gazella*, *Procavia capensis*, *Canis lupus*). Several species of fishes and crustaceans are also found. The oasis of Al Fashkha is an important wetland area for migratory and endemic birds. The area is the habitat for threatened species such as the Dead Sea sparrow (*Passer moabiticus)* and the lesser kestrel (*Falco naumanni*)	EQA Report (2006), Palestine wild life society (PWLS Website).
WadiAl-Quf /Beit Kahel)	24.5; 7000	600 - 700	31 33`N 35 07`E.	This is a large region located west of Hebron and planted with wooded trees. The area is rich in biodiversity because of its trees and plentiful water. There are also springs, among them Al Sukar, Al Haska and Al Majnounha. Animals in this region include *Hyena hyena*, *Hystrix indica*, *Canis lupus*, *Meles meles*, *Lepus capensis*, *Lepus timidus*, G*azella gazella*, S*us scrofa* and other mountain-region animals. Birds in this region include many sedentary	EQA Report (2006), Palestine wildlife society (PWLS Website), Albaba (2014).

				and migratory birds (raptors, storks, partridges, waders and other water-related species) of conservation concern.	
Shobash	55.53; 2700	200-350	32° 25′ 17.73″ N, 35° 23′ 5.63″ E	Forest of *Ceratonia siliqua – Pistacia lentiscus* The habitat of Shobash is typical of the foothills of the central highlands facing the eastern slopes (eastern watershed). The plant communities here are more drought and heat resistant than those dominated by *Quercus calliprinos*. In addition to the main tree species, various species, including but not limited to *Calicotome villosa*, *Rhamnus alaternus* and *Ruta chalapensis* occur. At Shobash, the principal natural habitat occurs in a mosaic, typically on slopes and other inaccessible sites, with agricultural lands of various types. Bedouins with their livestock live in the area.	EQA Report (2006), Palestine wildlife society (PWLS Website), Albaba (2014).
Siris	1.38; 5400	500-630	32 18 55.47 N , 35 19 04.32 E	The habitat of Siris CPA is an open savannah of trees and shrubs of *Quercus calliprinos*, accompanied by a remarkable number of *Q. boisseri*, *Ceratonia siliqua* and *Pistacia palaestina*. This is typical of north-facing slopes where solar radiation is low, and relatively moist Terra Rossa soils are present. The undergrowth at the reserve is covered in low shrubs including *Sarcopoterium spinosum*, and herbaceous vegetation	EQA Report (2006), Palestine wildlife society (PWLS Website), Albaba (2014).
BaniNaim Wilderness (Bethlehem/Hebron district)	172; 900	250 -600	31°30’58″ N, 35 9’ 51″ E	It is a protectoral area ranging from southeast of Bethlehem to the south of Hebron, at which point it reaches to the ridge surrounding the Dead Sea. There are still some mosaics in some a few agro-ecosystems. This area connects to the Ain Gedi region along the south eastern region of the West Bank. The most important animals of this area are *Capra ibex nubiana*, *Gazella gazella*, *Procavia capensis*, *Vulpes vulpes*, *Hyaena hyaena*. Large raptors of conservation concern are present, including *Neophron percnopterus*, G*yps fulvus*. This area is used for training Israeli soldiers year round in the use of heavy machines.	EQA Report (2006)
Wadi Qana	9.39; 3106	500-775	32° 09’ 36” .78 N 35° 08’ 01” .60 E	This site separates Salfit and Qalqilya Governorates and is considered one of the most prominent natural attractions in	Applied Research Institute

				Palestine. The valley is famous for its natural beauty, its abundance of water, and its many springs. The area is also known for the prevalence of trees, crops and livestock. The occupation forces, through the Israeli Civil Administration's (ICA) Protection of Nature Committee announced its control over the region, which it claims to be an Israeli nature reserve area, as because it is located within Area "C" (Oslo II Agreement). Israeli occupation forces, established seven settlements and eight outposts at the top of the Qana Valley, and today they have almost complete control over the water sources of this valley.	(2013)
Khirbit Quis: Sector South of Salfit) administrative zone	0.49; 250	400-490	32° 3' 43" N, 35° 10' 36" E	This site is a populated West Bank location. The nearest town has more than 50,000 inhabitants. The site is unprotected, but considered an IPA Site (Important Plant Area). The landscape is mostly covered with mosaic vegetation /croplands as well as some remnant evergreen broadleaved sclerophyllous woodland. Khirbit Quis has a semi-arid climate, classified as a Mediterranean (mild with dry, hot summer), with a subtropical thorn woodland bio-zone.	Applied Research Institute (2013).
Um AL-Tout	0.51; 1250	250-600.	32 25''55.42''N, 35 20'39.67″ E	This is a protected site located in the northern part of the West Bank, to the east of Jenin near the villages of Umm Al Tut, Jalqamus and Deir Abu Daeef, Qabatiya. Jenin located within Mediterranean ecosystem. Forest vegetation covers no more than 79% of the actual forest area. The reserve includes a forest of carob and *Pistacia lentiscus,* and semi-natural coastal zones, and it is limited to the eastern slopes of the mountains of Palestine (Tubas and east of Nablus and Jenin) in the northern West Bank in the Mediterranean climate zone. There is limited vegetation and dendritic trees in this forest of carob and bushes, in addition to many types of dwarf shrubs (Batha), but now there are only 1-3 carob trees per acre.	Applied Research Institute (2013), Dudeen (2001).

Reference : (AlHirsh, Battisti and Schirone ., 2016)

Site name	Ein ALFashkha
Common Plant	*Aaronsohnia factorovskyi warb & Eig, Anthemis maris-mortui, Rumex cyprius Murb ,Asphodelus tenuifolius Cav, Atriplex halimusL., Brachypodium distachyon L.,Carthamus nitidus Boiss, Erodium touchyanum Delile, Erucaria rostrata Boiss ,Forsskaolea tenacissima L., Pulicaria incise (Lam.) DC, Haplophyllum tuberculatum (forssk.) A. Juss, Juncus acutus L., Mercurialis annua L. , Nitraria retusa (Forssk) Asch.* *Mesembryanthemum nodiflorum L., Ochradenus baccatus Delile, Parietaria alsinifolia Delile ,Phoenix dactylifera L., Phragmites australis (Cav). Trin.ex steud, Prosopis farcta(Bank&Sol.)J.F.Macbr., Pteranthus dichotomus Forssk, Silene linearis Decne , Stipa capensis Thumb ,Suaeda fruticosa (L.) Forsk ,Suaeda monoica Forssk.ex J.F.Gmel,Tamarix tetragyna Ehrenb , Tamarix jordanis Boiss ,Urginea maritime (L.) Baker ,Urospermum picroides(L.)schmidt, Zygophyllum dumosum Boiss.*
Common Animal	*Capra ibex , Gazelle (Gazella gazella , Rocky Hyrax (Procavia capensis), wolf (Canis Lupus) , Caracals (Caracal caracal) , Wild Asses , Kingfishers (Coraciiformes) , Bee-eaters (Merops apiaster)Herons , Babblers (Turdoides caudate), hyenas (Crocuta Crocuta) , jackals (Canis aureus) , leopard (Panthera pardus)* *Birds : Lapwing (Vanellus armatus), Robin (Erithacus rubecula) , Warblers (Setophaga pinus), Chukar (Alectoris chukar) , Flamingo , Storks , Pelicans , Lesser Kestrel, Night Heron , Griffon Vultlure*

Site name	Wadi AlQuf
Common Plant	*Bellevalia longipes , Majorana syriaca, Salvia heirosolymitana , Pinus halepensis Quercus coccifera, Pistacia lentiscus ,Pistacia Palaestina , Cupressus sempervirens Rhamnuslycioides , Cupressus* spp *, Cistuscreticus , Teucrium divaricatum Coridothymus capitatus, Thymus capitatus ,sarcopoterium spinosum , Smilax aspera Carlina hispanica , Capparis spinosa ,Helichrysum sanguineum*
Common Animal	*Ophiomorus latastii , Chalcides guentheri , Testudo graeca , Eirenis levantinus, Gazella gazelle , Hyaena hyaena , Anthus campestris , Circus macrourus , Aquila clanga Aquila chrysaetus , Aquila heliacal , Apus affinis , Rhinolophus blasii , Falco naumanni Plecotus austriacus , Falco biarmicus, Tadarida teniotis, Neophron percnopterus Gyps fulvus , Hieraaetus fasciatus*
Site name	**Um AlTut**
Common Plant	*Teucrium capitatum ,Teucrium divaricatum,Majorana syriaca, Origanum dayi Pistacia lentiscus, Quercus calliprinos, Phillyrea Latifolia, Rhamnuslycioides (Palaestinus),Pistacia palaestina , Asphodelus ramus (microcarpus), Asphodelus lutea , Clemantis cirrhosa , calycotome villosa, Asparagus stipularis, Pinus halapensis, Cyclamen persicum ,Cyclamen coum, Phagnalon rupestre, Chiliadenus iphionoides, Bryonia syriaca ,Sedum hispanicum , Anemone coronaria, Poa bulbosa, Arisarum vulgare ,Hordium bulbosum.*
Common Animal	*Erinaceus europaeus , Pipistrellus kuhlii, Canis aureus, Vulpes vulpes, Herpestes ichneumon Hyaena hyaena, Sus scrofa , Gazella gazelle, Meriones tristrami, Acomys dimidiatus, Mus musculus, Hystrix indica, Lepus capensis, Pseudepdalea variabilis, Ptyodactylus guttatus, Chameleo chameleon , Meboya vittata , Coluber jugularis, Vipera palaestina Testudo graeca , Buteo rufinus , Aquila chrysaetos, Lullala arborea, Columba livia, Streptopelia senegalensis, Streptopelia decaocto, Garrulus galandarius, Corvus corone Falco tinunculus, Serinus serinus, Ptyonoprogne fuligula, Lanius excubitor, Parus major Alectoris graeca , Alectoris chukar, Buteo rufinus, Passer domesticus, Pycnonotus xanthopygos , Athene noctua, Sylvia atricapilla , Sylvia curruca , Cercotrichus galactotes Tyto alba , Upupa epops*

Site name	Shobash
Common Plant	Ceratonia siliqua , Pistacia lentiscus, Callicotome villosa, Rhamnus alaternus, Ruta chalapensis , Verbascum galilaeum, Turgenia latifolia, Stachys zoharyana Salvia syriaca, Hydrocotyle ranunculoides
Common Animal	Ophiomorus latastii, Chalcides guentheri, Testudo graeca, Francolinus francolinus Merops apiaster, Anthus campestris, Anthus similes, Sylvia conspicillata, Corvus corax, Circus macrourus, Aquila clanga, Aquila heliacal, Rhinolophus hipposideros, Rhinolophus mehelyi , Rhinolophus blasii, Rhinolophus Euryale , Plecotus austriacus, Canis lupus, Gazella gazelle

Site name	Khirbit Quis
Common Plant	Tulipa agenesis, Ophrys species Salvia fruticosa , Origanum syriaca, Teucrium polium ,Pistacia palaestina, P. lentiscus, Rhamnus palaestinus, Quercus calliprinos, Cistus incanus, C. salviifolius, Smilax aspera Calycatome villosa , Styrax officinalis, Lonicera etrusca, Ruta chalapensis, Sarcopotrium spinosa, Inula viscose, Ceratonia siliqua, Salvia fruticosa, Origanum syriaca,Thymbra spicata, Teucrium polium , Ophrys species .
Common Animal	Ophiomorus latastii , Chalcides guentheri, Testudo graeca ,Francolinus francolinus, Anthus campestris, Circus macrourus, Aquila clanga ,Aquila heliacal , Rhinolophus hipposideros, Rhinolophus mehelyi , Rhinolophus Euryale ,Plecotus austriacus

Site name	BaniNaim
Common Plant	*Majorana syriaca , Malva sylvestris, Matricaria comomilla, Gundelia tornifortii Achillea biebersteinii, Teucrium capitatum, Artemisia sieberii, Salvia dominica Balanites aegyptiaca , Black iris, Anthemis palaestina, Capparis spinosa, Iris chrysographes ,Papaver rhoeas, Rhus coriaria, Anchusa strigosa, Centaurea iberica, Coridothimus capitatus Ecbarium elatrium , Echinops polyceras, Gladiolus italicus, Rosamarinus officinalis,Crataegus aronia, Colchium richtii, Gynandriris sisyrinchium, Cistanche tubulosa, Haloxylon persicum, Prunus amygdalus, Dittrichia viscose, Hammada salicornica, Anemone coronaria ,Helianthemum vesicarium , Helianthus annuus, Capparis spinosa, Ziziphus lotus , Acanthus syriacus, Anthemis pseudocotula, Arum palaestinum, Astragalus callichrous, Atriplex leucoclada , Avena sterilis, Thymelea hirsute, Noaea mucronata, Narcissus tazetta, Sternbergia clusiana, Atriplex halimus.*
Common Animal	Common Spiny Mouse , Jackal, Wolf, Nubian ibex, Dorcas gazelle, Mountain Gazelle Wagner's Gerbil, Egyptian Mongoose, Striped hyena, Desert Hedgehog, Hyrax Red Fox, European Badger, Long-eared Hedgehog , Mediterranean horseshoe bate Gray Long-eared bate, Common spiny mouse, Greater Egyptian jerboa Black Stork, White Stork , Griffon Vulture, Egyptian Vulture, Black Kite, Short-toed Eagle Eurasian Sparro whawk , Steppe buzzard, Long-legged Buzzard , Honey Buzzard Steppe Eagle, Golden Eagle, Bonelli's Eagle, Booted Eagle, Lesser Kestrel, Common Kestrel Lanner Falcon, Merlin, Chucker, House Martin, Lesser Spotted Eagle, Sand Partridge, Common Quail , Common Crane, Stone-curlew , Rock Dove, Collared Dove , European Turtle-Dove, Laughing Dove, Rock Martin, Little Owl, Common Swift, Eurasian Hoopoe,Desert Lark , Crested Lark , Eurasian Skylark

3.2 Descriptive taxonomy of direct threats

From 2013 to 2015, all possible information and data on the direct and indirect human-induced threats to biodiversity targets were collected for each of 8 selected sites (‘target’ refers to those biological/ecological entities that appeared to suffer a reduction in population abundance or experienced stress related to a key ecological attribute due to specific threats; Salafsky et al. 2003). In particular, we had a panel of 4 local experts review a large number of available local sources (Applied Research Institute 1997; Applied Research Institute 2007; Applied Research Institute 2013; Isaac 2000; Basim 2001; Environment Quality Authority 2010; Ghattas et al. 2006; Ghattas 2011; Isaac & Gasteyer 1995; Helal & Khalilieh 2005; Khalaf 2010; International Women’s Peace Service 2012; Merlo & Croitoru 2005). Each locally referred expert had a strong background in the region; they either lived in Palestine, and had a background in the environmental sector in general and direct or indirect knowledge of individual study sites in particular, or spent at least one year frequenting the studied sites. This approach is somewhat similar to other experience-based methodologies, including the Delphi method (Linstone & Turoff 1975), and is effective in the evaluation of those threats that are empirically un-known, have different metrics, are difficult to compare, and thus potentially have a very high degree of uncertainty (e.g., Hess & King 2002).This assessment resulted in the production of a list of direct and indirect threats to the eight sites (threat taxonomy) (Tab. 2). List items were based on the original threat check-list developed by Salafsky et al. (2003) and the more recent IUCN-CMP (2006) list.

3.3 Measurement of direct threats

Following Cole’s approach (Cole 1994) the panel of experts performed a paired analysis of each threat at each site. The approach consisted of: 1) a significance analysis, where each expert assigned a threat magnitude score; and 2) a knowledge analysis, where each expert scored their estimated level knowledge of the threat.

3.4 Significance analysis

In December 2014, the panel of experts provided an assessment of the magnitude of each threat at each site. Magnitude refers to the degree to which a threat has had an impact on the viability/integrity of specific ta rgets in each study area within the last 10 years. A score of 4

Table (3: 1) Threat magnitude for each threat type in each selected site

Threat	Siris	shobash	Um AL-Tut	Wadi Qana	Wadi ALQuf	Bani Naim	Khirbit Quis	Ein ALFashkha
Urbanization								
Conv. To agri								
Intensive grazing								
Cutting wood								
Active quarries								
Hunting								
Collecting wild plant								
Recreation								
Fire threat								
Reforestation effort								
pollution								
Total Marks								

was assigned if the threat induced a very serious impact or loss of the targets; 3 was assigned if the threat induced a medium-high impact; 2 was assigned if induced a medium-low impact;

induced a minimal or no impact (Salafsky et al. 2003). Here, threat magnitude includes both the scope (e.g., size area of threat) and severity (i.e., the impact on a set of local targets) of a specific threat (Salafsky et al. 2003).

At the network level we derived a total score and a mean score of threat magnitude (and ± standard deviation) for each site and for each threat across sites from the scores assigned by individual experts. Then, the magnitude scores for each threat and each site were ranked. At the individual site level, we obtained a mean score of the magnitude (and ± standard deviation) of each threat, as an averaged value of the expert scores.

3.5 Knowledge analysis

The panel of experts provided a self evaluation of their level of knowledge regarding each threat magnitude at each site. A score of 4 was assigned if the knowledge of a specific threat at a specific site was very high; a 3 was assigned if it is relatively high; a 2 was assigned if it was relatively low; and a 1 was assigned if it was very low (adapted from Cole 1994). At the network level, we obtained a total score and a mean score of threat magnitude (and ± standard deviation) for each site and for each threat.

For each threat, we calculated the experts' total level of knowledge as the sum of the ratings for each site and for each threat. Then, the magnitude scores for each threat at each site were ranked. Moreover, at the individual site and threat level, we calculated a mean score of knowledge (and ± standard deviation), as the averaged value provided by the experts. Both in the significance and the knowledge analysis, scores were relative to the total effects of threats on identified target. No values were obtained related to the magnitude or knowledge of the effects of each threat on an individual target level (e.g., single species/community).

Table (3:3) Knowledge Value for each threat in each selected site

Threat	Siris	shobash	Um AL-Tut	Wadi Qana	Wadi ALQuf	Bani Naim	Khirbit Quis	Ein ALFashkha
Urbanization								
Conv. To agri								
Intensive grazing								
Cutting wood								
Active quarries								
Hunting								
Collecting wild plant								
Recreation								
Fire threat								
Reforestation effort								
pollution								
Total Marks								

Table of Knowledge Values for each threat /each site

In each cell write score from (1 : low , to 4 : High) that indicate the level of your knowledge on the Relationship of Threat/ site
For example : if you have a very low knowledge of how much is the magnitude of Hunting in Wadi ALQuf you should assign the score : 1 and if your knowledge about the magnitude of Fire Threat in Siris is high you should assign 4 .

3.6 Statistical analysis

We used the non- parametric Friedman test to compare the mean scores of magnitude and knowledge among threats and among sites with the same number of cases (n = 8 and n = 11, respectively). The null hypothesis states that the values have the same medians (Dytham 2011). We used a non-parametric Wilcoxon paired test to compare the scores obtained from the significance (magnitude) and knowledge analysis at each site and for each threat with the same number of cases (related samples; respectively, n = 8 and n = 11). The null hypothesis in this case also states that the values will have the same medians (Dytham 2011).

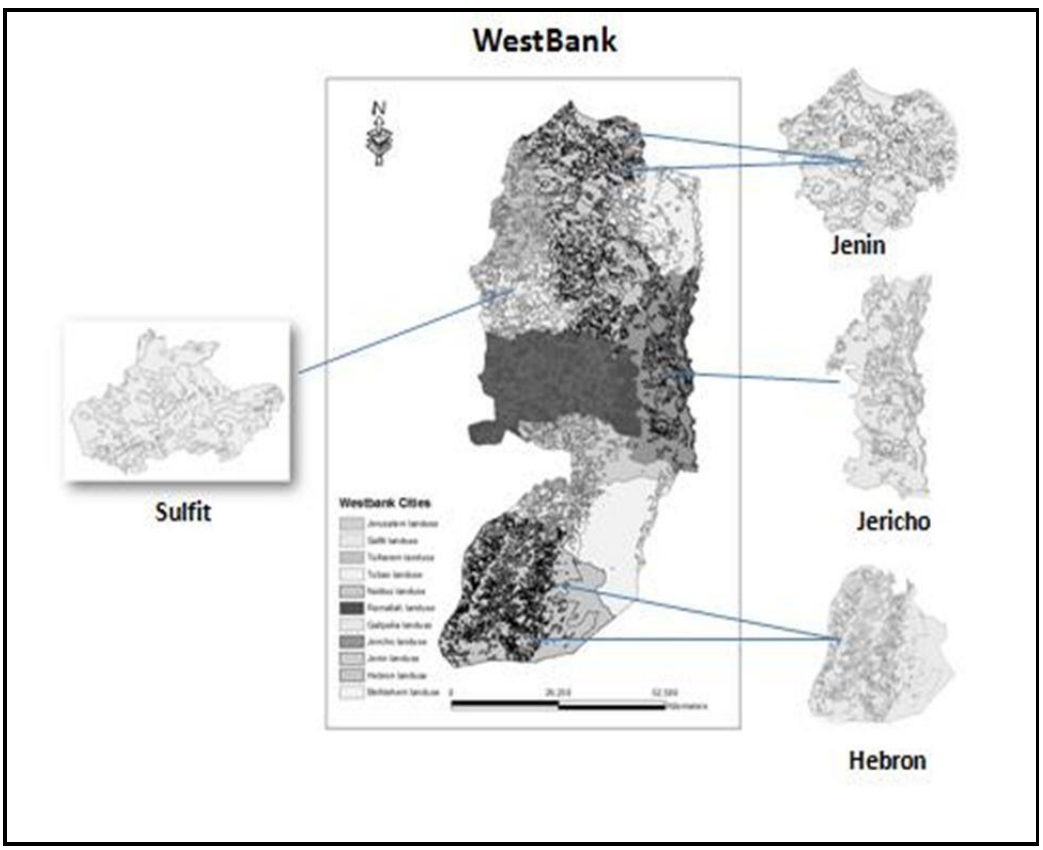
A non-parametric Spearman rank correlation test (two-tailed) was performed to compare the total magnitude scores with the human population density of each site (n = 7: data from Al Fashkha site were not available).

We used the SPSS 13.0 software for Windows (SPSS Inc. 2003). Alfa was set at the 0.05 level.

3.7 Quantifying landscape

Quantifying land scape metrics for the district of (Hebron , Jenin , Sulfit and Jericho) in the West Bank of Palestine where the eight important ecological sites located the figure below show their geographical location on the map. in our study we use landuse map related to the year 2000 for each district it is essential to characterise a landscape and its structural and functional dynamics . Patch Analysis of the Landscape dynamics was performed depending on landuse map for each district .

Figure (3.2) Geographical location map for (Jenin , Sulfit , Jericho , Hebron)



3.8 The Second Step : Landscape metric calculations

Different landscape metrics were calculated in this study using Patch Analyst 3.1 in ArcView (Elkie et al., 1999). A brief description for each of them follows McGarigal and Marks (1994).

(1) Class Area (CA): The sum of areas of all deforested patches in hectares.

(2) Mean Patch Size (MPS): Average patch size. MPS =CA/number of patches in hectares.

(3) Patch Size Standard Deviation (PSSD): The standard deviation of patch sizes in hectares. PSSD =0 when all patches in the class are the same size or when there is only 1 patch.

(4) Patch Size Coefficient of Variation (PSCoV): It measures the variability (as a percentage) in patch size relative to the mean patch size.

PSCoV =(PSSD /MPS) * 100. PSCoV =0 when all patches in the class are the same size or when there is only one patch.

(5) Edge Density (ED): The amount of edge relative to total landscape area in meters/hectare.

Mean Shape Index (MSI): MSI is the average Perimeter to Area Ratio. It is given as:

$$\mathrm{MSI} = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n}\left(\frac{.25p_{ij}}{\sqrt{a_{ij}}}\right)}{N}$$

Where, Pij is the perimeter for each patch, aij is the area for the corresponding patch, and N is the number of patches. No unit. MSI=1 if when all patches are square and increases as the shape complexity of patches increases.

(AWMSI): AWMSI is the Perimeter to Area Ratio, weighted by patch area so that larger patches weigh more than smaller ones.

$$\mathrm{AWMSI} = \sum_{i=1}^{m}\sum_{j=1}^{n}\left[\left(\frac{.25p_{ij}}{\sqrt{a_{ij}}}\right)\left(\frac{a_{ij}}{A}\right)\right]$$

AWMSI=1 if when all patches are square and increases as shape complexity of patches increases.

Mean Patch Fractal Dimension (MPFD): Measures the average fractal dimension of patches:

$$\text{MPFD} = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n}\left(\frac{2\ln(.25p_{ij})}{\ln a_{ij}}\right)}{N}$$

$1 \leq \text{MPFD} \leq 2$. 1It measures the irregularity or complexity of patch shape.

Area Weighted Mean Patch Fractal Dimension (AWMPFD): AWMPFD equals the average patch Fractal Dimension (FRACT) of patches in the landscape, weighted
by patch area.

$$\text{AWMPFD} = \sum_{i=1}^{m}\sum_{j=1}^{n}\left[\left(\frac{2\ln(.25p_{ij})}{\ln a_{ij}}\right)\left(\frac{a_{ij}}{A}\right)\right]$$

1_< AWMPFD <_2. It measures the irregularity or complexity of patch shape. (Frohn and Hao ,2006)

3.9 Cultivation possibilit for Plant target Species in Sulfit , Hebron , Jenin , Jericho

In this part depending on the land use map classes give value in the range (0-10) for each Species (pistacia palaestina the abbreviation used in this study (P .pa) , Quercus calliprinus with abbreviation (Cc) , Rhus coriaria (Rh-c) , Wild almond (W-a) , Ceratonia siliqua (Ce-s)
According to the type of class and our background about the ecological situation and other physical factors we give the value for possibility for cultivation for this species . In this evaluation method we depend on Arcview (3.1) using the landuse map then dissolving of these classes and for each class the value is given , For Example the possibility for cultivation of Pistacia Palaestina in the colonies number zero is given while in Sclerophylous vegetation value 8 is given ,the same process is done for the other species in the other three district .

Table 3:4 Sulfit cultivation possibility values for the target species for each class type

File Edit Table Field Window Help

0 of 16 selected

Attributes of Disolv15.shp

Shape	Class_name	Count	P_pa	C_c	Rh_c	W_a	Ce_s
Polygon	Agr.Land With Nat. Veg	11	7	7	8	8	7
Polygon	Citrus plantations	1	5	5	5	5	5
Polygon	Colonies	26	0	0	0	0	0
Polygon	Construction sites	2	1	1	2	1	1
Polygon	Discontinuous Urban Fa	26	2	2	4	2	2
Polygon	Drip Irrigated Arable	3	4	4	4	4	4
Polygon	Dump site	1	1	1	1	1	1
Polygon	Forest	3	9	9	9	9	9
Polygon	Fruit trees&berry plan	8	5	5	5	8	5
Polygon	Industrial or com.unit	2	1	1	2	1	1
Polygon	Mineral extrac. sites	2	0	0	0	0	0
Polygon	Natural grass land	26	6	6	7	7	8
Polygon	Non-Irrigated Arable L	3	6	6	8	7	7
Polygon	Non-irrig. complex cul	1	5	5	5	7	5
Polygon	Olive groves	21	3	3	4	4	3
Polygon	Sclerophylous vegt.	5	8	8	9	7	8

Table 3:5 Jenin District cultivation possibility values for the target species for each class type

File Edit Table Field Window Help

0 of 19 selected

Attributes of Jenin l.shp

Shape	Class_name	Count	P.Pa	C_c	Rh_c	W_a	Ce_s
Polygon	Citrus plantations	1	4	4	5	5	4
Polygon	Colonies	11	0	0	0	0	0
Polygon	Continuous Urban Fabri	2	1	1	1	1	1
Polygon	Discontinuous Urban Fa	125	1	1	2	2	1
Polygon	Drip Irrigated Arable	17	3	3	3	5	3
Polygon	Drip irrig. Vineyards	1	4	3	3	5	4
Polygon	Forest	25	9	9	9	9	9
Polygon	Industrial or com.unit	1	1	1	1	1	1
Polygon	Irrig. complex cult. p	6	5	4	2	7	5
Polygon	Military camps	5	0	0	0	0	0
Polygon	Mineral extrac. sites	8	0	0	0	0	0
Polygon	Natural grass land	71	4	5	7	8	4
Polygon	Non-Irrigated Arable L	41	5	5	7	7	5
Polygon	Non-irrig. complex cul	12	4	3	5	6	4
Polygon	Olive groves	46	2	2	5	5	2
Polygon	Others	3	3	3	2	2	3
Polygon	Refugee Camps	2	2	2	2	2	2
Polygon	Sclerophylous vegt.	7	5	6	8	7	5
Polygon	Transitional wood land	4	7	8	7	7	7

Table 3:6 Hebron cultivation possibility values for the target species for each class type

File Edit Table Field Window Help

0 of 20 selected

Attributes of Hebron l.shp

Shape	Class_name	Count	P.Pa.#	C_c	Rh_c	W_a	Ce_s
Polygon	Agr.Land With Nat. Veg	138	6	6	8	8	7
Polygon	Citrus plantations	1	4	4	5	5	5
Polygon	Colonies	38	0	0	0	0	0
Polygon	Construction sites	1	1	1	2	1	1
Polygon	Continuous Urban Fabri	1	1	1	4	2	2
Polygon	Discontinuous Urban Fa	315	3	3	4	4	4
Polygon	Drip Irrigated Arable	10	4	4	1	4	1
Polygon	Forest	42	9	9	9	9	9
Polygon	Fruit trees&berry plan	8	4	5	5	8	5
Polygon	Industrial or com.unit	2	1	1	2	1	1
Polygon	Irrig. complex cult. p	1	5	5	5	5	7
Polygon	Military camps	1	0	0	0	0	0
Polygon	Mineral extrac. sites	21	0	0	0	0	0
Polygon	Natural grass land	106	4	6	7	7	8
Polygon	Non-Irrigated Arable L	82	7	7	8	7	7
Polygon	Non-irrig. complex cul	65	4	4	5	7	5
Polygon	Olive groves	76	2	2	4	4	3
Polygon	Sparsely veg. area	4	3	3	5	3	4
Polygon	Transitional wood land	11	7	8	8	6	8
Polygon	Vineyards	47	4	4	5	5	3

Table 3:7 Jericho District cultivation possibility values for the target species for each class type

Attributes of Disolv5.shp

Shape	Class_name	Count	P_pa	C_c	Rh_c	W_a	Ce_s
Polygon	Agr.Land With Nat. Veg	9	4	4	5	7	4
Polygon	Bare rock	5	4	4	5	4	4
Polygon	Beaches, dunes&sand pl	2	1	1	1	1	1
Polygon	Citrus plantations	4	3	3	3	3	3
Polygon	Colonies	36	0	0	0	0	0
Polygon	Construction sites	2	1	1	1	1	1
Polygon	Continuous Urban Fabri	1	1	1	1	1	1
Polygon	Discontinuous Urban Fa	31	3	3	3	3	3
Polygon	Drip Irrigated Arable	19	4	4	4	5	4
Polygon	Drip irrig. Vineyards	5	3	3	4	3	3
Polygon	Forest	1	5	5	6	6	5
Polygon	Halophytes	11	1	1	1	1	1
Polygon	Industrial or com.unit	1	1	1	1	1	1
Polygon	Irrig. complex cult. p	34	4	4	4	5	4
Polygon	Military camps	2	0	0	0	0	0
Polygon	Natural grass land	30	3	3	6	6	3
Polygon	Non-Irrigated Arable L	18	2	2	4	5	2
Polygon	Non-irrig. complex cul	2	2	2	4	4	2
Polygon	Olive groves	10	4	4	3	3	4
Polygon	Others	6	2	2	2	2	2
Polygon	Palm groves	11	2	2	2	2	2
Polygon	Pannana Plantation	3	2	2	2	2	2
Polygon	Refugee Camps	2	2	2	2	2	2
Polygon	Salines	3	0	0	0	0	0
Polygon	Salt marshes	8	0	0	0	0	0
Polygon	Sea and ocean	8	0	0	0	0	0
Polygon	Sparsely veg. area	25	2	2	4	4	2
Polygon	Sport&leisture facilit	1	1	1	1	1	1
Polygon	Vineyards	1	2	2	2	2	2
Polygon	Water bodies	2	0	0	0	0	0

Chapter Four

4. Results and Discussion

4.1 Results for Threat analysis approach

Averaged scores from the experts' significance and knowledge analyses are reported in Tables 3 and 4 for the site level, and 5 and 6 for the network level.

4.2 Significance analysis

The mean magnitude scores were significantly different among site or threats (χ^2 = 17.939, p = 0.012, d.f. = 7 and χ^2 = 42.286, p= 0.000, d.f. =10; respectively; Friedman test). At the network level, the highest mean threat magnitude scores were (in decreasing order) for intensive grazing (code IUCN 2.3), pollution (code 9.1, 9.2, 9.3), collecting wild plants (code 5.2), recreation (code 6.1), fire (code 7.1) and urbanization (code 1.1)(Tab. 4. 1, Fig(4. 1). The sites with the greatest threat magnitude values were Bani Naim, Wadi Al Quf, Siris and Wadi Qana (Tab. 4.2 Fig4.2). The lowest mean threat magnitude scores were given to cutting wood (code IUCN 5.3), active quarries (code 3.2) and reforestation (code 2.2); the sites with the lowest threat magnitudes were Shobash, Khirbit Quis and Ein Al Fashkha.

Comparing the mean magnitude scores of sites with population density we did not observed a significant correlation (r_s = 0.414, p = 0.355; n = 7; Spearman rank correlation test; 2 tail).

Table (4.1) Significance analysis. Expert scores of threat magnitude for the 8 sites in West Bank, Palestine. Mean values (and ± standard deviation, s.d.) for each threat at each site are reported (in bold, the highest scores for each threats in each site). Local threats are classified following the IUCN standard (IUCN-CMP 2006).

IUCN code	Local threat/Site	Siris	Shobash	Um Al Tout	Wadi Qana	Wadi Al Quf	Bani Naim	Khirbit Quis	Ein Al Fakhash
2.1	Conversion to Agriculture	2.20 (0.84)	2 (0.712)	2.20 (1.10)	2 (0.71)	1.4 (0.55)	1.8 (0.84)	1.8 (0.84)	1 (0)
1.1	Urbanization	1.6 (0.89)	1.6 (0.89)	2 (1)	2.4 (1.34)	2.2 (0.83)	1.8 (1.30)	**2 (0.71)**	1.4 (0.55)
2.3	Intensive Grazing	**3.4 (0.55)**	**2.8 (1.3)**	**3 (0.71)**	**3 (0.71)**	2 (1)	**3.2 (0.84)**	1.8 (0.84)	1.2 (0.45)
5.3	Cutting Wood	2 (1)	1(0)	1.8 (0.84)	1.4 (0.55)	2 (1)	1.2 (0.45)	1.4 (0.55)	1 (0)
3.2	Active Quarries	1(0)	1(0)	1(0)	1.2 (0.45)	1 (0)	2.8 (1.30)	1(0)	1 (0)
5.1	Hunting	1.6 (0.55)	1.8 (0.84)	1.2 (0.45)	1.6 (0.89)	1.4 (0.55)	1.8 (0.84)	1.4 (0.55)	1.4 (0.55)
5.2	Collecting Wild Plants	2.6 (1.14)	2 (0.71)	2 (0.71)	2.4 (0.79)	1.8 (0.84)	2.8 (0.84)	**2 (1)**	1.2 (0.45)
6.1	Recreation	2 (0.71)	1.6 (0.89)	1.8 (0.84)	1.8 (0.84)	3 (0.71)	1.8 (0.84)	1.6 (0.55)	**2.8 (0.45)**
7.1	Fire Threat	2.2 (0.84)	1.4 (0.55)	2.2 (0.45)	2 (0.71)	**3.2 (0.84)**	1.6 (0.55)	1.6 (0.55)	1.8 (0.84)
2.2	Reforestation	1.6 (0.55)	1.4 (0.55)	1.4 (0.55)	1(0)	1.8 (0.45)	1.2 (0.45)	1 (0)	1 (0)
9.1, 9.2 , 9.3	Pollution	1.8 (1.3)	1.8 (1.3)	2.4 (0.55)	2.8 (0.84)	2.2 (0.84)	2.2 (1.3)	**2 (1)**	2.4 (1.52)

4.3 Knowledge analysis

The mean knowledge scores were significantly different among sites (χ^2 = 55.085, p = 0.000, d.f. 7) and among threats (χ^2 = 24.639, p = 0.006, d.f. = 10; Friedman test).

Urbanization (code IUCN 1.1), conversion to agriculture (code 2.1) and intensive grazing (code 2.3) were better known threats (highest mean knowledge values; Tab. 5, Fig. 2). Experts also indicated that they understood the threats at Wadi Al Quf, Siris, Wadi Qana, and Bani Naim (Tab. 6, Fig. 3). Experts knew the least about the threats of reforestation (code IUCN 2.2), active quarries (code 3.2), collecting wild plants (code 5.2) and hunting (code 5.1) and they understood the threats facing Shobash, Khirbit Quis and Ein Al Fashkha the least (Tab. 4.2 Fig. 3).

Table 4.2 Knowledge analysis. Expert scores of threat knowledge for the 8 sites in West Bank, Palestine. Mean values (and ± standard deviation, s.d.) for each threat at each site are reported in bold, the highest scores for each threats in each site). Local threats are classified following the IUCN standard (IUCN-CMP 2006).

code IUCN	Threat/Site	Siris	Shobash	Um Al Tout	Wadi Qana	Wadi Al Quf	Bani Naim	Khirbit Quis	Ein Al Fashkha
2.1	Conversion to Agriculture	3 (1)	2.2 (1.10)	**2.8 (1.1)**	3.20 (0.84)	2.8 (0.45)	2.6 (0.89)	1.6 (0.55)	2.2 (0.45)
1.1	Urbanization	2.4 (0.55)	2 (1)	2.6 (0.55)	**3.85 (0.45)**	**3.6 (0.55)**	2.8 (0.84)	1.6 (0.55)	**2.4 (0.55)**
2.3	Intensive Grazing	**3.2 (0.84)**	2 (1)	2.6 (0.55)	3 (0.71)	2.8 (0.45)	**3 (0.71)**	1.6 (0.55)	2.2 (1.1)
5.3	Cutting Wood	2.6 (1.34)	**2.4 (1.52)**	2.6 (1.34)	2.2 (0.84)	3 (1)	2 (0.71)	1.6 (0.55)	1.6 (0.55)
3.2	Active Quarries	2.2 (1.64)	1.8 (1.1)	2.2 (1.64)	2.4 (1.52)	2.4 (1.52)	2.8 (1.1)	**2 (1)**	1.6 (0.55)
5.1	Hunting	2.2 (0.84)	1.6 (0.55)	1.8 (0.45)	1.8 (0.45)	2.2 (0.84)	2 (0.71)	1.6 (0.55)	1.6 (0.55)
5.2	Collecting Wild Plants	2.2 (0.84)	2 (1)	2.2 (0.84)	2.2 (0.84)	2.2 (0.84)	2.8 (0.84)	1.6 (0.55)	1.4 (0.55)
6.1	Recreation	3 (1.22)	1.6 (0.55)	2.4 (0.89)	2.2 (0.84)	3.4 (0.89)	2.6 (0.55)	1.6 (0.55)	**2.4 (1.14)**
7.1	Fire Threat	2.8 (1.30)	2.2 (1.64)	**2.8 (1.3)**	2.6 (1.14)	**3.6 (0.89)**	2 (0.71)	1(0)	1.4 (0.89)
2.2	Reforestation	2.6 (1.34)	1.8 (1.1)	2.6 (1.52)	2 (0.89)	3.2 (1.09)	2.2 (0.45)	1.4 (0.55)	1.6 (0.89)
9.1, 9.2 , 9.3*	Pollution	2.4 (0.89)	1.8 (1.1)	2.4 (0.55)	3 (0.71)	3.4 (0.55)	2.6 (0.89)	1.4 (0.55)	2.2 (1.31)

4.4 Comparison between magnitude and knowledge

Averaged values of magnitude (significance) and knowledge scores in 8 sites were significantly and directly correlated (r_s = 0.850, p = 0.007, n = 8, Spearman rank correlation test; 2 tail). Excluding Khirbit Quis (for sites) and collecting wild plants (for threats), knowledge showed everywhere higher values when compared to paired magnitude with significant differences in some cases (Wilcoxon paired test; Table 4.3 and 4.4).

	Significance	Knowledge	statistic	
Local threat	mean (±s.d.)	mean (s.d.)	Wilcoxon	p
Urbanization	9.38 (1.69)	**13.25 (3.73)**	-2.328	0.020**
Conversion to Agriculture	8.88 (1.96)	12.75 (2.60)	-2.319	0.020**
Intensive grazing	**12.75 (3.92)**	12.75 (2.82)	-0.256	0.798
Cutting wood	7.38 (2.07)	11.25 (2.49)	-2.536	0.011**
Active quarries	6.25 (3.15)	10.88 (1.89)	-2.384	0.017**
Hunting	7.63 (1.06)	9.25 (1.28)	-2.157	0.031*
Collecting wild plants	10.5 (2.51)	10.38 (2.13)	-0.322	0.748
Recreation	10.25 (2.71)	12 (3.12)	-1.802	0.072

Fire threat	10 (2.83)	11.5 (4.17)	-1.496	0.135
Reforestation	6.5 (1.51)	10.88 (2.99)	-2.536	0.011**
Pollution	11 (1.69)	12 (3.16)	-0.949	0.343

Table 4.4 Averaged scores of magnitude for local threats (total value for all sites; in bold, the highest values for significance and knowledge analyses). Statistic comparisons have been reported (value of coefficient W and probability, p; Wilcoxon paired test; *: p<0.05; **: p<0.01).

Sites	Significance mean (s.d.)	Knowledge mean (s.d.)	statistic Wilcoxon	p
Siris	10 (3.13)	13 (1.79)	-2.683	0.007**
Shobash	8.36 (2.54)	9.73 (1.27)	-1.481	0.139
Um Al-Tout	9.45 (2.81)	12.27 (1.49)	-2.620	0.009**
Wadi Qana	9.82 (3.22)	12.91 (3.02)	-2.608	0.009**
Wadi Al Quf	10 (3.29)	**14.82 (2.64)**	-2.956	0.003
Bani Naim	**10.1 (3.3)**	12.45 (1.86)	-2.503	0.012**
Khirbit Quis	8 (1.84)	7.78 (1.19)	-0.669	0.503
Ein Al Fashkha	7.36 (3.07)	9.36 (2.01)	-1.966	0.049*

Table 4.5 Total averaged scores of magnitude for each site (total value for all threats; in bold, the highest values for significance and knowledge analyses). Statistic comparisons have been reported (value of coefficient W and probability, p; Wilcoxon paired test; *: p<0.05; **: p<0.01).

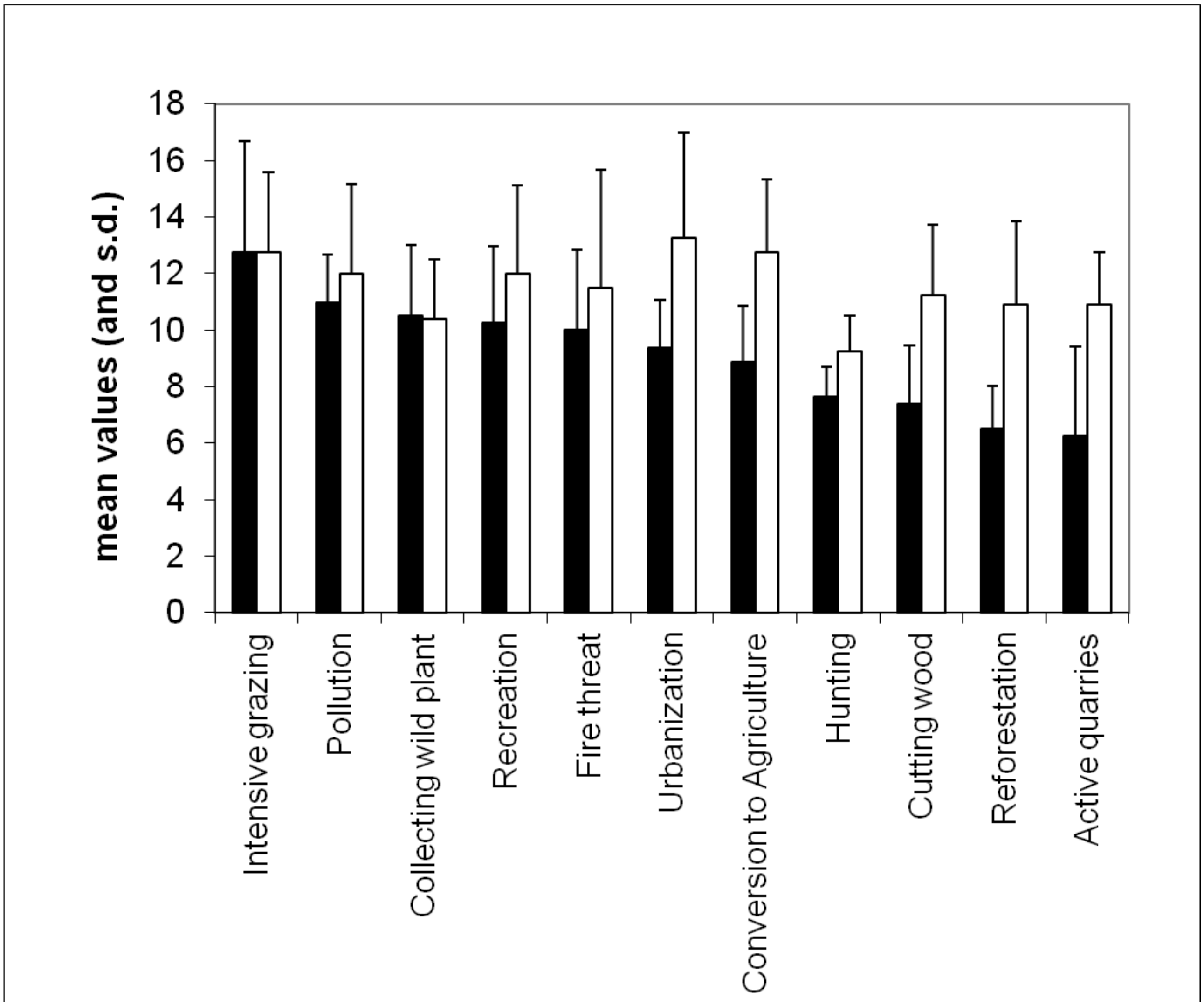


Figure (4.1). Histogram reporting the averaged scores (and ± standard deviation) for magnitude (significance analysis; black columns; in decreasing order) and knowledge (white columns) of local threats (total value for all sites).Values are in order of decreasing magnitude.

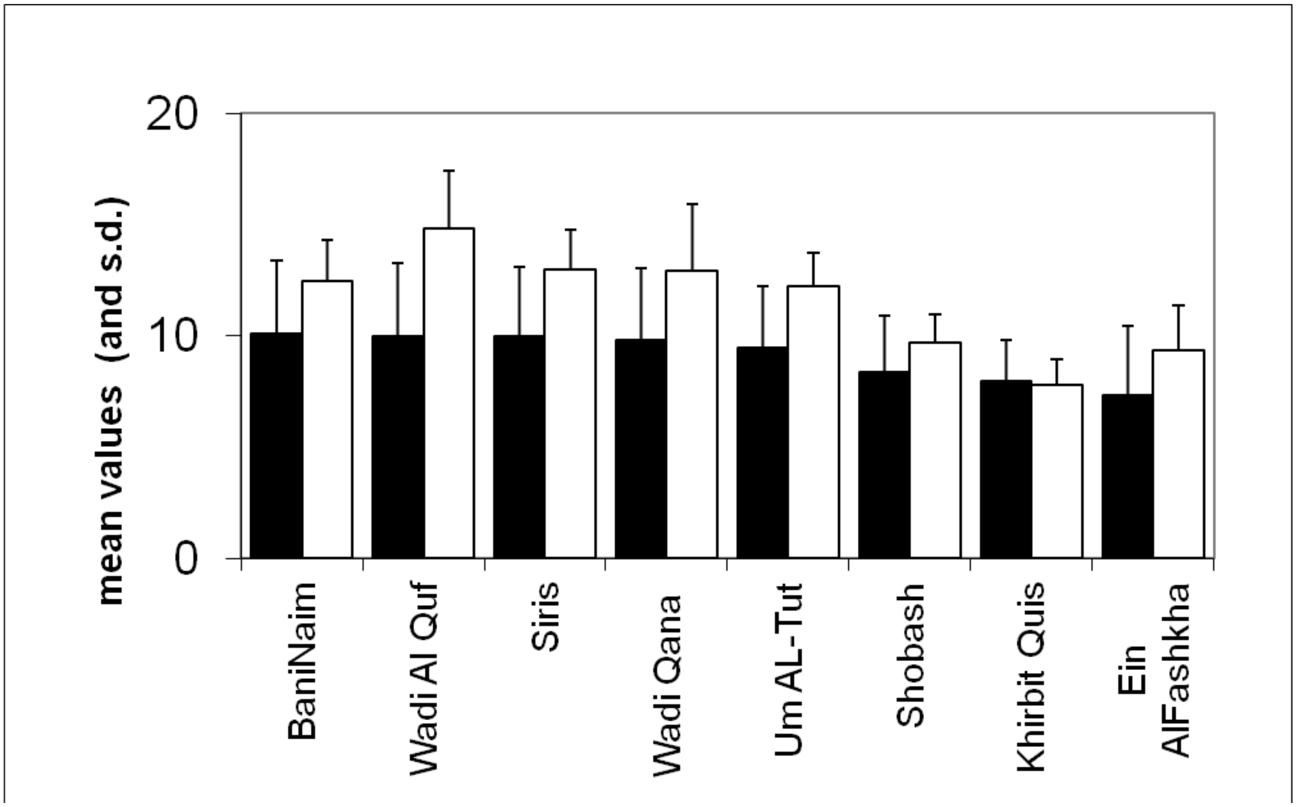


Fig (4.2) Total averaged scores (and ± standard deviation) for magnitude (significance analysis; black columns; in decreasing order) and knowledge (white columns) at each site (total value for all threats). Values are in decreasing order of total magnitude.

Recent reports have highlighted the critical state of Palestine's biodiversity as a result of a large number of human-induced direct and indirect threats (Applied Research Institute 2007, 2011). These threats are a consequence of several driving forces related to a highly unsustainable economic activities; increasing population density; and the region's current political status, including the division of Palestinian accessible areas by Israeli occupation activities (e.g., intensive building of settlements and associated roads and related activities, expansion of the segregation wall, and land confiscation) (Sultan & Abu-Sbaih 1996; Applied Research Institute 2007). As a result, many biological species and habitat types are under serious threat of becoming rare or disappearing altogether. More particularly, their local impacts are primarily felt at the ecosystem and community level on shrub vegetation, water and soil quality, remnant bush patches and Mediterranean forests that host peculiar diversity (Al sheikh and Salman2000).

Our expert-based approach identified intensive grazing, generic pollution, collecting wild plants, recreation, fires and urbanization to be the greatest threats to biodiversity at the network level and, therefore, the most important priorities for management actions. These threats are widely recognized to be short-term or long-term processes that strongly affect biodiversity targets at the regional and global level (Ayash et al. 1995; Mysterud 2006; Ukmar et al. 2006; Irwin & Bockstael 2007). More particularly, our threat analysis largely match with analogous studies carried out in the Middle East where fires, intensive grazing, un-planned urbanization and pollution (mainly of freshwaters and ponds) have been considered the main human-induced disturbances inducing evident land use changes, degradation (e.g., desertification; Winslow & Thomas 2007) and impact of biodiversity, at least during the last three decades (Perevolotsky & Seligman 1998; Rundel, 1998; Naveh & Carmel 2004; Wittenberg & Malkinson 2009; Alrababah et al. 2007; Tourenq & Launay 2008).

Among these threats, intensive grazing by sheep and goats may be considered a long-term disturbance historically occurring in Palestine (Applied Research Institute 2011) and in a large part of Middle East wherever livestock exceeds the land carrying capacity (e.g. Naveh & Carmel 2004). This anthropogenic disturbance (inconstant among seasons, being particularly high in intensity during spring; Applied Research Institute 2011), together to fires and stochastic drought events act to prevent the natural vegetation dynamic toward dwarf shrub communities, leading to a reduction of seed regeneration and inducing effect at level of plant populations and communities (disrupting density, species richness, diversity, biomass, and cover), with cascade effects on soil invertebrates and habitat-related vertebrates (Zaady et al. 2001; Wittenberg & Malkinson 2009). In a long-term span grazing, fires and drought events favour habitat degradation and desertification at landscape scale (Winslow & Thomas 2007).

Water and soil pollution is a threat having strong implication at socio-political and economic level, as well as ecological ones, being a causal factors for further conflicts (Kliot 1994). Probably, water, in terms of their quality, quantity and availability is the local key resource, both for human populations and for biodiversity targets (Vőrősmarty et al.2010). In this sense, water pollution may be considered the "key threat" for the whole socio-ecological systems in this geographic area.

Water pollution is strictly related to urbanization (mainly un-planned urban sprawl) and (secondarily) un-managed recreation activities. With the building of settlements, bypass roads and military outposts, Segregation Wall, confiscation of their land for building settlements and related agricultural and industrial activities, Palestinians have been largely restricted to specific areas. Here a process of positive feedback have induce a rapid land use change and urbanization (high population density and birth rate, need for Palestinian housing and buildings for other activities, high pressure on ecosystems) with cascade effect on water quality, risk of fires and other threats (Palestinian National

Authority 2006). More particularly, regarding the fires there are evidences that their frequency and intensity have markedly increased in Palestine, matching a trend at Mediterranean scale (Wittenberg and Malkinson 2009): the role of urbanization (and road/Wall construction) and related increased human activities appear also in this case the main causal driver. However, yet Lambin et al. (2001) highlighted as neither population nor poverty alone constitute the sole and major underlying causes of land-cover change. Rather, peoples' responses to economic and political opportunities may drive land-cover changes.

Other threats also affect biological diversity in the study area, partially linked to which before reported. For example, collecting wild plants and hunting (and illegal trade) is common in Palestine (and, at least for large mammals, throughout the Middle East) (Quemsiyeh et al. 1996; Tourenq & Launay 2008). Hunting typically affects large mammals and illegal trade also affects various desert reptiles and songbirds. In addition, farmers have been reported to use poisons to kill wolves and hyenas as precautionary measures to protect their herds (Applied Research Institute 1997; Applied Research Institute 2007). Analogously to the previous main threats, also in this case, exploitation of animal and plant resources may be partially due to socio-economic driving forces. Many Palestinians are living in extreme poverty (Palestinian National Authority 2006). As they seek new sources of income, many Palestinians are compelled to exploit natural resources (physical and biological) in marginal lands and wilderness areas so acting as a significant factor of pressure on biodiversity. Interestingly, our results suggest that hunting is a threat of particular concern because its magnitude is little understood by experts, as shown in the knowledge analysis (lowest values).The initial findings presented here also suggest that priorities at the network scale should focus on conservation strategies and actions that control intensive grazing, pollution, un-managed collecting wild plants, recreation and fire. However, site scale strategies should also address additional local threats (e.g., the impacts of hunting and of active quarries).

Recently, the Palestinian Authority (through the Palestinian Legislative Council) has adopted a number of laws and regulations on agriculture, soil conservation and biodiversity (Palestinian National Authority 2006; Applied Research Institute 2011). Nevertheless, a large number of international reports (e.g. inside the United Nations Development Programme) and guidelines have stressed that it is necessary update these acts making them more effective. Moreover, among the suggested measures it has been highlighted also the necessity to increase in skill in rangeland (shrub and cropland) managers and practitioners and develop specific conservation projects, listing actions in order of priority and taking into account the close connection between environmental problems and political and social issues in this crisis context (Palestinian National Authority 2010).

When analysing threats at the local level, we identified four sites (Bani Naim, Siris, Wadi Qana and Wadi Al Quf) that were of particular concern. These sites include many relevant targets of interest because of the presence of water bodies and tree vegetation: e.g., *Gazella gazella*,; *Hyaena hyaena* (both of them Vulnerable in IUCN Red List, IUCN 2016),*Hystrix indica* and *Canis lupus*, occur in Wadi Al Quf; *Gazella gazella*, *Capra nubiana*, *Hyaena hyaena* (Near Threatened) and *Neophron percnopterus* (Endangered) in Bani Naim (EQA Report 2006) and face several critical threats, including all of those identified to be priorities at the network level. Counter-intuitively, we did not observe a direct correlation between population density and the threat magnitude at the network level. Likely, other economic and political driving factors (poverty, conflicts, new Israeli settlements) contribute as further causal processes determining the type and magnitude of existing threats. For example, new settlements constructed at certain sites (e.g., Wadi Qana) have induced a strong urban sprawl and water pollution independently from demographic density (Applied Research Institute

2003). The experts' level of knowledge differs significantly among sites and threats. It is likely that the data required evaluating each site and the existing context-specific background available differed from site to site, affecting the general judgement from the experts. Analogously, the highly different characteristics of selected threats (in terms of their type and regime) and the different background of experts may have affected our results. Our preliminary, cursory approach may help increase knowledge and facilitate conservation strategies both at the site and network levels (e.g., for ecological network planning and connectivity conservation; Crooks & Sanjayan, 2006) in critical circumstances where there is a lack of sufficient data and information to fully evaluate the biological resources and ecological functions and in areas where urgent protection is needed (Salafsky et al. 2002). However, despite the general importance and the potential of Salafsky et al.'s conceptual approach (2003), there is a clear subjectivity in this expert-based tool: a methodological weakness that may lead to serious mismanagement (see Game et al. 2013). For instance, potential problems associated with the measurement of threat magnitudes may arise from perception-based evaluations and the differing reliability of bibliographic sources as well as from the individual performance of reviewers with different areas of expertise. In addition, the significant correlation between magnitude and knowledge scores should be carefully examined, especially if the greatest threats (i.e., with higher magnitude) are perceived to be better known, or if their duration, frequency, intensity or size are not completely understood. For this reason, a more analytical approach using specific metrics of diversity as indicators of stress, pressure and impact of local threats may also be required to inform management priorities (Dornelas et al. 2011; see also the DPSIR approach: Kristensen, 2005). Moreover, the limited number of panel of experts may affect the data's variance. In the case of this study, the small sample size was due to the limited number of scientists and technicians living in this critical geographic area where data on conservation targets and threats are very difficult to obtain.

Nevertheless, in crisis conditions such as those in conflict areas (Hanson et al. 2009), where there is a lack of quantitative field data, and when the definition of strategies is an urgent priority, expert-based approaches may support first steps in decision making regarding conservation actions (Auld & Keith 2009). In this regard, our research (the first available in the Middle Eastern area) serves as a first-step pilot study for additional, more in-depth surveys.

4.5 Results for the Quantifying landscape metrics in (Sulfit , Jenin ,Hebron , Jericho)

4.6 Sulfit Patch Analysis Results :

Table 4:6 Land scape Metrics Results for Sulfit

SulfitClasses	CA	%	NumP	MPS	PSCoV	PSSD	TE	ED	MPE	MSI	AWMSI	MPAR	MPFD	AWMPFD
Colonies	1419.55	0.76	26	54.60	115.16	62.88	106473.41	0.57	4095.13	1.71	1.84	0.01	1.28	1.27
Forest	65.27	0.03	3	21.76	50.37	10.96	10068.62	0.05	3356.21	2.09	2.12	0.02	1.33	1.32
Construction sites	15.32	0.01	2	7.66	14.41	1.10	3707.42	0.02	1853.71	1.86	1.93	0.02	1.33	1.33
Natural grass land	16658.57	8.93	26	640.71	132.41	848.38	683917.23	3.67	26304.51	2.82	4.35	0.01	1.30	1.33
Olive groves	153569.03	82.33	21	7312.81	116.16	8494.72	5561158.57	29.82	264817.07	6.74	13.23	0.01	1.34	1.40
Agr.Land With Nat. Veg	4891.34	2.62	11	444.67	88.59	393.93	223853.80	1.20	20350.35	2.58	3.42	0.01	1.29	1.31
Discontinuous Urban Fa	1344.93	0.72	26	51.73	101.45	52.48	119591.19	0.64	4599.66	1.95	2.01	0.01	1.30	1.29
Non-irrig. complex cul	168.36	0.09	1	168.36	0.00	0.00	7418.73	0.04	7418.73	1.61	1.61	0.00	1.24	1.24
Non-Irrigated Arable L	193.33	0.10	3	64.44	48.07	30.97	16604.20	0.09	5534.73	1.94	2.08	0.01	1.29	1.29
Sclerophylous vegt.	8101.55	4.34	5	1620.31	79.41	1286.61	193180.57	1.04	38636.11	2.59	3.39	0.01	1.28	1.29
Fruit trees&berry plan	45.19	0.02	8	5.65	77.18	4.36	9978.85	0.05	1247.36	1.58	1.69	0.04	1.33	1.31
Industrial or com.unit	24.36	0.01	2	12.18	95.92	11.68	3093.22	0.02	1546.61	1.41	1.60	0.04	1.31	1.28
Dump site	0.87	0.00	1	0.87	0.00	0.00	368.07	0.00	368.07	1.11	1.11	0.04	1.30	1.30
Mineral extrac. sites	2.84	0.00	2	1.42	20.31	0.29	1175.89	0.01	587.95	1.43	1.37	0.04	1.34	1.33
Citrus plantations	3.77	0.00	1	3.77	0.00	0.00	902.45	0.00	902.45	1.31	1.31	0.02	1.29	1.29
Drip Irrigated Arable	16.15	0.01	3	5.38	63.36	3.41	2786.18	0.01	928.73	1.20	1.24	0.03	1.28	1.27

*** TLA = 186520.43 Ha

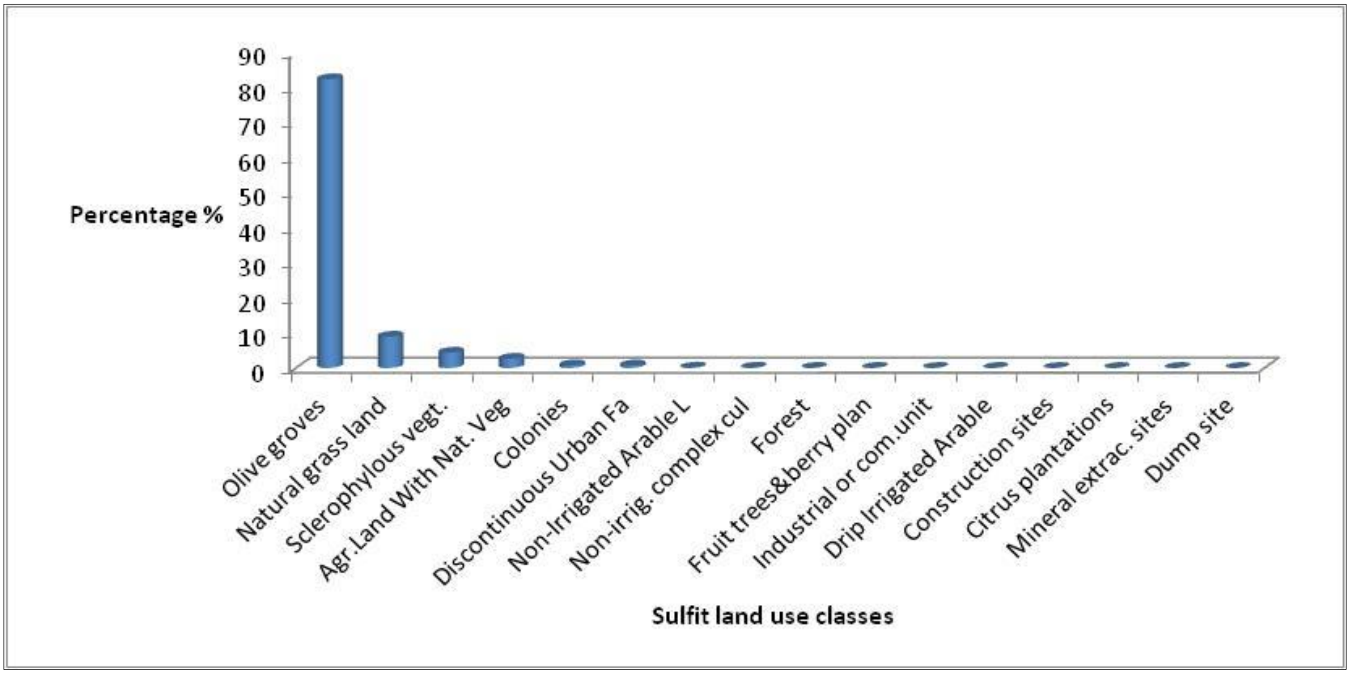


Figure (4.3) percentage for Sulfit landuse classes at class level

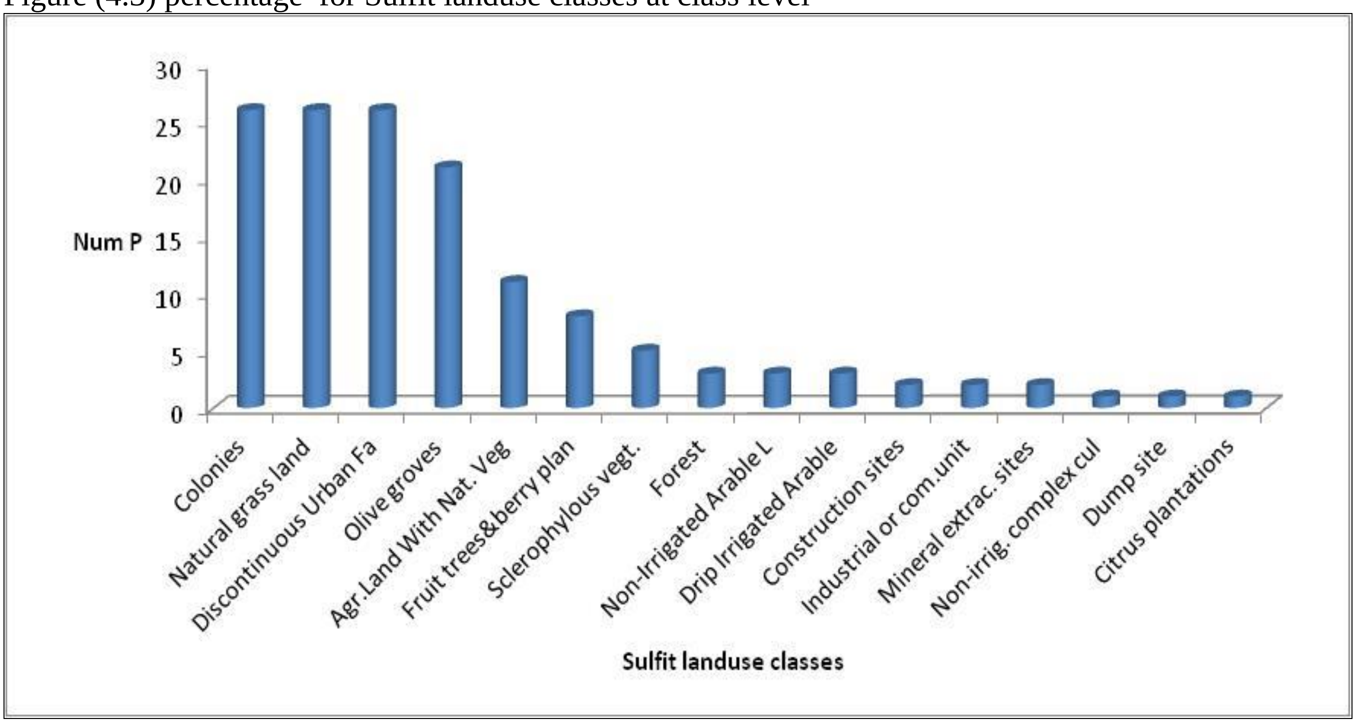


Figure (4.4) Number of Patches for Sulfit landuse classes at class level

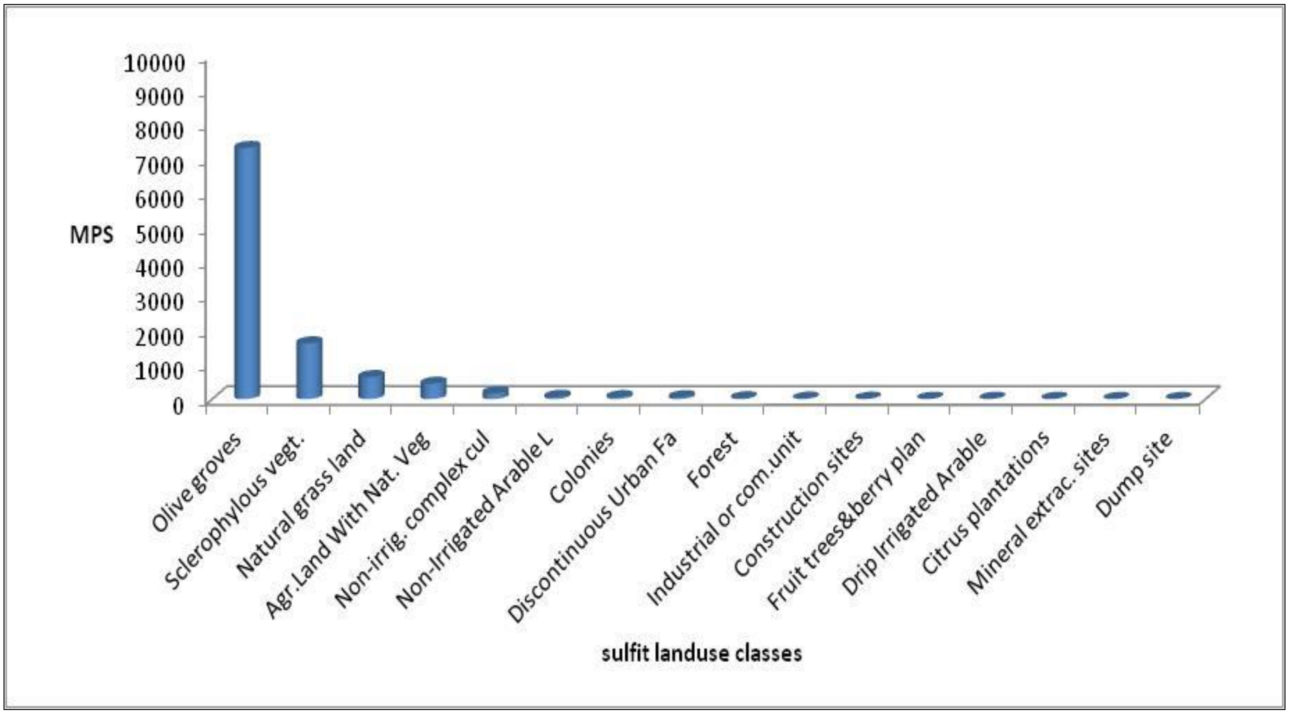


Figure (4.5) Mean Patch Size (MPS) for sulfit landuse classes at class level

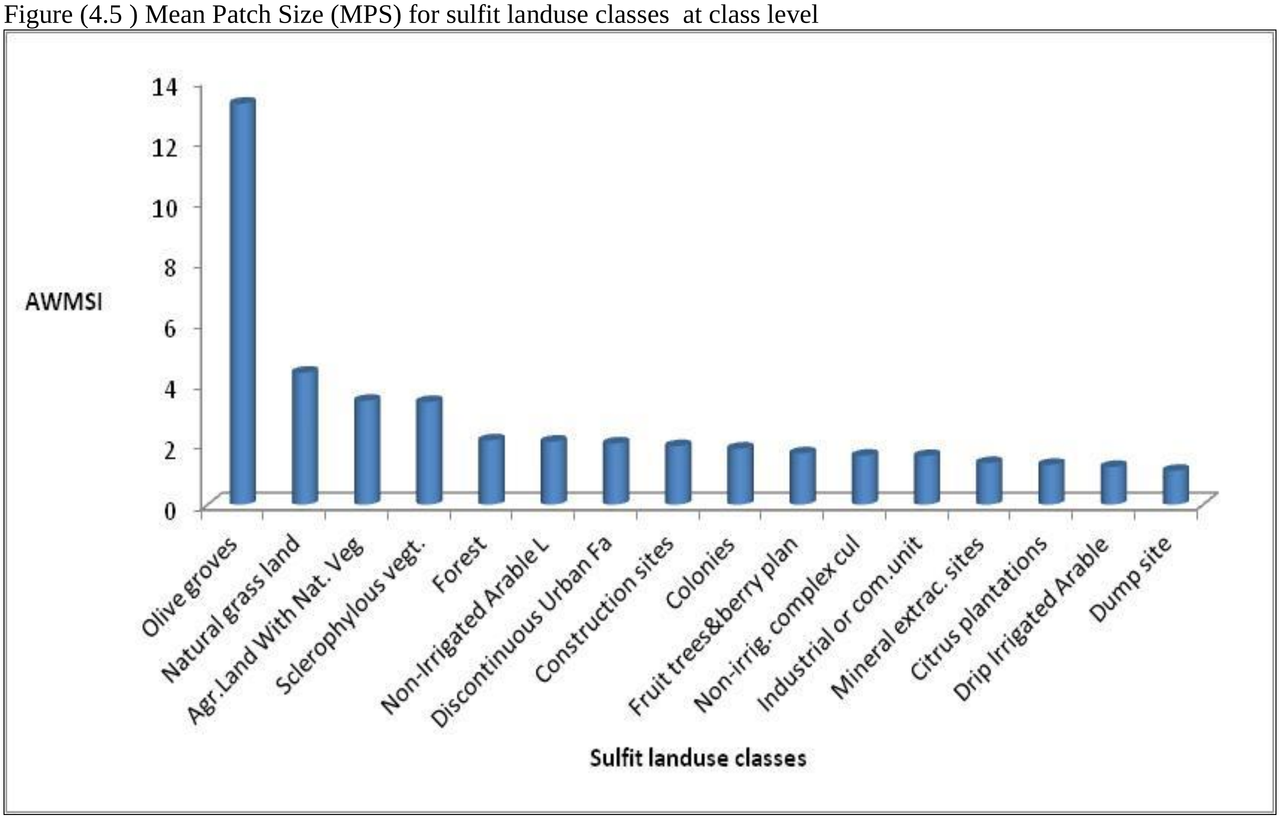


Figure (4.6) Area Weight Mean Shape Index for Sulfit landuse classes at class level

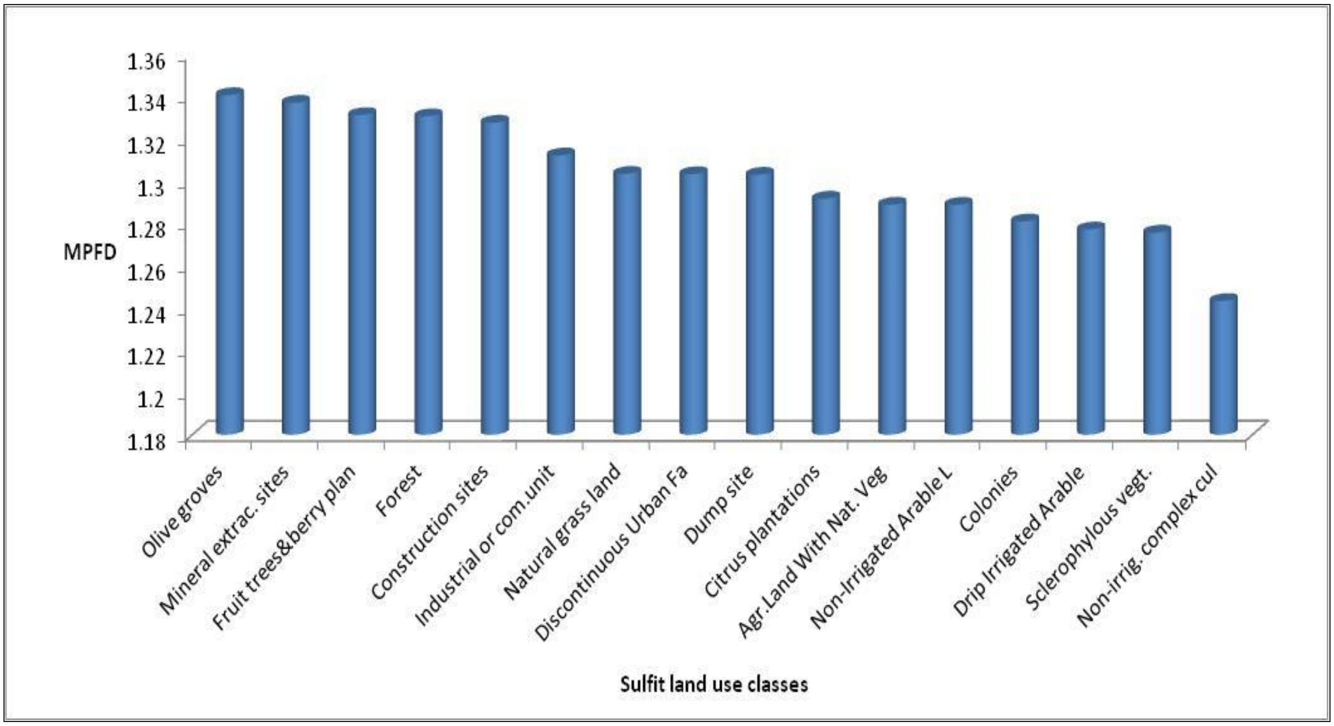


Figure (4.7) Mean Patch Fractal Dimension for Sulfit land use classes at class level

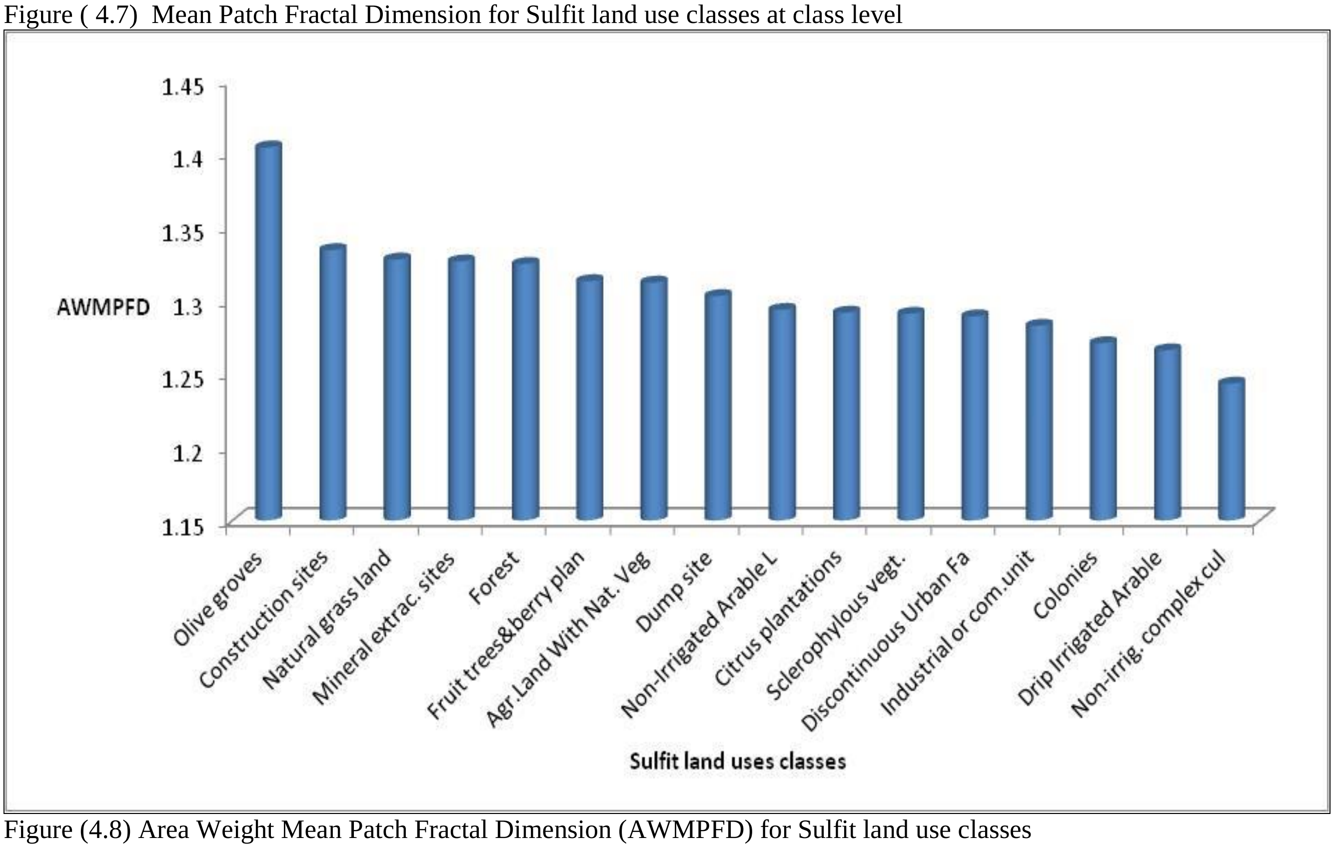


Figure (4.8) Area Weight Mean Patch Fractal Dimension (AWMPFD) for Sulfit land use classes

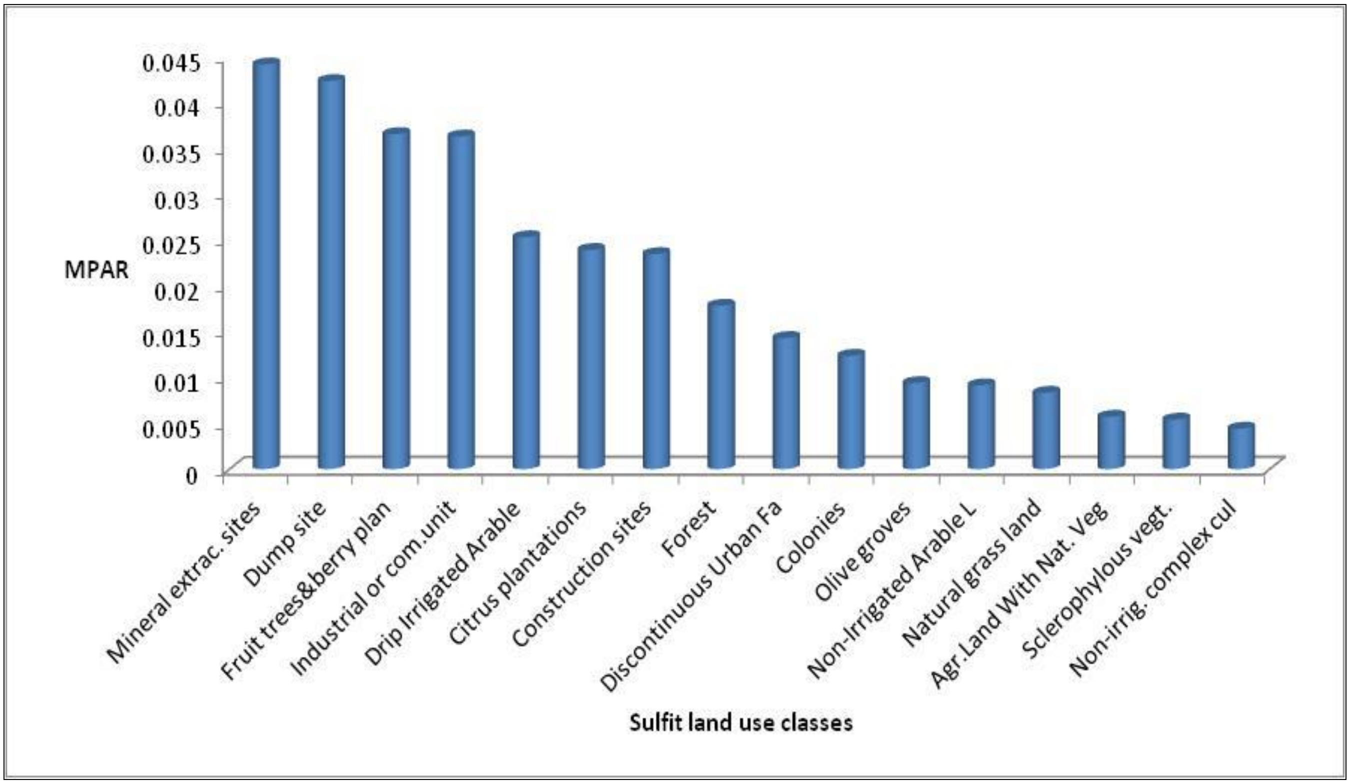


Figure (4.9) Mean patch Area Ratio (MPAR) for Sulfit land use classes at class level

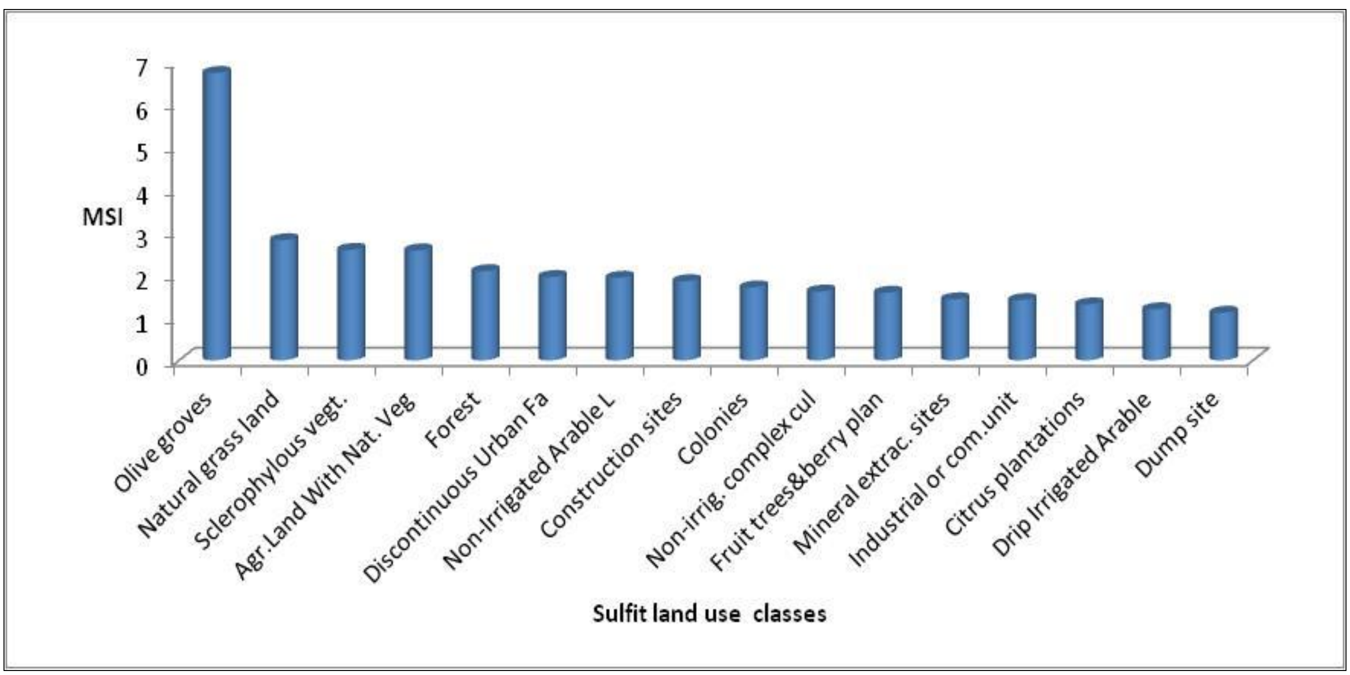


Figure (4.10) Mean Shape Index (MSI) for sulfit landuse classes at class level

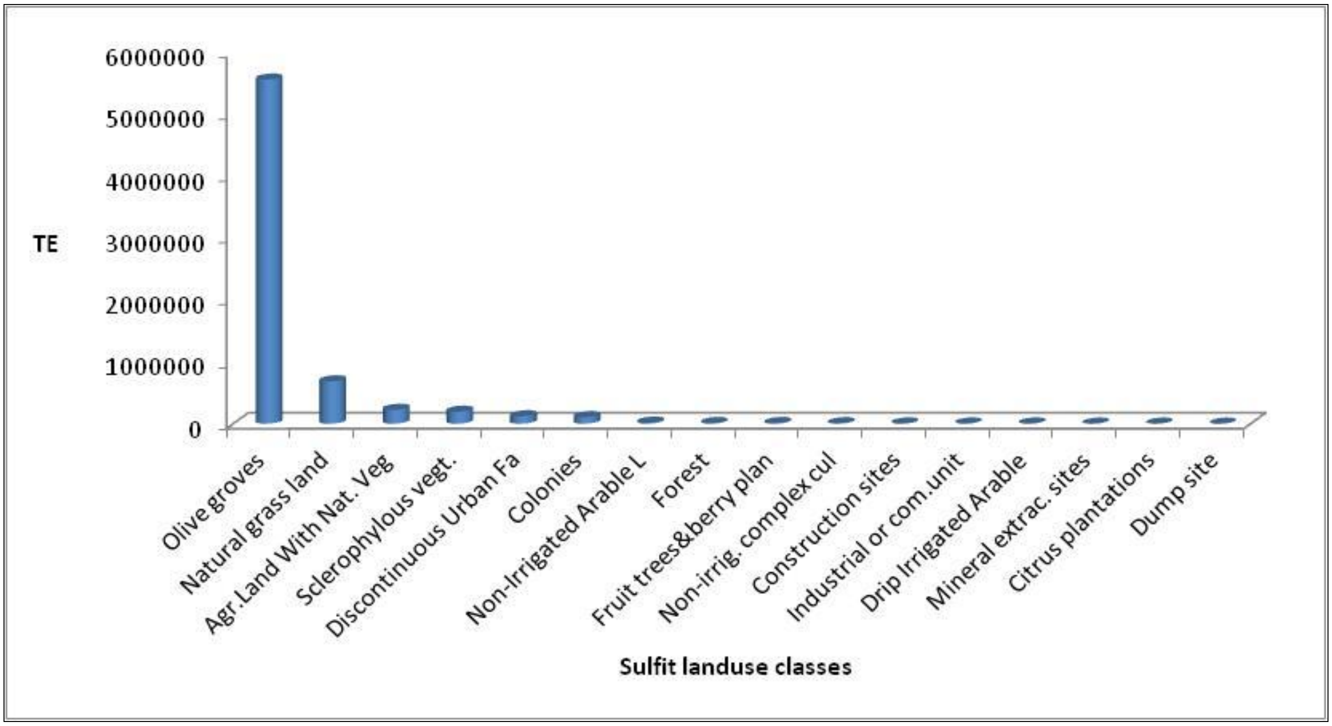


Figure (4.11) Total Edge (TE) for Sulfit landuse classes at class level

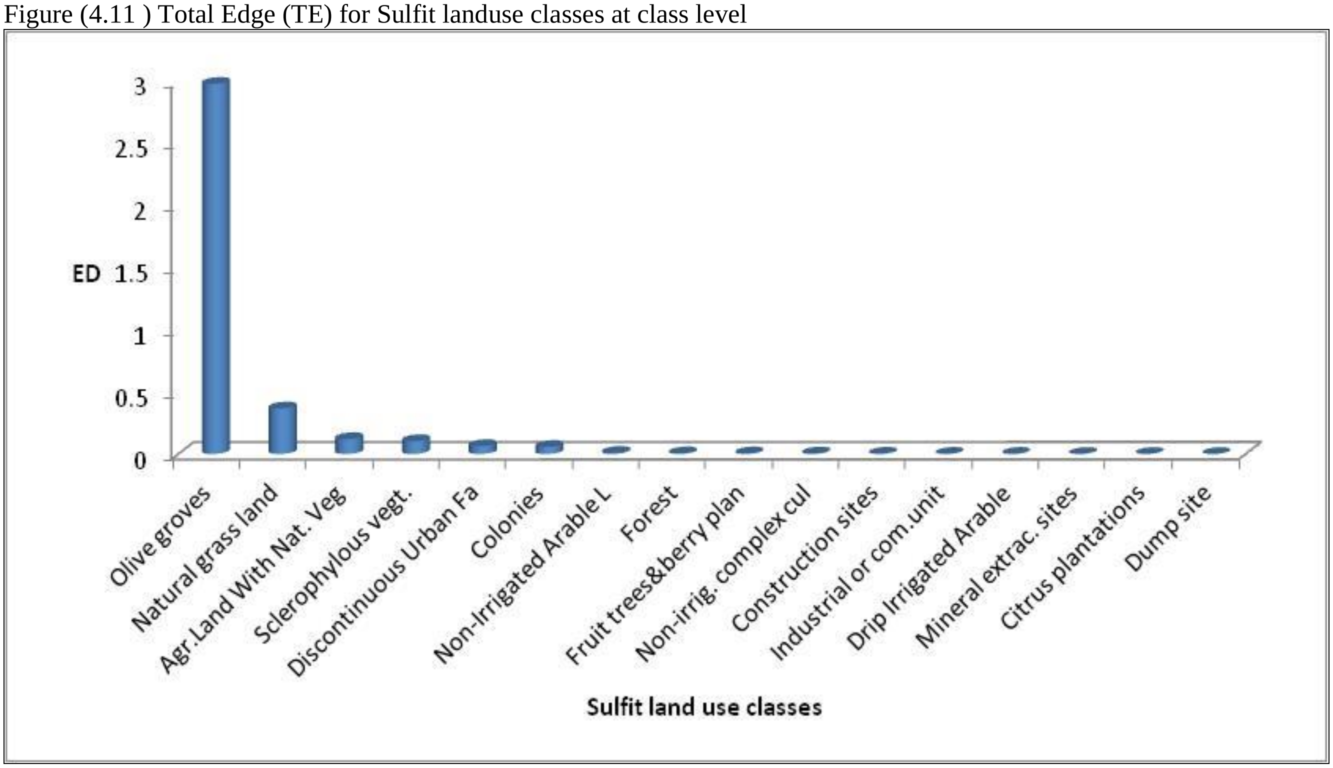


Figure (4.12) Edge Density (ED) for Sulfit landuse classes at class level

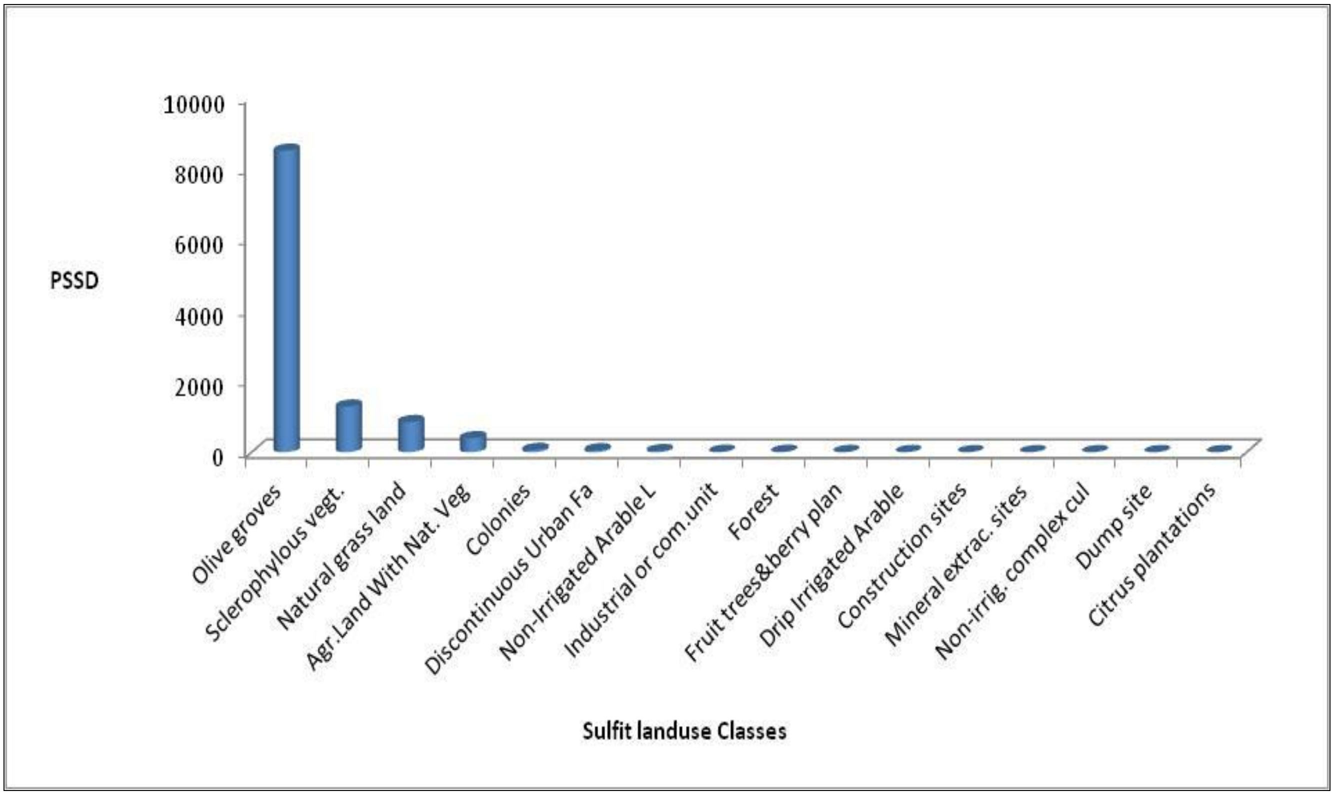


Figure (4.13) Patch Size Standard Deviation (PSSD) for Sulfit landuse classes at class level

Sulfit land use map consist of 16 classes the highest percentage for olive groves class with 82 % with area around (153569Ha) followed by Natural grass land 8.93 % with area around (16658 Ha) and sclerophylous vegetation represent 4.34 % with area around (8101,54 Ha)

Area Weight Mean Shape Index: colonies represent the highest value 13.23 followed by Forest 4.35 and construction sites 3.42 while the lowest value is citrus plantation 1.24 Drip irrigated arable 1.11, all calculated index values are greater than one which serve as benchmarks value for patches having complex and irregular shape .

Mean Shape Index: colonies represent the highest value 6.74 followed by forest 2.81 followed by construction 2.59 the lowest value for citrus plantation (1.19) and drip irrigated Arable (1.11). It can be observed that the values for all classes greater than one indicate that the patch shape had increasing irregularity and complexity. This indicates a more fragmented and more heterogeneous landscape.

Mean Patch Fractal Dimension (MPFD): olive groves class show the highest value 1.340 followed by Mineral extract sites class (1.336) and fruit trees class (1.331)

Forest represent 1.33, Sclerophylous vegt 1.275 and none irrigated complex cultivation 1.243. It was observed that the value for classes was greater than one, suggesting a more complex shape, high patch shape irregularity, and a highly fragmented landscape.

4.7 Jenin land use Patch analysis results

Class	Class area	NumP	MPS	PSCoV	PSSD	TE	ED	MPE	MSI	AWMSI	MPAR	MPFD	AWMPFD
Discontinuous Urban Fa	5601.76	125	44.81	169.91	76.14	457837.70	2.06	3662.70	1.69	2.26	0.02	1.30	1.29
Non-irrig. complex cul	7660.10	12	638.34	271.68	1734.22	308517.60	1.39	25709.80	2.53	6.93	0.01	1.29	1.36
Irrig. complex cult. P	247.55	6	41.26	96.25	39.71	18615.29	0.08	3102.55	1.59	1.57	1.20	0.56	1.26
Agr.Land With Nat. Veg	9458.29	47	201.24	221.55	445.85	463960.10	2.09	9871.49	2.05	3.29	0.01	1.29	1.31
Natural grass land	111638.77	71	1572.38	245.04	3852.95	3781408.00	17.05	53259.27	2.93	9.33	0.01	1.31	1.38
Drip Irrigated Arable	1105.85	17	65.05	163.77	106.53	78719.16	0.35	4630.54	1.88	2.33	0.02	1.31	1.29
Non-Irrigated Arable L	12179.94	41	297.07	159.97	475.23	524141.60	2.36	12783.94	2.38	3.01	0.17	1.44	1.30
Olive groves	45307.54	46	984.95	213.35	2101.34	1878401.00	8.47	40834.80	2.80	8.12	0.45	1.11	1.37
Forest	1488.55	25	59.54	125.99	75.01	123939.30	0.56	4957.57	1.97	2.24	0.01	1.30	1.29
Military camps	106.90	5	21.38	82.46	17.63	9990.84	0.05	1998.17	1.34	1.27	0.01	1.26	1.24
Refugee Camps	35.93	2	17.96	54.74	9.83	3520.44	0.02	1760.22	1.22	1.23	0.01	1.25	1.24
Mineral extrac. Sites	146.19	8	18.27	141.54	25.87	17641.31	0.08	2205.16	1.52	1.97	0.02	1.29	1.30
Industrial or com.unit	34.92	1	34.92	0.00	0.00	3060.18	0.01	3060.18	1.46	1.46	0.01	1.26	1.26
Continuous Urban Fabri	177.40	2	88.70	33.46	29.68	9805.27	0.04	4902.64	1.48	1.50	0.01	1.24	1.24
Citrus plantations	6.93	1	6.93	0.00	0.00	1266.81	0.01	1266.81	1.36	1.36	0.02	1.28	1.28
Others	34.31	3	11.44	34.40	3.93	4691.99	0.02	1564.00	1.28	1.37	0.01	1.26	1.26
Colonies	192.96	11	17.54	64.21	11.26	20417.52	0.09	1856.14	1.31	1.36	0.01	1.26	1.25
Sclerophylous vegt.	24968.28	7	3566.90	74.07	2641.88	536903.60	2.42	76700.51	3.80	4.15	0.00	1.31	1.30
Transitional wood Land	1438.95	4	359.74	92.64	333.25	65884.51	0.30	16471.13	2.45	3.13	0.01	1.30	1.31
Drip irrig. Vineyards	1.35	1	1.35	0.00	0.00	485.11	0.00	485.11	1.18	1.18	0.04	1.30	1.30

*****TLA = 221832, 4918 Ha

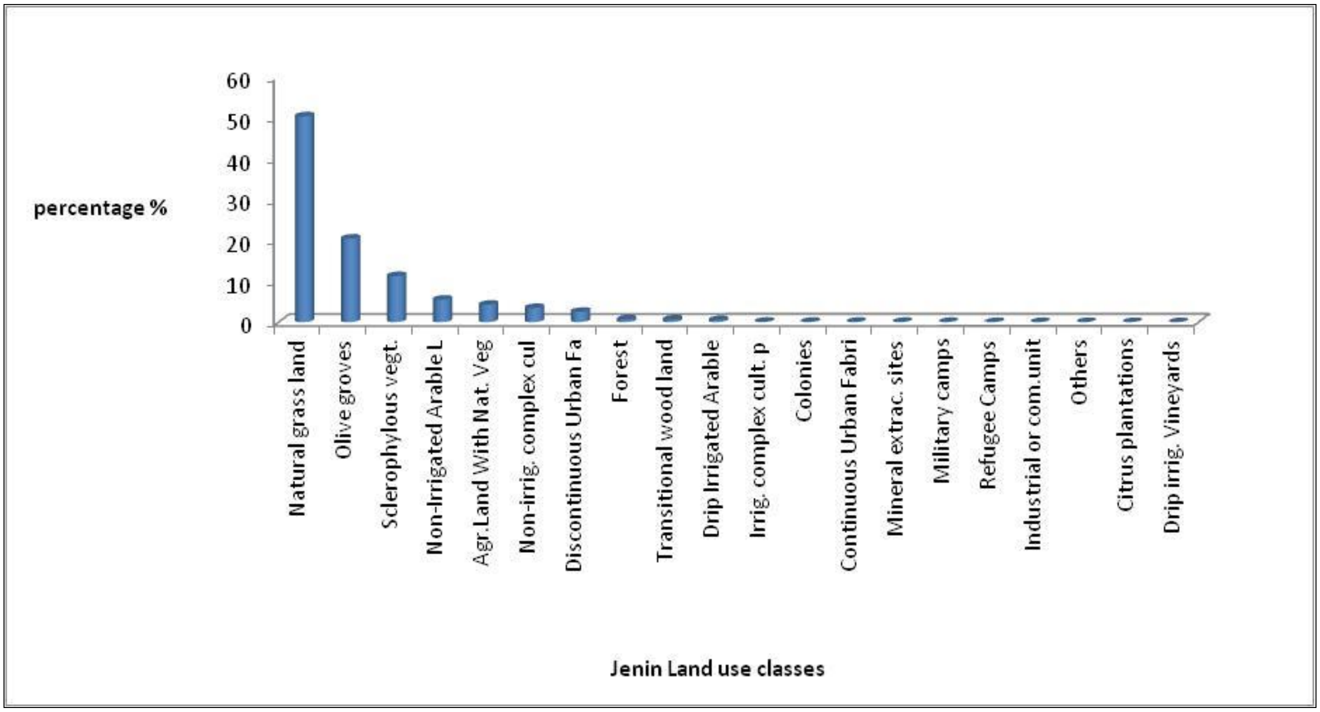


Figure (4.14) Percentage for Jenin landuse classes

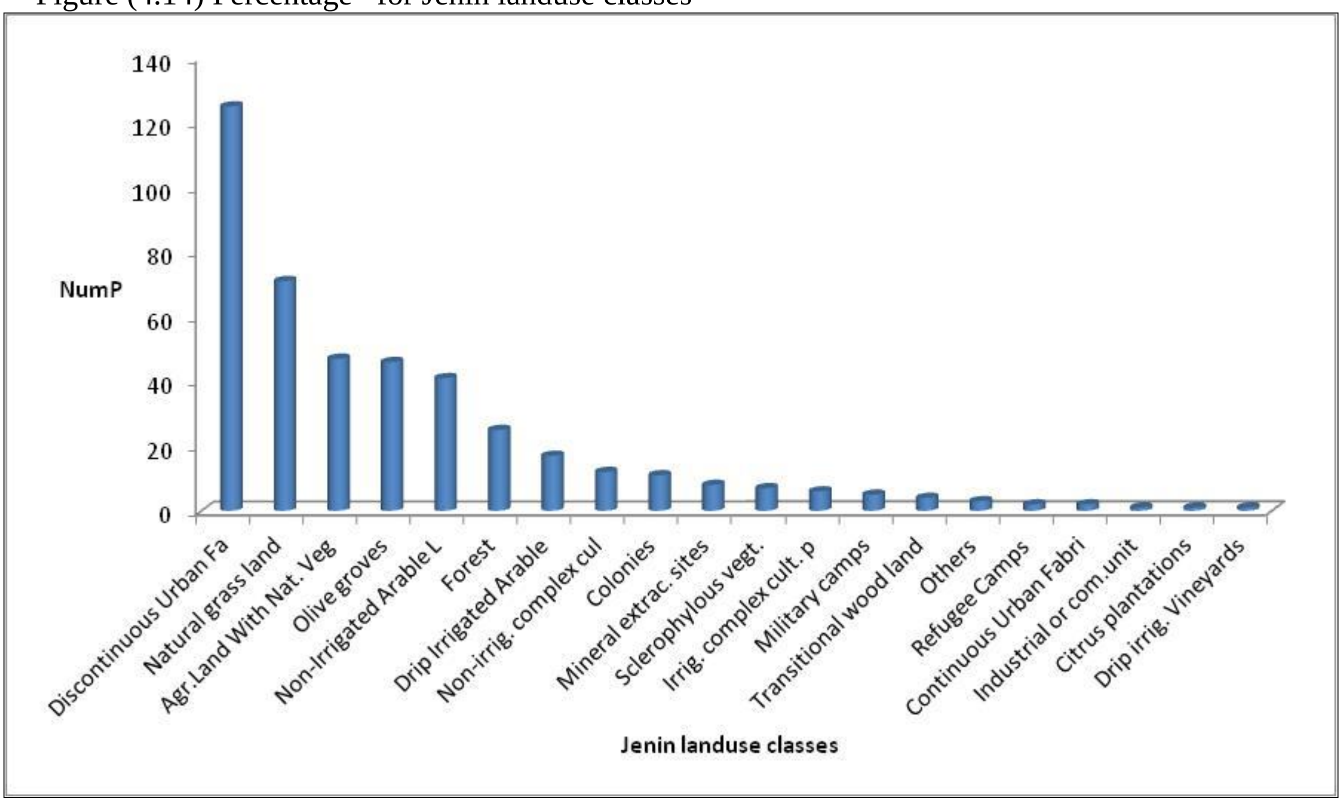


Figure (4.15) Number of patches for Jenin landuse classes

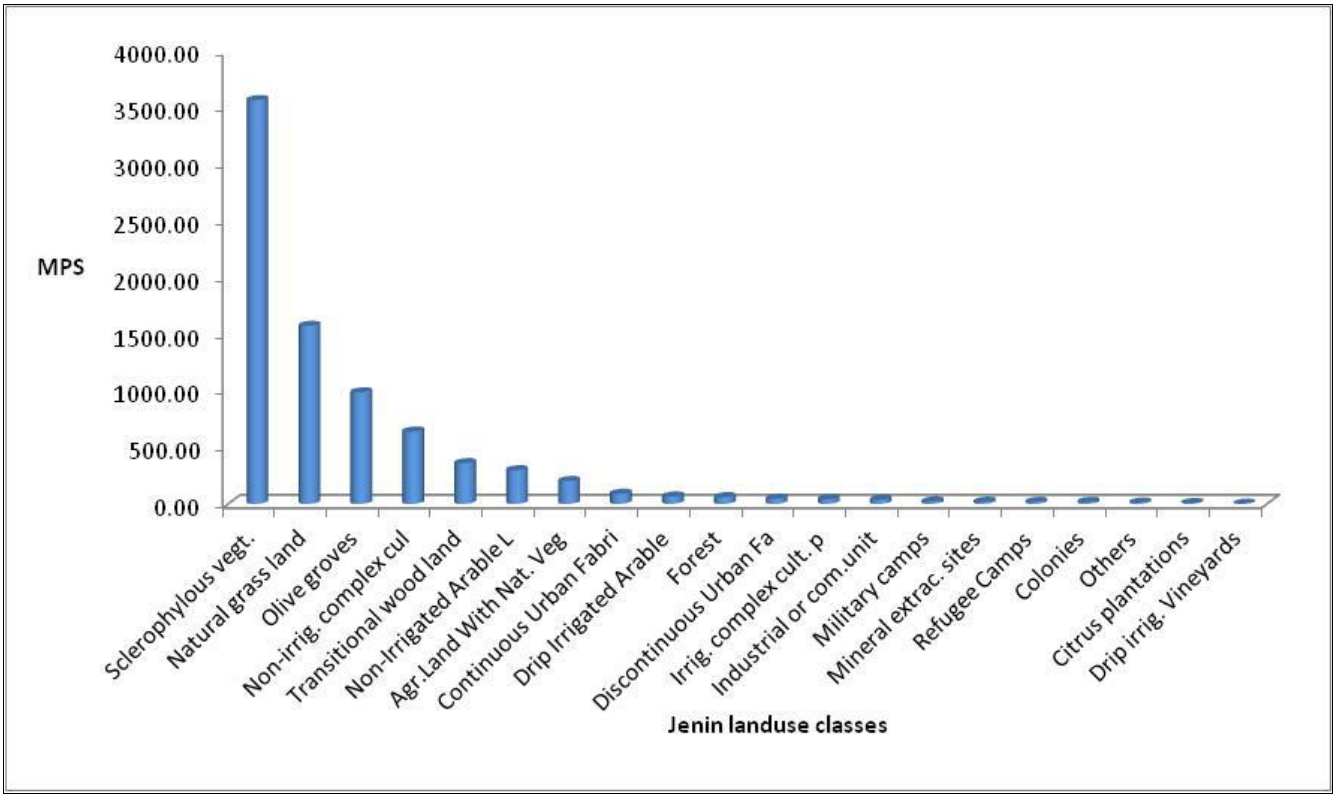


Figure (4.16) Mean patch size (MPS) for Jenin landuse classes at class level

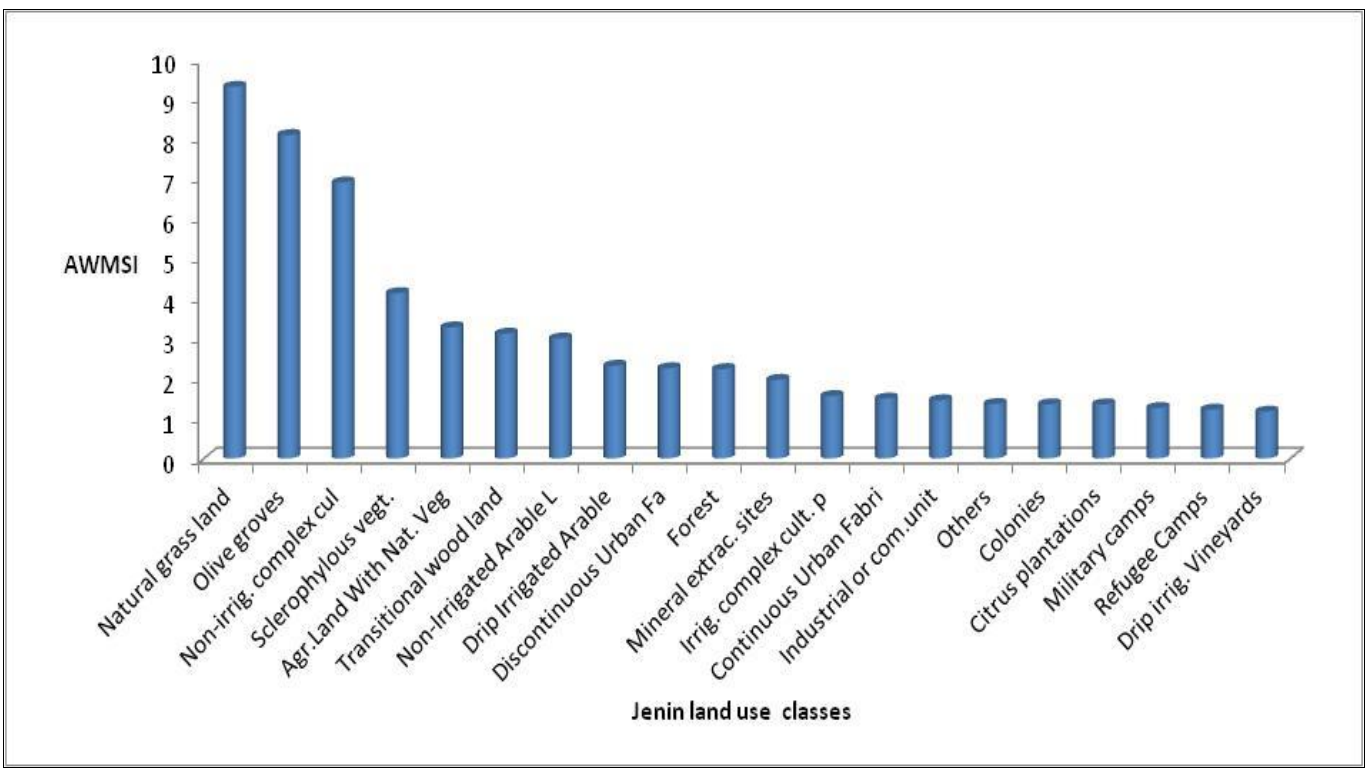


Figure (4.17)Area Weight Mean Shape Index (AWMSI) for Jenin land use classes at class level

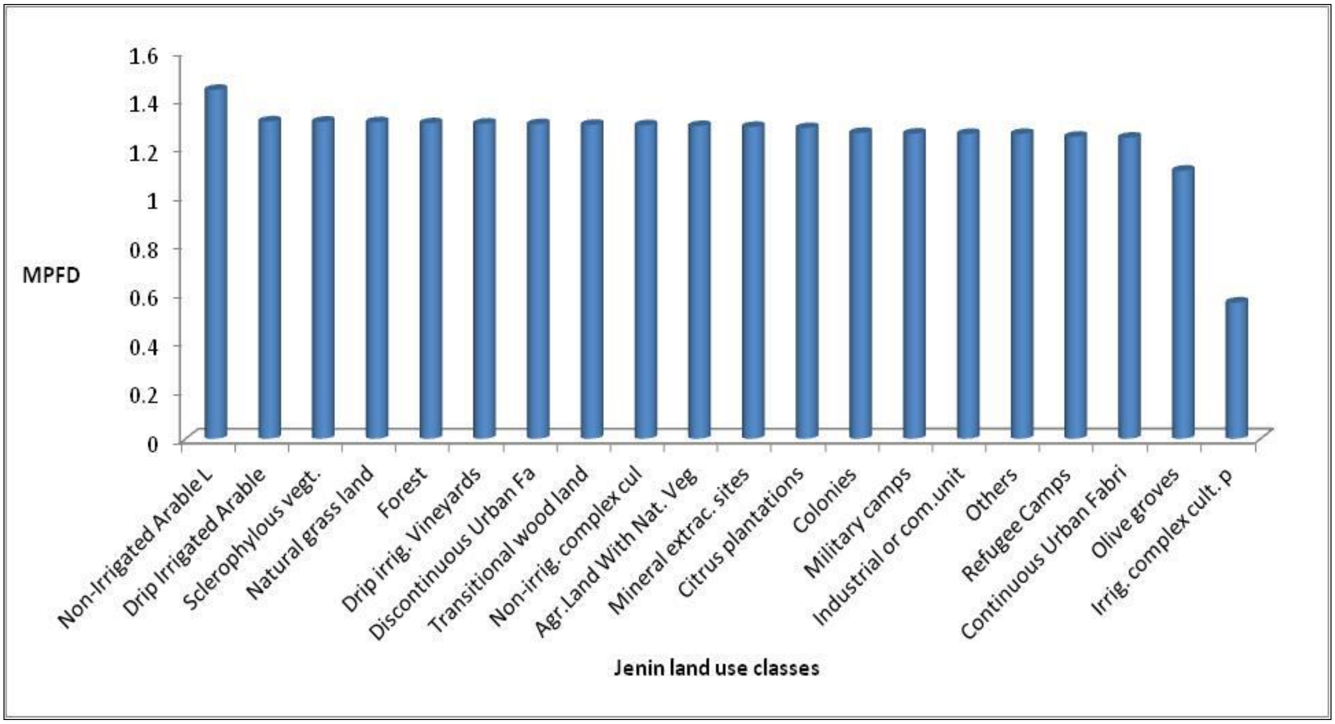


Figure (4.18) Mean Patch Fractal Dimension (MPFD) for Jenin landuse classes at class level

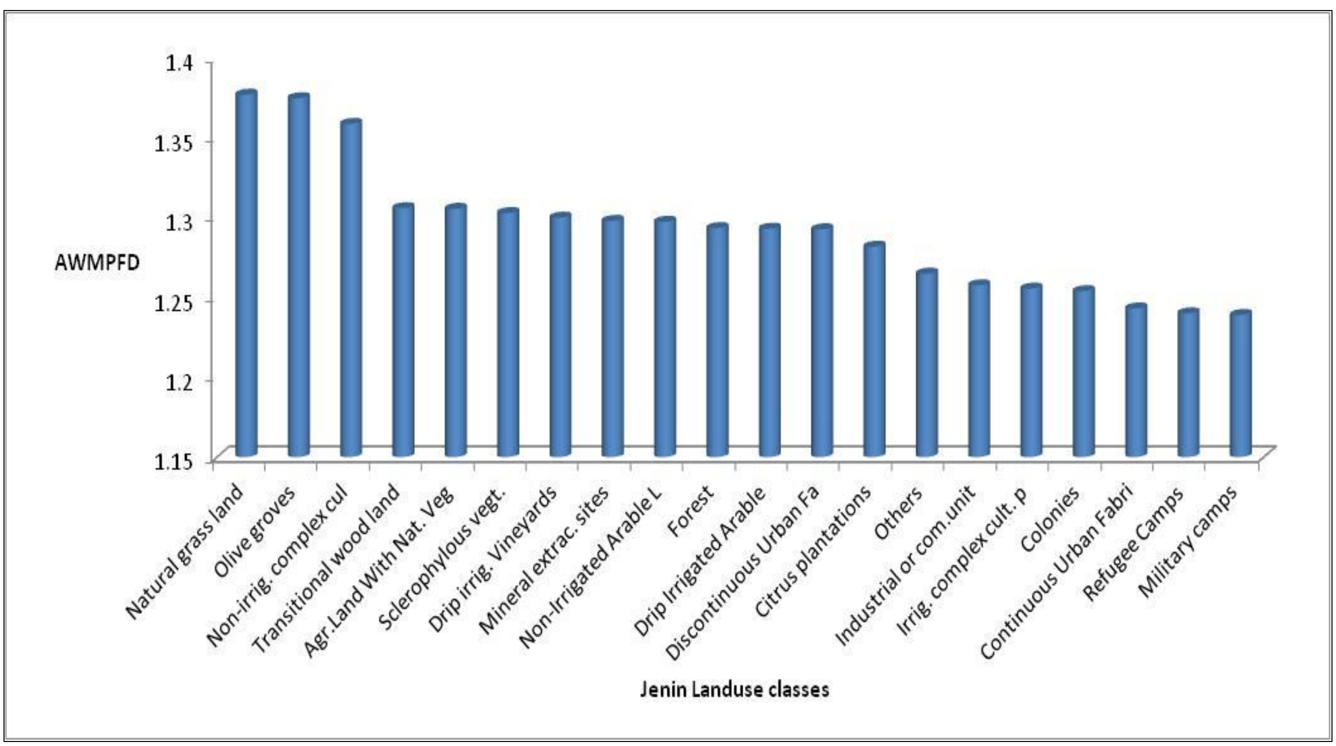


Figure (4.19) Area Weight Mean Patch Fractal Dimension for Jenin landuses classes at class level

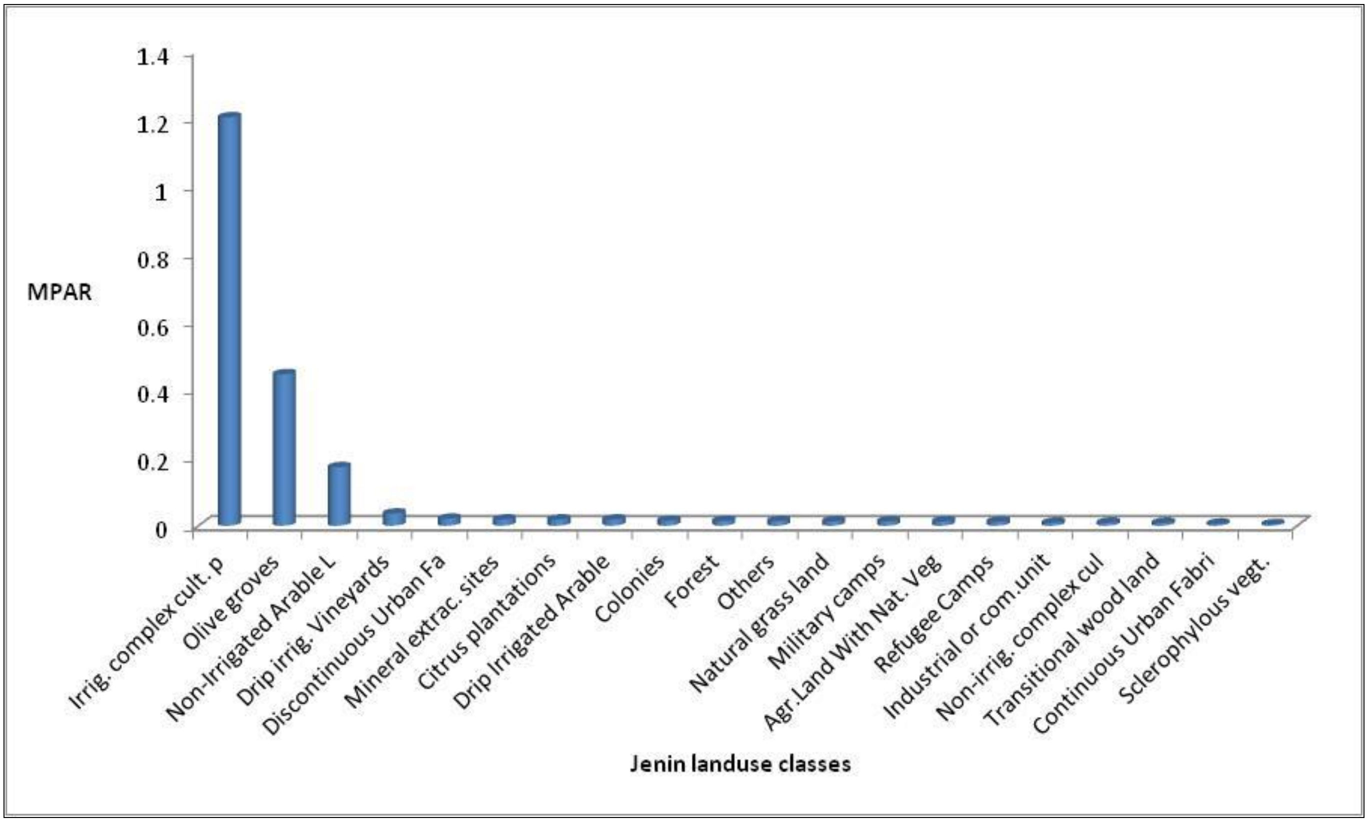


Figure (4.20) Mean Patch Area Ratio (MPAR) for Jenin landuse classes at class level

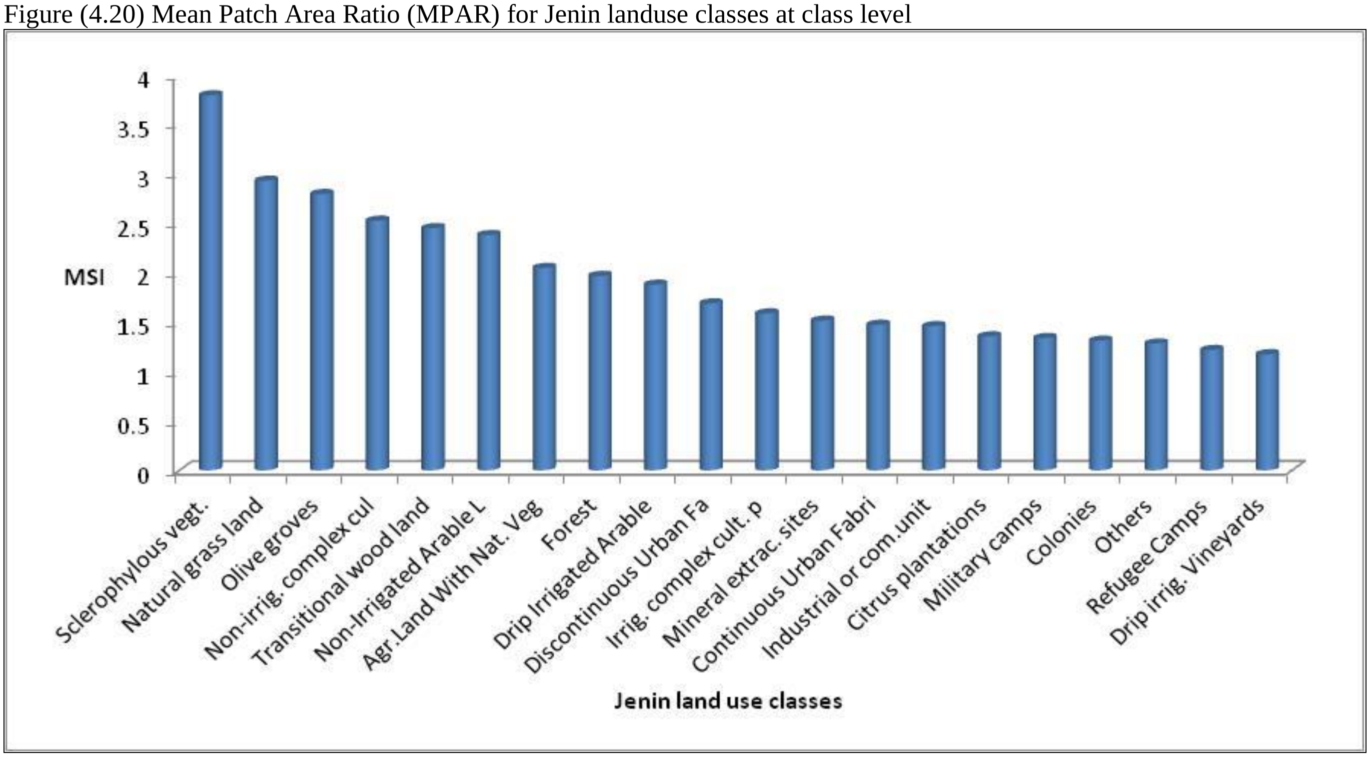


Figure (4.21) Mean Shape Index (MSI) for Jenin landuse classes at class level

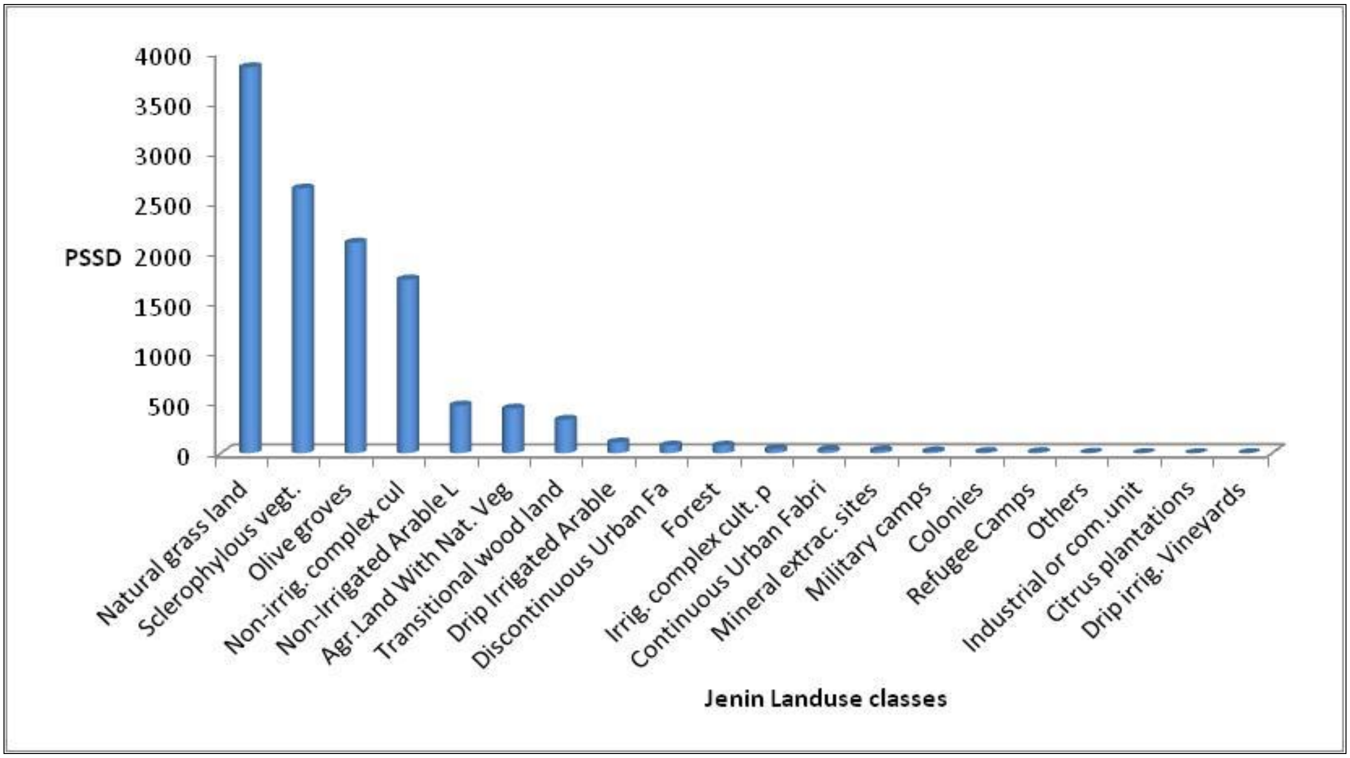


Figure (4.22) Patch size standard Deviation (PSSD) for Jenin landuse classes at class level

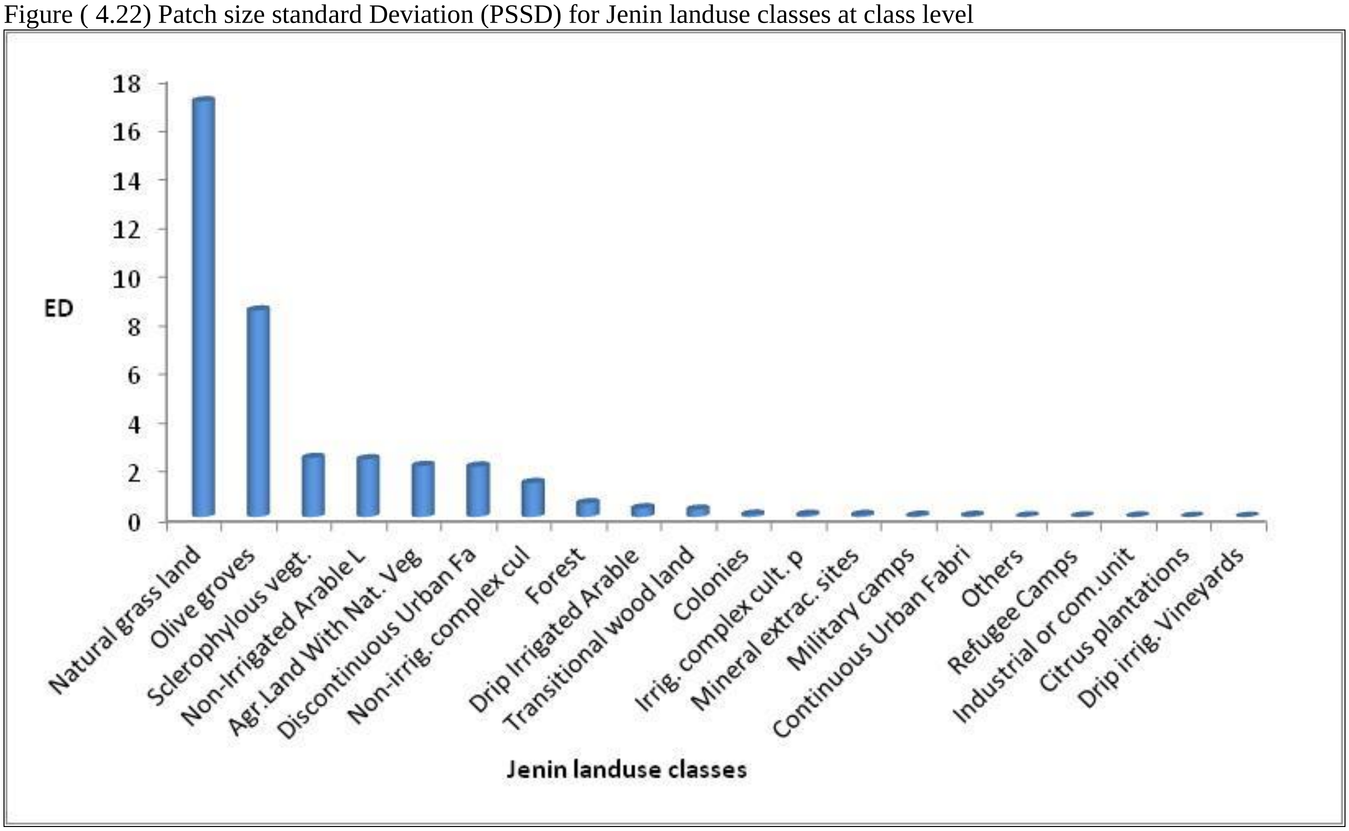


Figure (4.23) Edge Density (ED) for Jenin landuse classes at class level

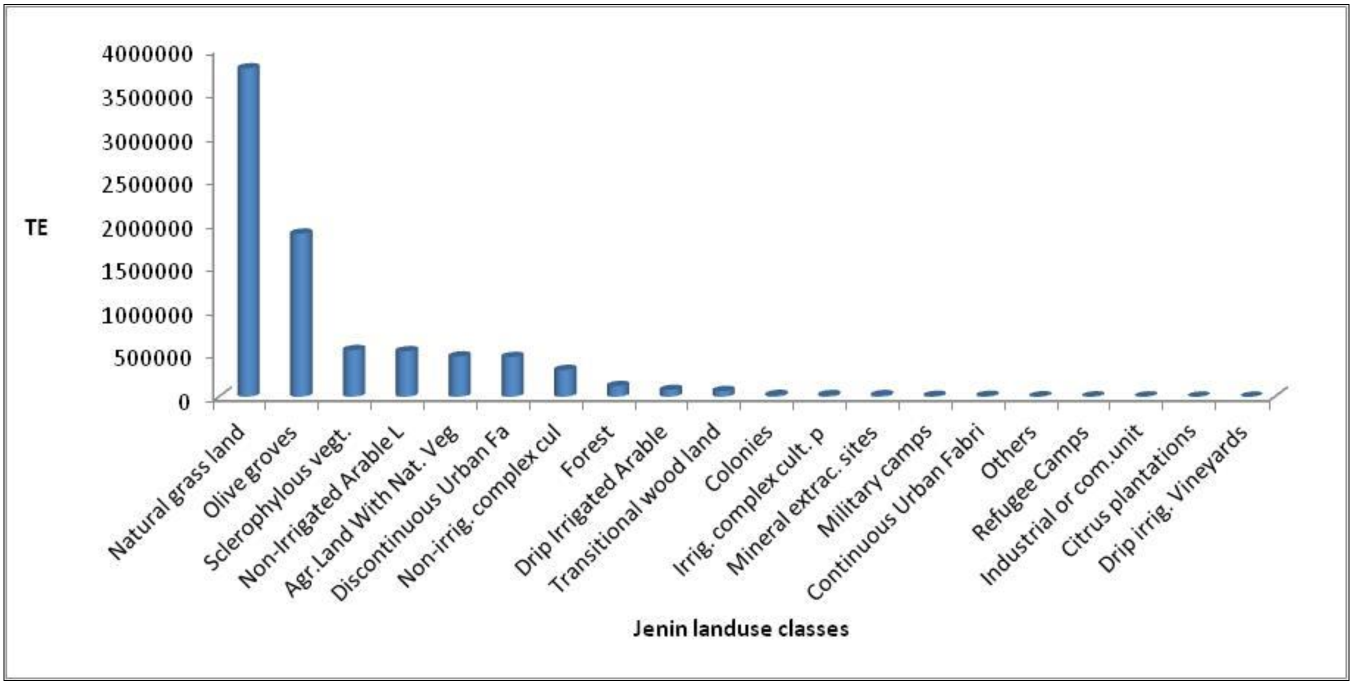


Figure (4.24) Total Edge (TE) for Jenin landuse classes at class level

In Jenin District land use map as shown that there were 20 classes Natural grass land represent the Highest percentage with 50% (111638 Ha) followed by Olive groves represent 20% (45307 Ha) followed by Sclerophylous vegetation 11% (24968 Ha) Forest represent 0.67 % (1488,5 Ha) (the lowest value were for Drip irrigated vineyards .0006% (1,3549) and citrus plantation 0.003% (6,9331 Ha)

Landscape Pattern Analysis (Using Shape Metrics)

Area-Weighted Mean Shape Index (AWMSI) : the calculated index values in AWMSI for classes of Jenin district results show that Natural grass land Have the Highest computed AWMSI of 9.33 followed by Olive groves 8.12 , Forest class constitute 2.24 while Refugee camp and drip irrigated vineyard constitute the lowest value 1.22 , 1.17 Respectively . all calculated index values are greater than one which serve as benchmarks value for patches having complex and irregular shape .

2) **Mean Shape Index (MSI):** The calculated index values for MSI for all classes it can be observed that sclerophylous vegetation got the highest value 3.80 followed by Natural grass land 2.93 and olive groves 2.79 . Forests got the value 1.96 while Refugee camps and drip irrigated vineyards 1.21, 1.17 respectively . It can be observed that the values for all classes greater than one indicate that the patch shape had increasing irregularity and complexity.This indicates a more fragmented and more heterogeneous landscape .

3) **Mean Patch Fractal Dimension (MPFD) :** The computed index value for the land use classes of which Non-irrigated Arable land got the highest value 1.439 followed by Drip irrigated Arable 1.309 and sclerophylous vegetation 1.307 and Natural Grass land 1.306 , forest got the value 1.301 , the classes olive groves and irrigated complex cultivation plants got the lowest value (1.106 and 0.56) respectively .It was observed that the value for classes was greater than one, suggesting a more complex shape, high patch shape irregularity, and a highly fragmented landscape.

Landscape pattern analysis conducted in this study results show that the higher landscape

Metric value indicates that the forest patches were highly fragmented.Connections on isolated patches,mainly through corridor establishment is an excellent option of patches connections is imperative.

4.8 Hebron Landuse Patch analysis results

Hebron District Class	CA	% of each class	NumP	MPS	PSCoV	PSSD	TE	ED	MPE	MSI	AWMSI	MPAR	MPFD	AWMPFD
Non-Irrigated Arable L	4942.61	2.30	82	60.28	202.88	122.29	422980.5	1.97	5158.30	2.01	2.93	0.03	1.32	1.31
Agr.Land With Nat. Veg	22123.36	10.31	138	160.31	467.08	748.80	1463153	6.82	10602.56	2.28	7.13	0.04	1.33	1.37
Forest	1461.48	0.68	42	34.80	178.08	61.97	139917	0.65	3331.36	1.67	2.39	0.02	1.29	1.30
Discontinuous Urban Fa	16023.76	7.47	315	50.87	466.89	237.50	1559609	7.27	4951.14	2.04	5.10	0.03	1.33	1.37
Natural grass land	47752.19	22.25	106	450.49	580.70	2616.01	1702488	7.93	16061.20	2.28	8.15	0.10	1.37	1.36
Olive groves	3394.58	1.58	76	44.67	239.87	107.14	366756.1	1.71	4825.74	1.97	3.84	0.02	1.31	1.34
Non-irrig. complex cul	6042.54	2.82	65	92.96	175.87	163.50	508157.8	2.37	7817.81	2.24	3.62	0.04	1.32	1.33
Colonies	1363.31	0.64	38	35.88	97.77	35.08	123050.1	0.57	3238.16	1.53	1.86	0.01	1.27	1.28
Mineral extrac. sites	836.53	0.39	21	39.83	94.21	37.53	97025.21	0.45	4620.25	2.02	2.51	0.01	1.30	1.32
Sparsely veg. area	84944.33	39.58	4	21236.08	172.74	36682.23	695201.6	3.24	173800.39	2.85	6.61	0.01	1.28	1.31
Construction sites	14.20	0.01	1	14.20	0.00	0.00	1650.417	0.01	1650.42	1.24	1.24	0.01	1.25	1.25
Transitional wood land	391.41	0.18	11	35.58	68.27	24.29	37673.59	0.18	3424.87	1.65	1.76	0.01	1.28	1.28
Vineyards	24613.15	11.47	47	523.68	298.77	1564.63	1731171	8.07	36833.42	3.26	13.24	0.02	1.34	1.43
Military camps	33.84	0.02	1	33.84	0.00	0.00	2798.871	0.01	2798.87	1.36	1.36	0.01	1.25	1.25
Continuous Urban Fabri	131.37	0.06	1	131.37	0.00	0.00	10065.8	0.05	10065.80	2.48	2.48	0.01	1.31	1.31
Drip Irrigated Arable	209.37	0.10	10	20.94	88.46	18.52	24794.79	0.12	2479.48	1.63	1.74	0.02	1.30	1.29
Industrial or com.unit	81.10	0.04	2	40.55	82.73	33.55	6905.622	0.03	3452.81	1.65	1.78	0.01	1.29	1.28
Fruit trees&berry plan	206.25	0.10	8	25.78	126.24	32.55	24283.71	0.11	3035.46	1.88	2.16	0.02	1.32	1.30
Citrus plantations	0.68	0.00	1	0.68	0.00	0.00	340.752	0.00	340.75	1.17	1.17	0.05	1.32	1.32
Irrig. complex cult. p	54.47	0.03	1	54.47	0.00	0.00	4467.682	0.02	4467.68	1.71	1.71	0.01	1.27	1.27

**** TLA = 214620.5374 Ha

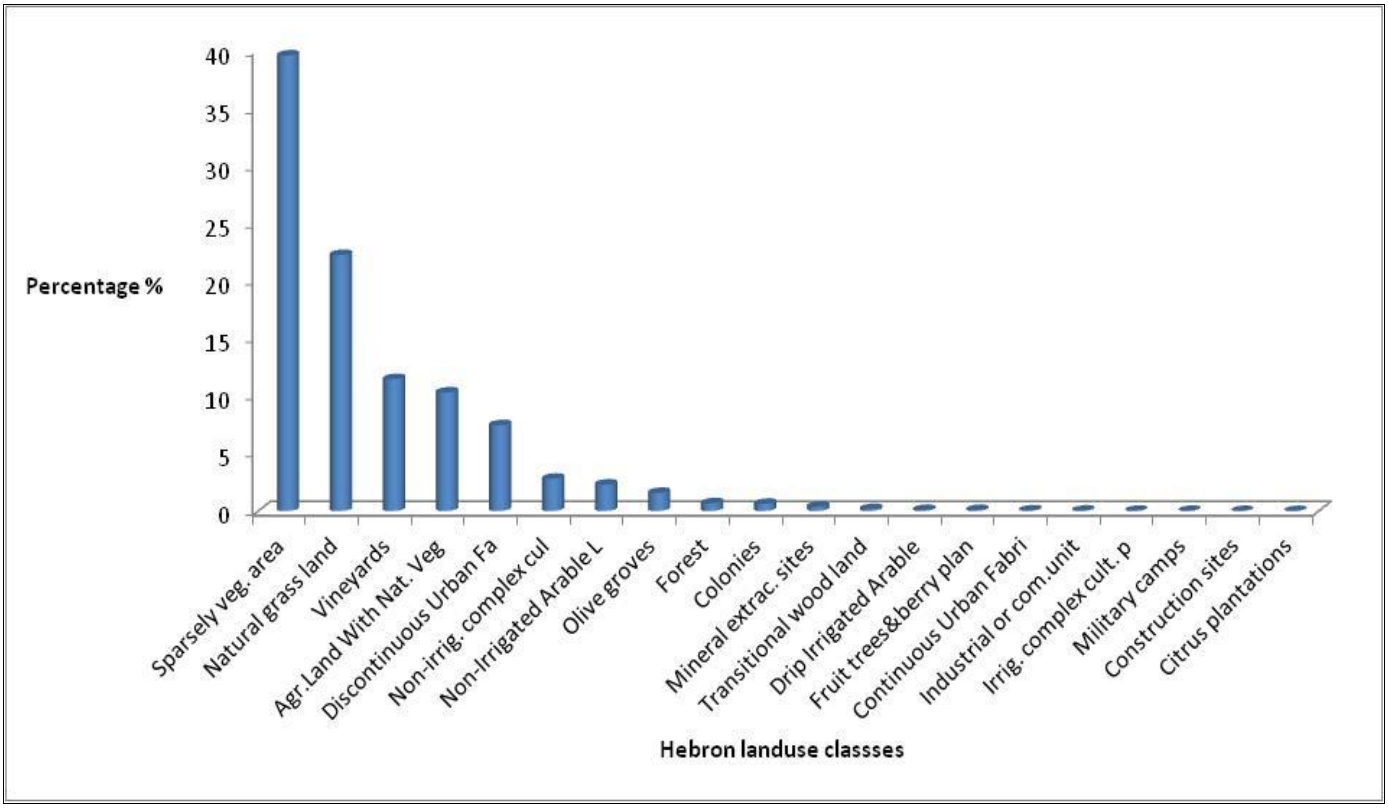


Figure (4.25) Percentage for each class of Hebron landuse classes

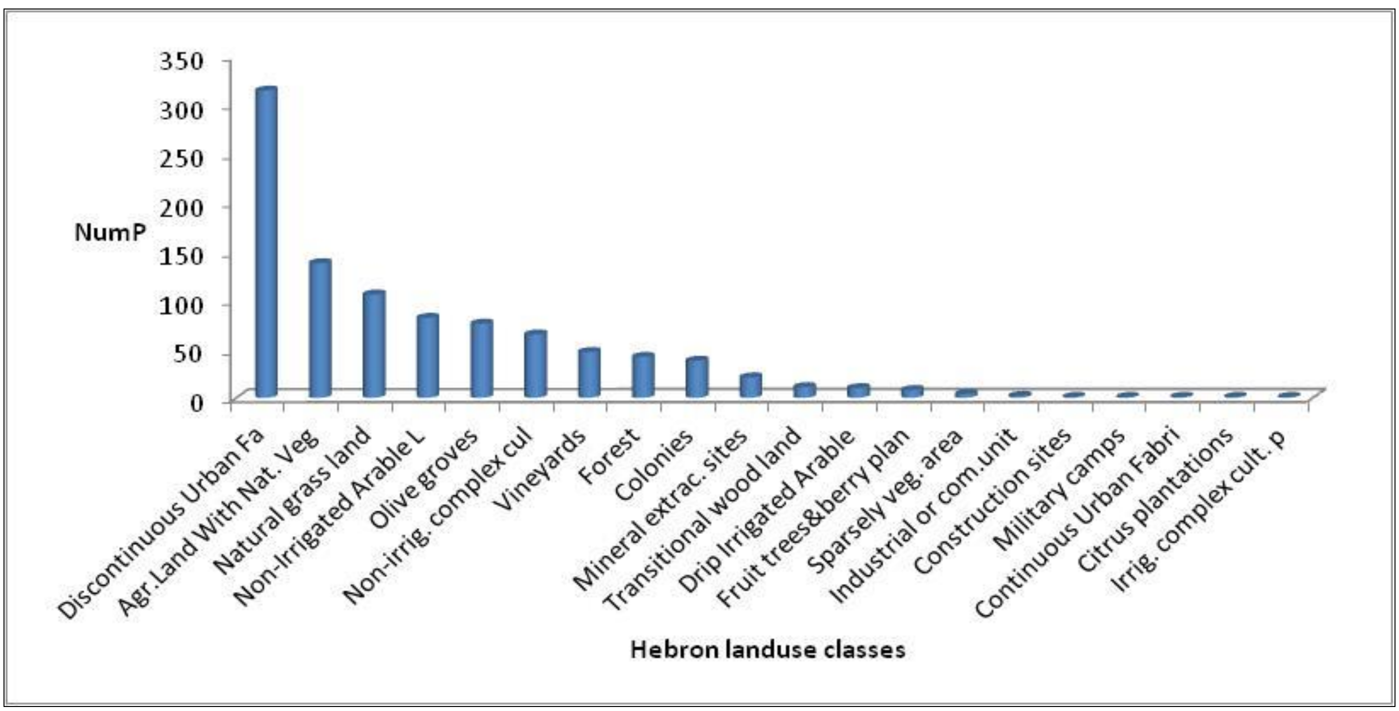


Figure (4.26) Number of patches for Hebron landuse classes at class level

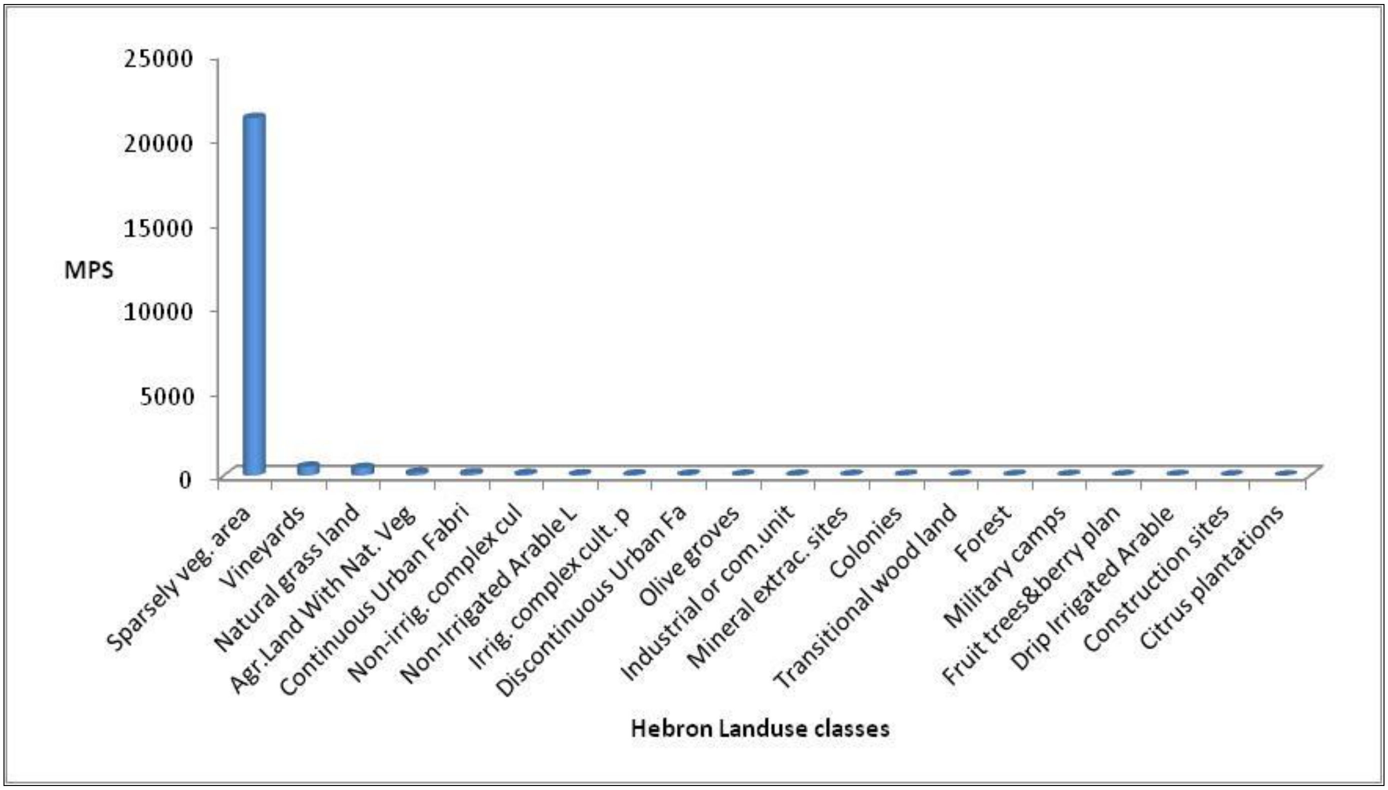


Figure (4.27) Mean Patch Size (MPS) for Hebron landuse classes at Class level

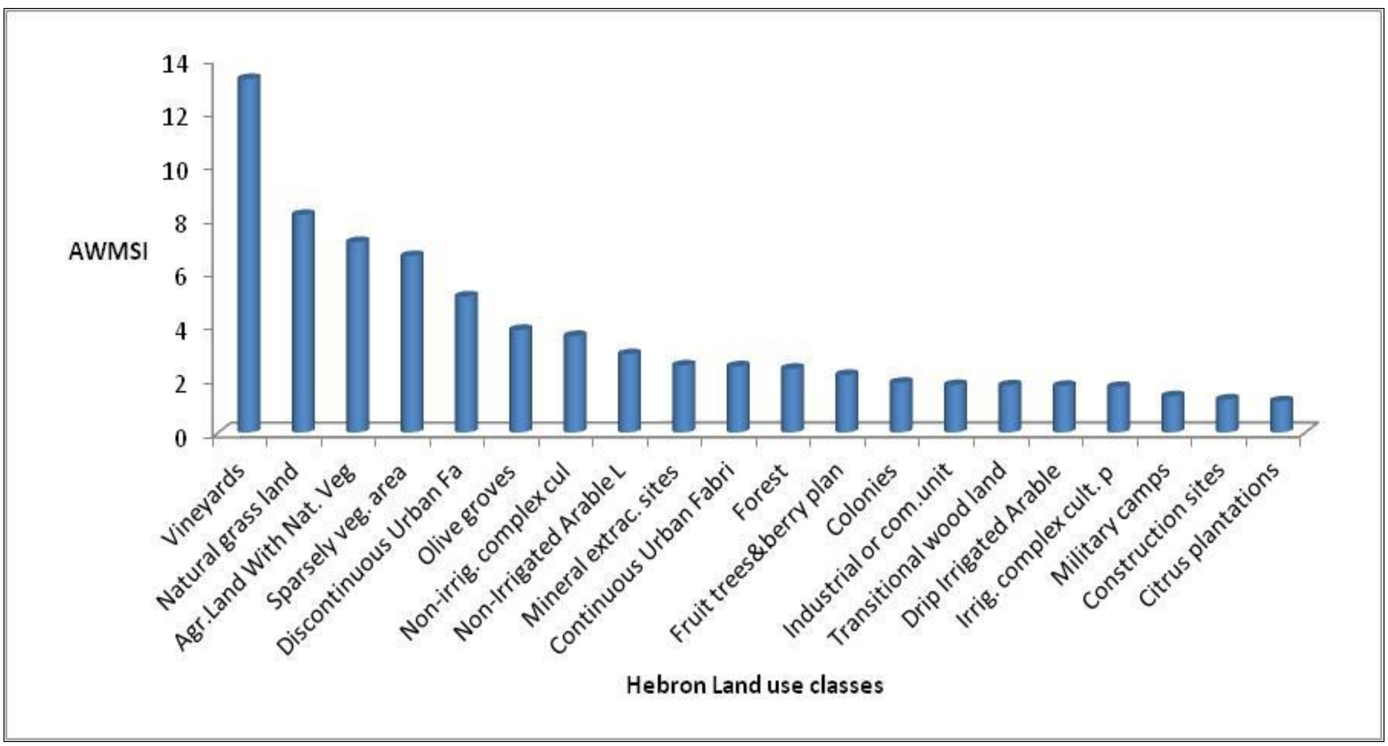


Figure (4.28) Area Weight Mean Shape Index (AWMSI) for Hebron landuse classes at class level

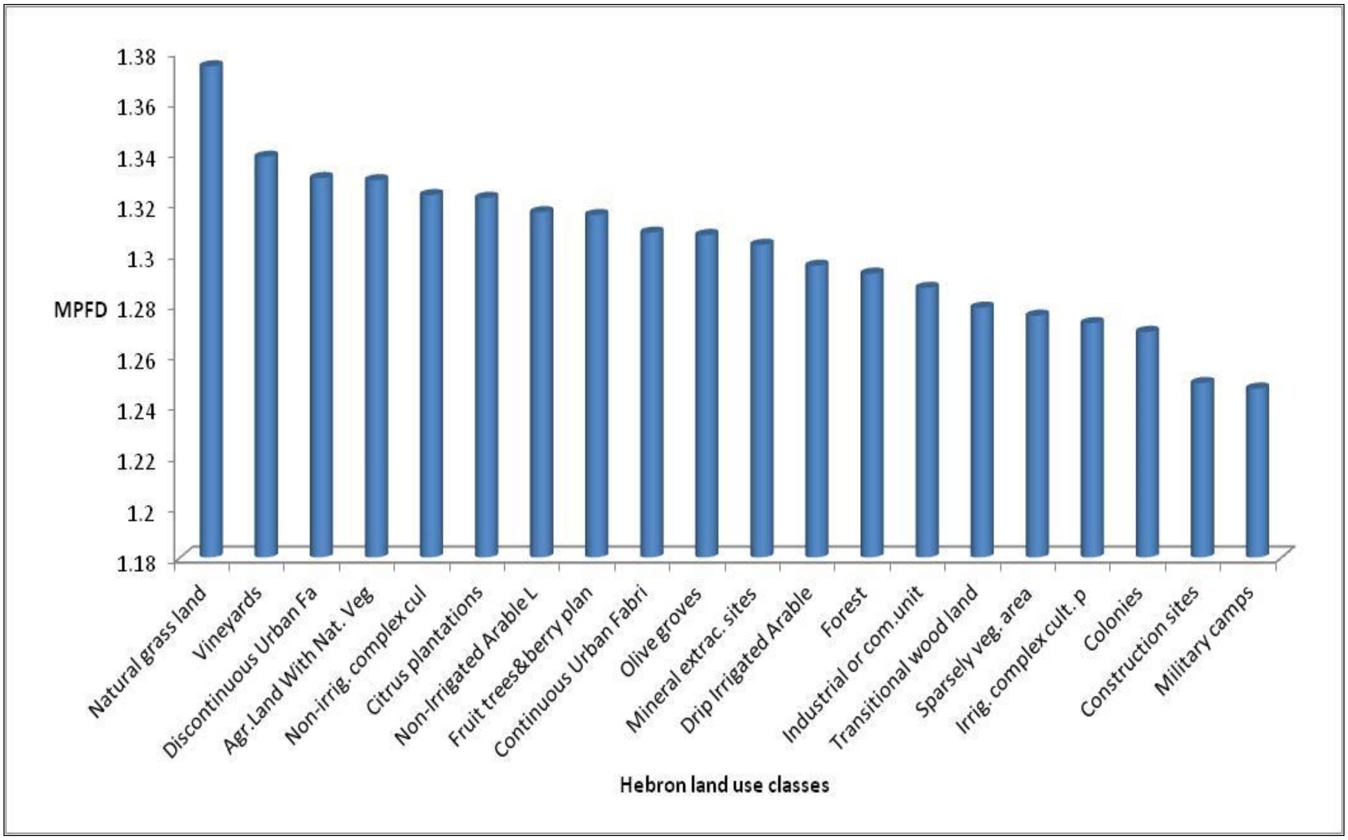


Figure (4.29) Mean Patch Fractal Dimension (MPFD) for Hebron landuse classes at class level

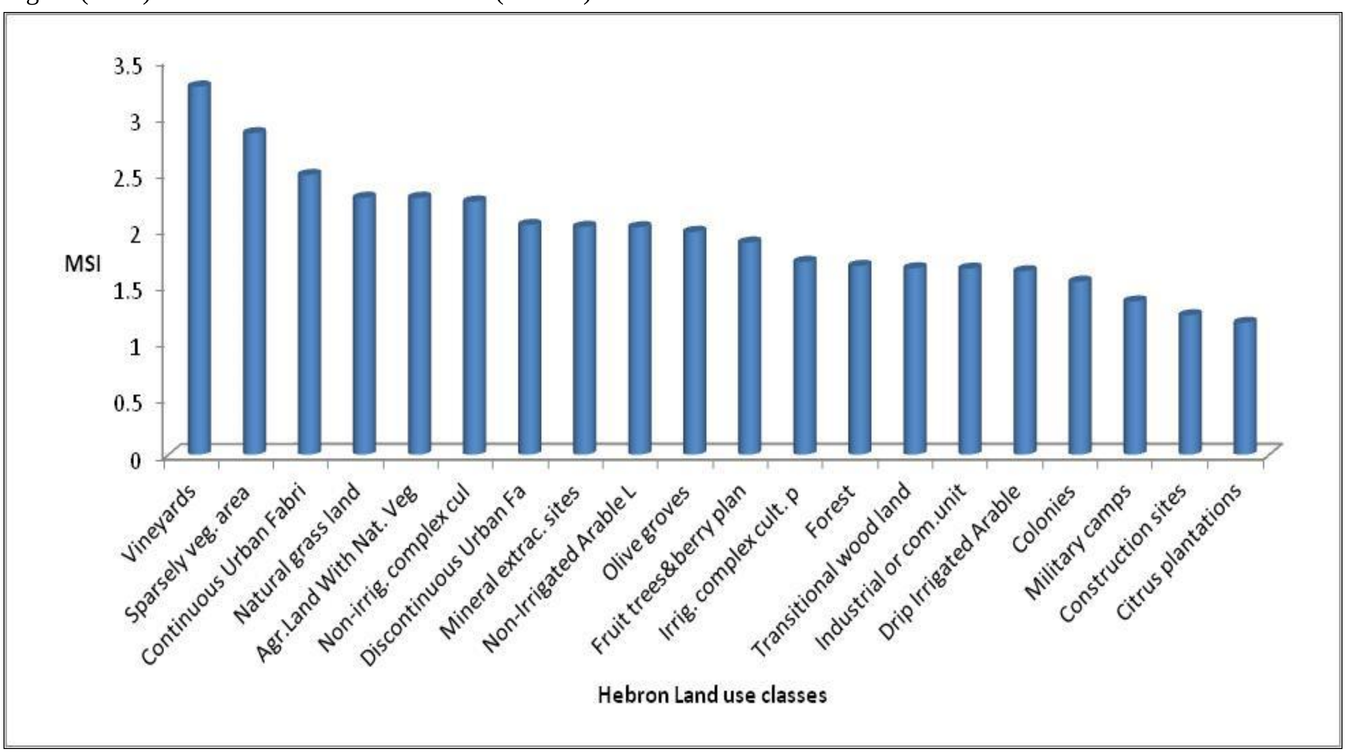


Figure (4.30)Mean Shape index (MSI) for Hebron landuse classes at class level

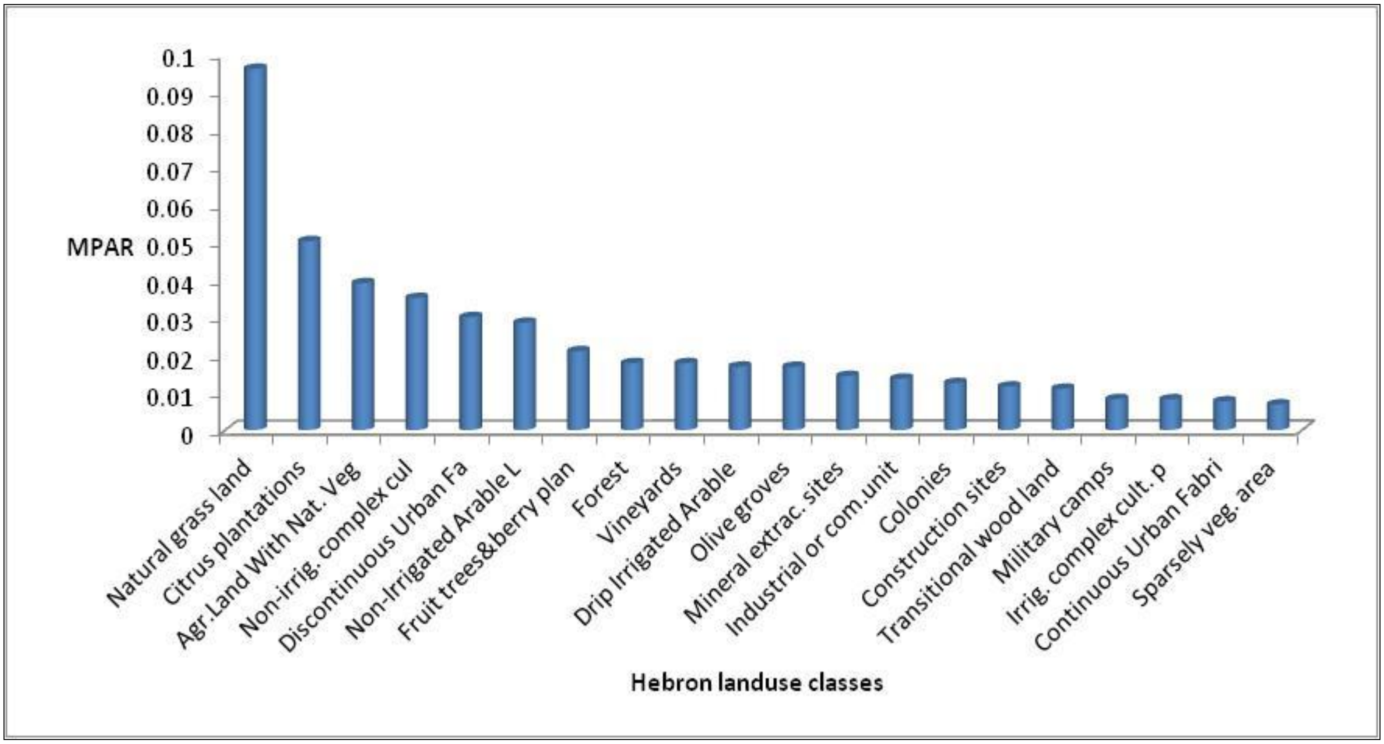


Figure (4.31) Mean Patch Area Ratio (MPAR) for Hebron landuse classes at class level

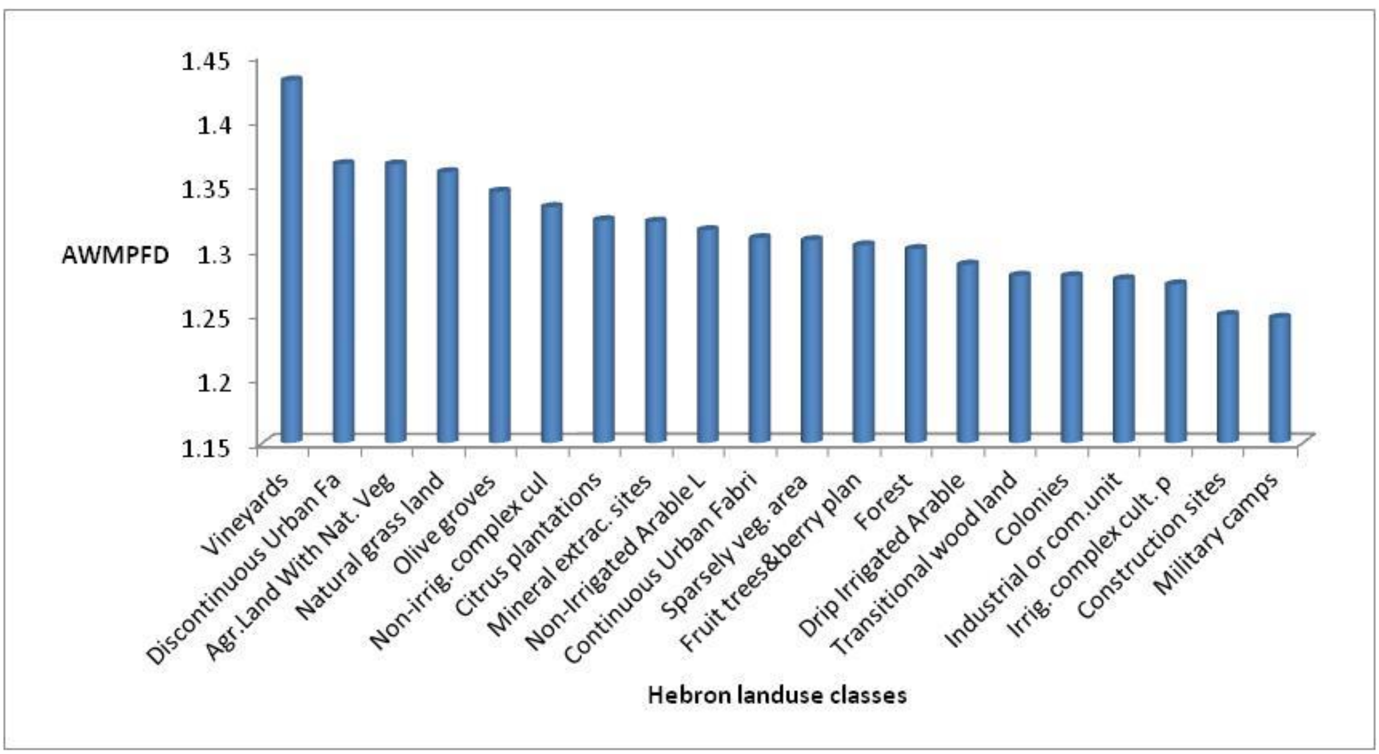


Figure (4.32) Area Weight Mean Patch Fractal Dimension (AWMPFD) for Hebron landuse classes at class level

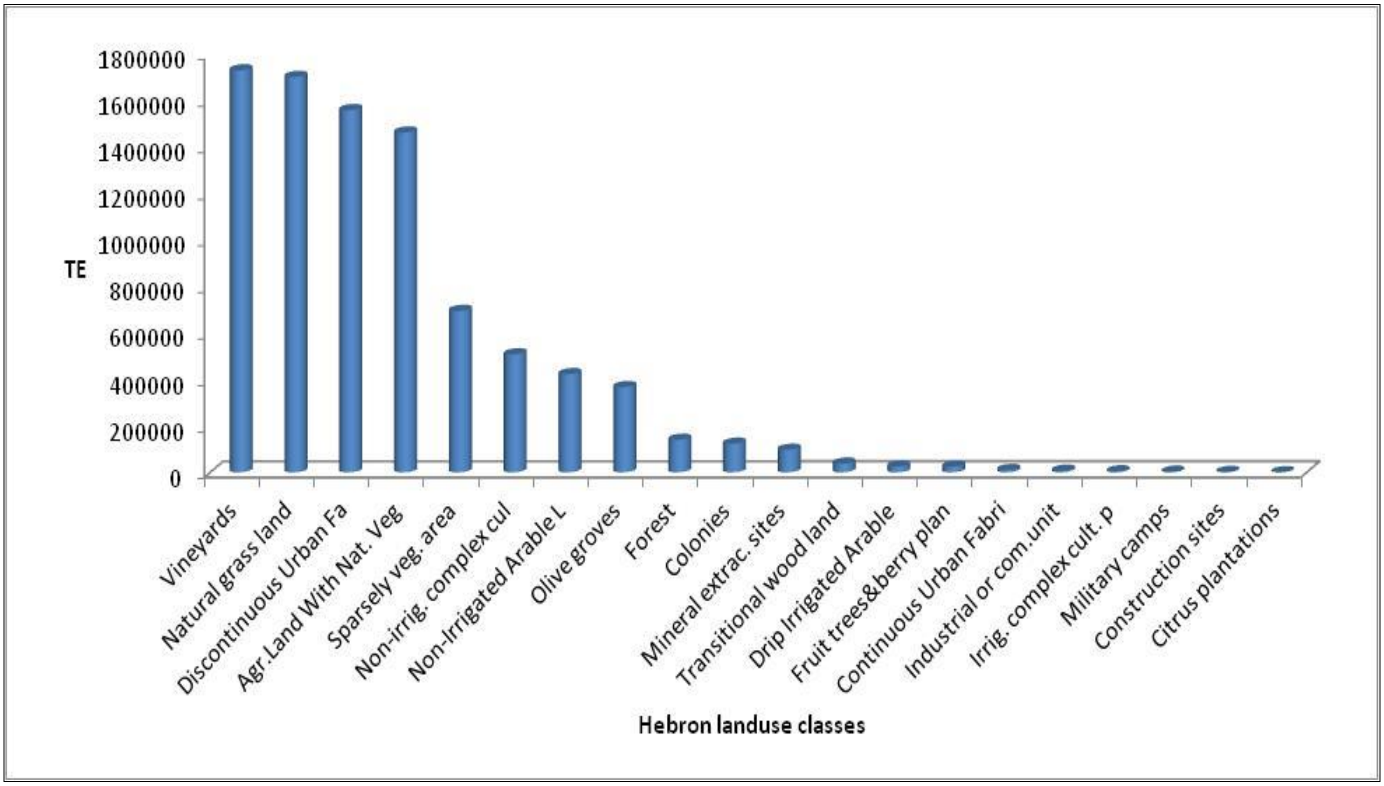


Figure (4.33) Total Edge (TE) For Hebron landuse classes at class level

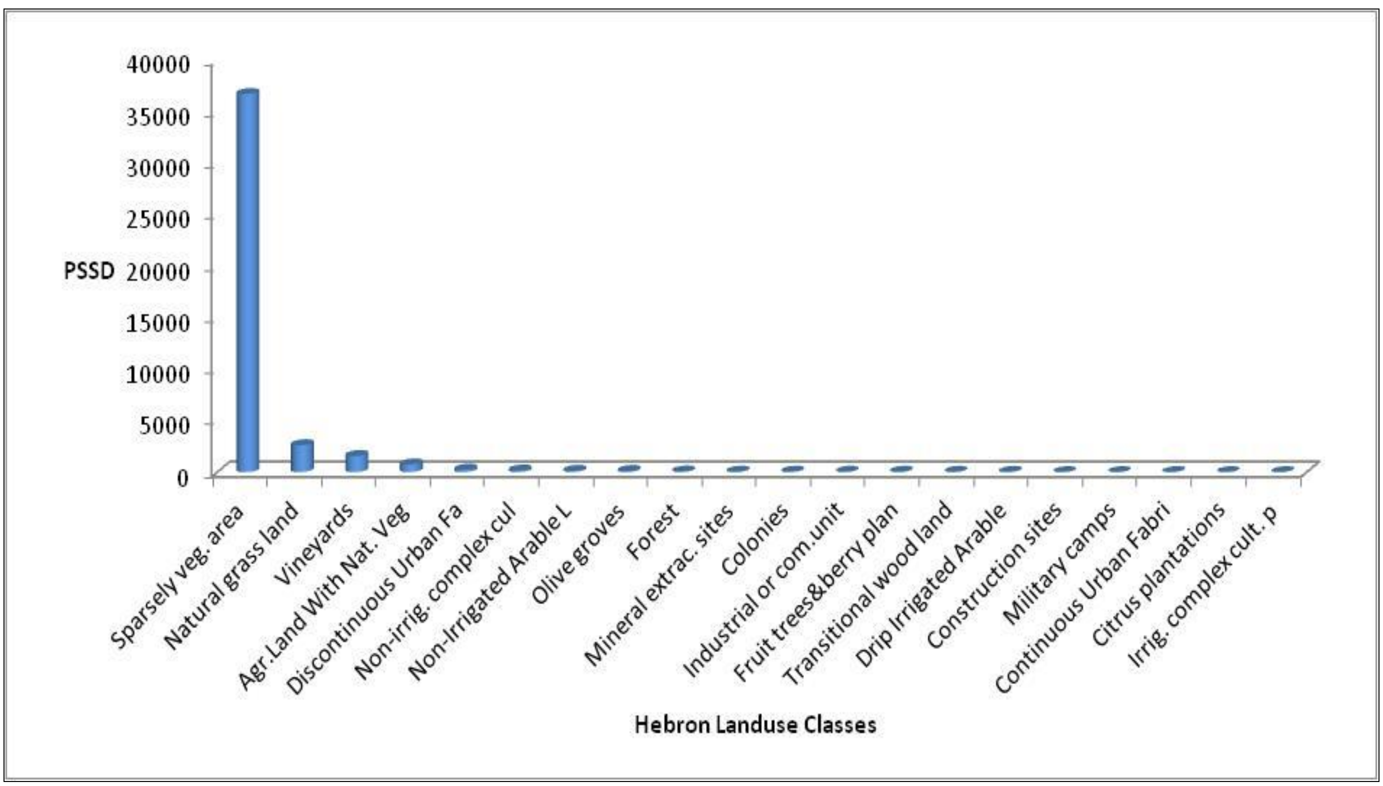


Figure (4.34)Patch size Standard Deviation (PSSD) for Hebron landuse classes at class level

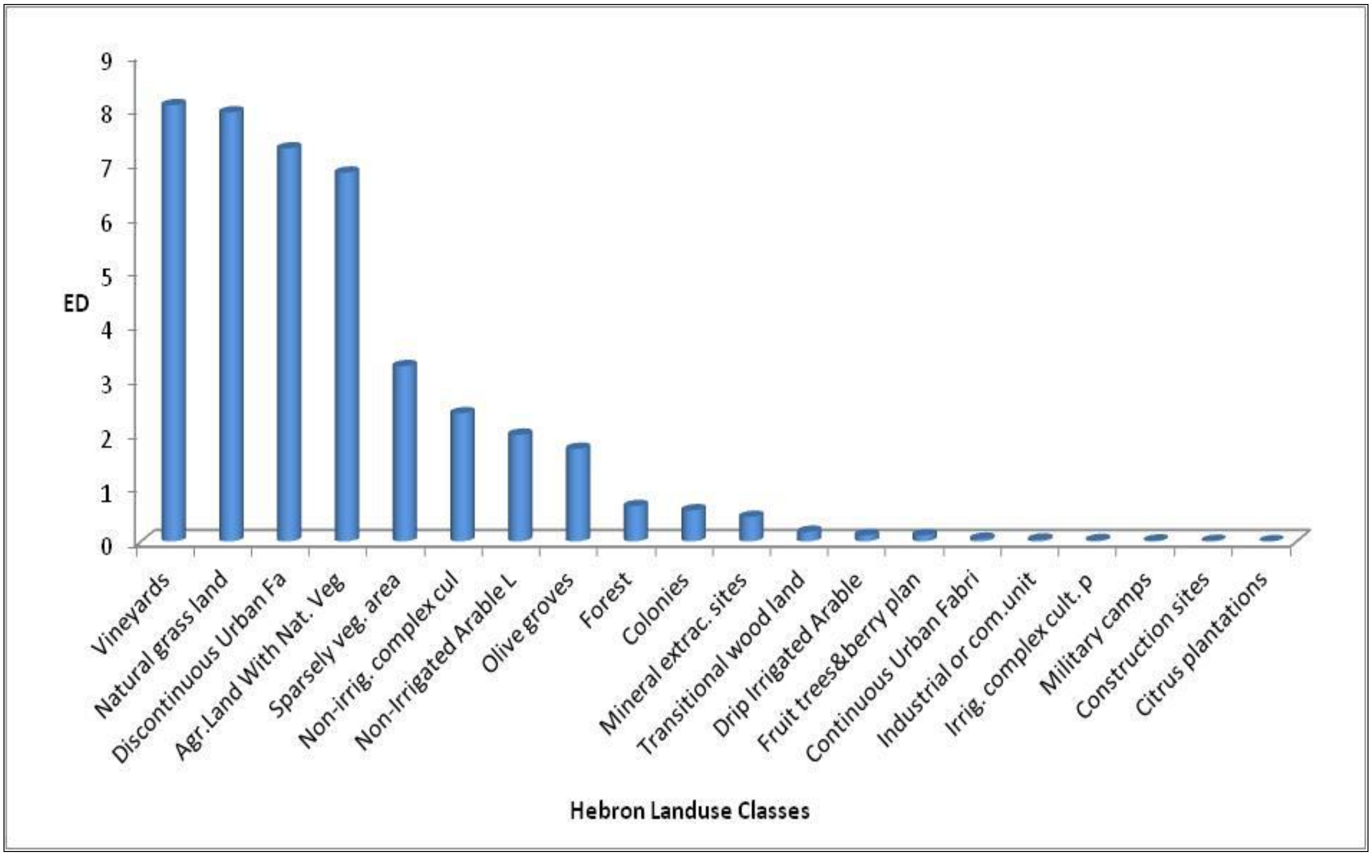


Figure (4.35) Edge Density for Hebron land use classes at class level

In Hebron District land use map shows 20 classes sparsely vegetation area represent the highest percentage around 39 % with area (84944Ha) followed by Natural Grass land 22% (47752Ha) and Vineyard 11 % While forest represent 0.68 % with area (1461 Ha) , Construction sites and citrus plantation show the lowest values 0.0066 , 0.0003 with area (14, Ha) , (0.66 Ha) respectively .

The Results for area weight mean shape index (AWMSI) The highest value for Vineyards class 13.23 followed by Natural grass land 8.14 and Agricultural land with natural vegetation 7.13 .

Forest value 2.38 while construction site (1.23), Citrus plantation (1.16) show the lowest value. All calculated index values are greater than one which serves as benchmarks value for patches having complex and irregular shape

Mean Shape Index (MSI): Vineyards has the highest value 3.26 followed by sparsely vegetation area 2.84, continuous urban fabri 2.47 while forest value 1.67 and the lowest value for construction sites 1.23 and citrus plantation 1.16. It can be observed that the values for all classes greater than one indicate that the patch shape had increasing irregularity and complexity. This indicates a more fragmented and more heterogeneous landscape.

Mean Patch Fractal Dimension (MPFD): The Natural grass land 1.374 was the highest Class value followed by Vineyards 1.338 and Discontinuous urban fa 1.330.

Forests 1.292 while construction sites 1.248 and Military camps 1.246. It was observed that the value for classes was greater than one, suggesting a more complex shape, high patch shape irregularity, and a highly fragmented landscape.

4.9 Jericho land use patch analysis results

Class / Jericho	CA	%	NumP	MPS	PSCoV	PSSD	TE	ED	MPE	MSI	AWMSI	MPAR	MPFD	AWMPFD
Discontinuous Urban Fa	1067.50	0.11	31	34.44	268.06	92.31	101001.36	0.10	3258.11	1.71	2.72	0.02	1.30	1.31
Agr.Land With Nat. Veg	908.62	0.09	9	100.96	101.29	102.26	62326.77	0.06	6925.20	2.12	2.22	0.01	1.30	1.29
Natural grass land	341385.59	35.17	30	11379.52	161.10	18332.02	8933519.74	9.20	297783.99	6.72	14.21	0.01	1.37	1.40
Irrig. complex cult. p	4847.01	0.50	34	142.56	175.68	250.44	273122.42	0.28	8033.01	1.97	2.76	0.01	1.28	1.30
Drip Irrigated Arable	2937.26	0.30	19	154.59	125.44	193.92	148407.37	0.15	7810.91	1.78	2.50	0.01	1.26	1.28
Non-Irrigated Arable L	1555.32	0.16	18	86.41	100.91	87.19	111510.28	0.11	6195.02	1.91	2.36	0.01	1.29	1.30
Colonies	1094.93	0.11	36	30.41	93.80	28.53	85945.41	0.09	2387.37	1.33	1.41	0.01	1.26	1.24
Drip irrig. Vineyards	1489.78	0.15	5	297.96	140.63	419.03	96295.58	0.10	19259.12	2.99	4.72	0.01	1.32	1.35
Vineyards	22.48	0.00	1	22.48	0.00	0.00	2056.80	0.00	2056.80	1.22	1.22	0.01	1.24	1.24
Bare rock	1303.55	0.13	5	260.71	127.36	332.03	96752.57	0.10	19350.51	3.02	4.98	0.01	1.32	1.36
Sparsely veg. area	460005.67	47.39	25	18400.23	181.44	33385.13	4354100.53	4.49	174164.02	3.79	6.54	0.01	1.31	1.31
Industrial or com.unit	25.06	0.00	1	25.06	0.00	0.00	3513.54	0.00	3513.54	1.98	1.98	0.01	1.31	1.31
Forest	25.89	0.00	1	25.89	0.00	0.00	2919.53	0.00	2919.53	1.62	1.62	0.01	1.28	1.28
Sport&leisture facilit	13.04	0.00	1	13.04	0.00	0.00	1687.55	0.00	1687.55	1.32	1.32	0.01	1.26	1.26
Halophytes	3029.85	0.31	11	275.44	75.66	208.40	138116.18	0.14	12556.02	2.11	2.46	0.01	1.27	1.28
Water bodies	34.55	0.00	2	17.28	30.70	5.30	3287.17	0.00	1643.59	1.12	1.14	0.01	1.23	1.23
Salt marshes	709.41	0.07	8	88.68	57.07	50.61	69745.49	0.07	8718.19	2.45	3.01	0.01	1.30	1.32
Palm groves	469.65	0.05	11	42.70	65.18	27.83	36427.45	0.04	3311.59	1.50	1.54	0.01	1.26	1.26
Olive groves	712.80	0.07	10	71.28	140.46	100.12	50906.41	0.05	5090.64	1.86	2.20	0.01	1.29	1.29
Construction sites	755.29	0.08	2	377.65	50.77	191.73	156703.92	0.16	78351.96	11.05	12.43	0.02	1.48	1.49
Military camps	71.37	0.01	2	35.69	13.59	4.85	5106.86	0.01	2553.43	1.20	1.22	0.01	1.23	1.23
Continuous Urban Fabri	23.16	0.00	1	23.16	0.00	0.00	3608.42	0.00	3608.42	2.12	2.12	0.02	1.33	1.33
Refugee Camps	262.24	0.03	2	131.12	31.04	40.71	13381.59	0.01	6690.79	1.63	1.70	0.01	1.25	1.25
Salines	78.24	0.01	3	26.08	41.33	10.78	7396.46	0.01	2465.49	1.42	1.35	0.01	1.26	1.25
Others	97.94	0.01	6	16.32	22.67	3.70	13829.37	0.01	2304.89	1.59	1.65	0.01	1.28	1.29
Beaches, dunes&sand pl	3008.10	0.31	2	1504.05	0.00	0.00	73757.96	0.08	36878.98	2.68	2.68	0.00	1.27	1.27
Sea and ocean	144249.72	14.86	8	18031.21	0.00	0.00	687115.70	0.71	85889.46	1.80	1.80	0.00	1.20	1.20
Pannana Plantation	33.85	0.00	3	11.28	104.85	11.83	3951.82	0.00	1317.27	1.34	1.22	0.02	1.28	1.24
Citrus plantations	361.47	0.04	4	90.37	108.65	98.18	24200.60	0.02	6050.15	1.86	2.34	0.01	1.29	1.29
Non-irrig. complex cul	47.12	0.00	2	23.56	63.49	14.96	4877.12	0.01	2438.56	1.60	1.43	0.02	1.29	1.26

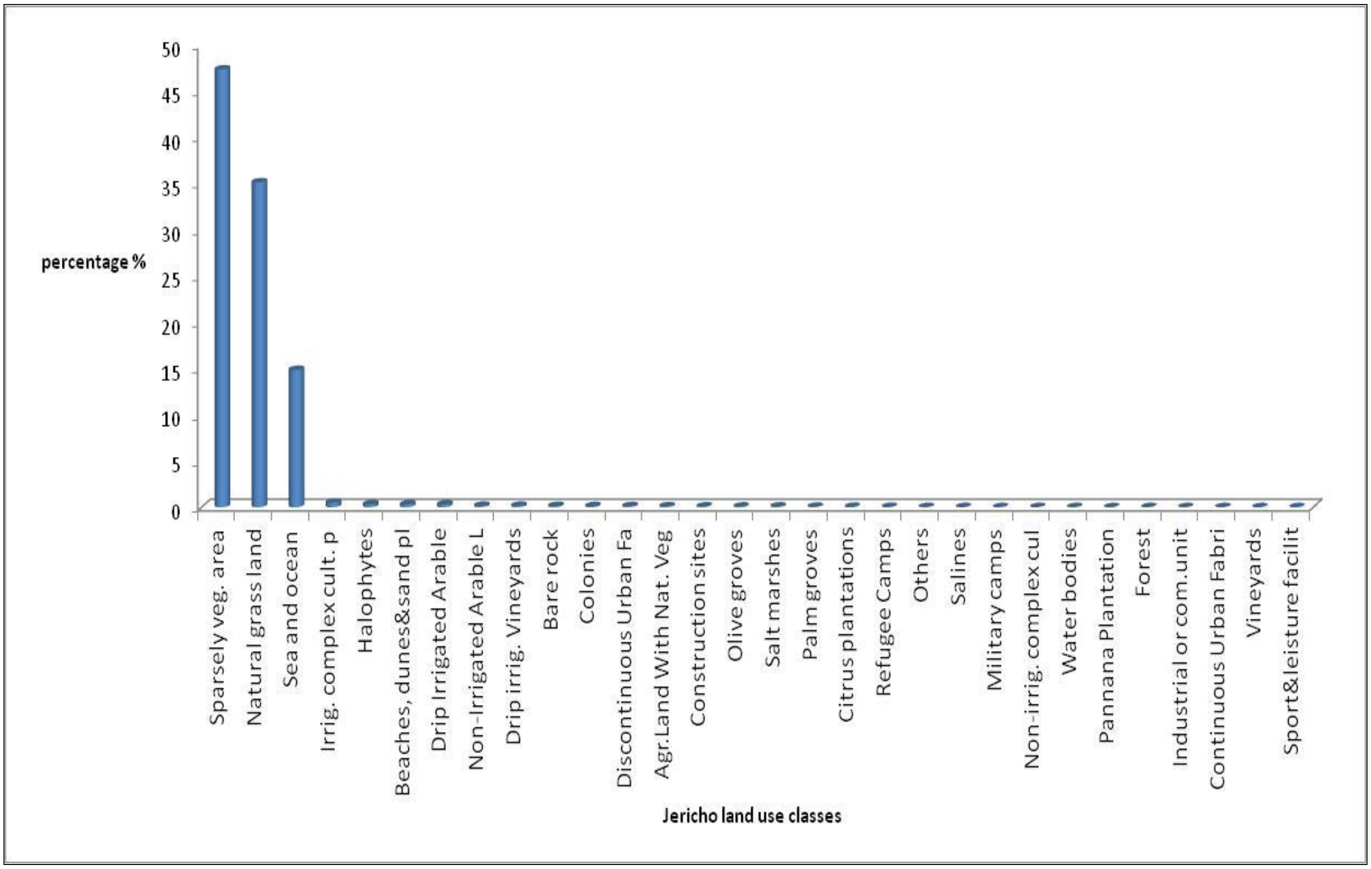


Figure (4.36)Percentage for Jericho landuse classes

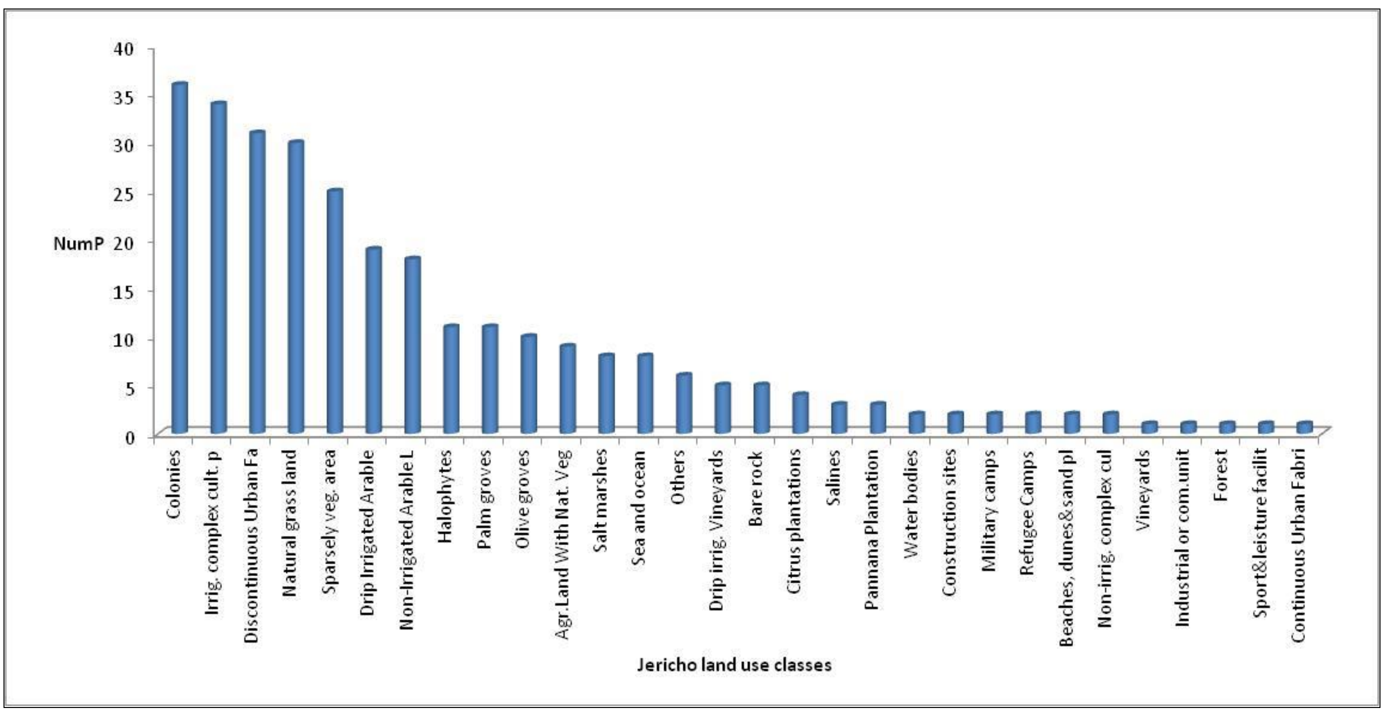


Figure (4.37) Number of Patches (Num P) for Jericho landuse classes at class level

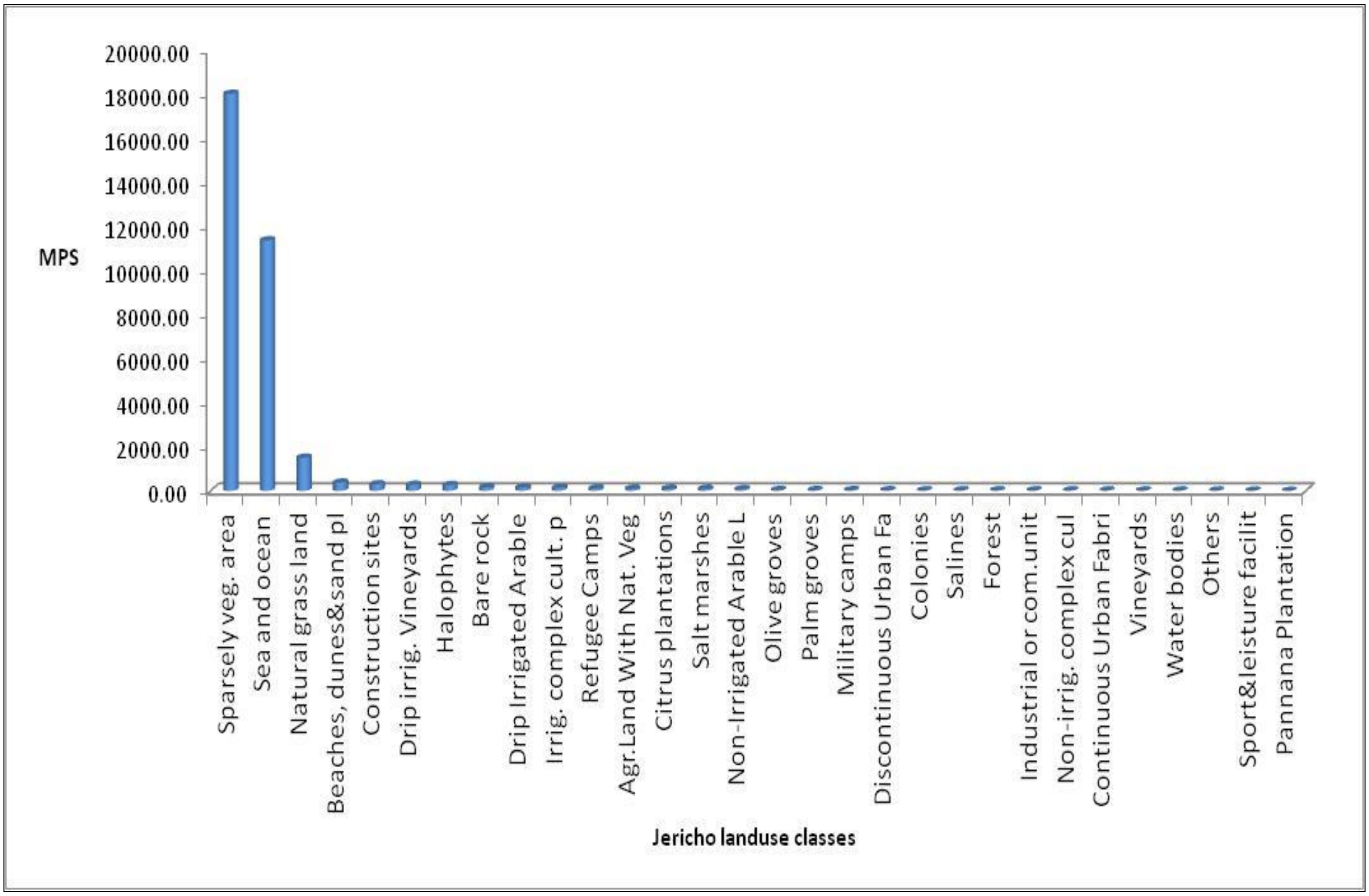


Figure (4.38) Mean patch size (MPS) for Jericho landuse Classes at class level

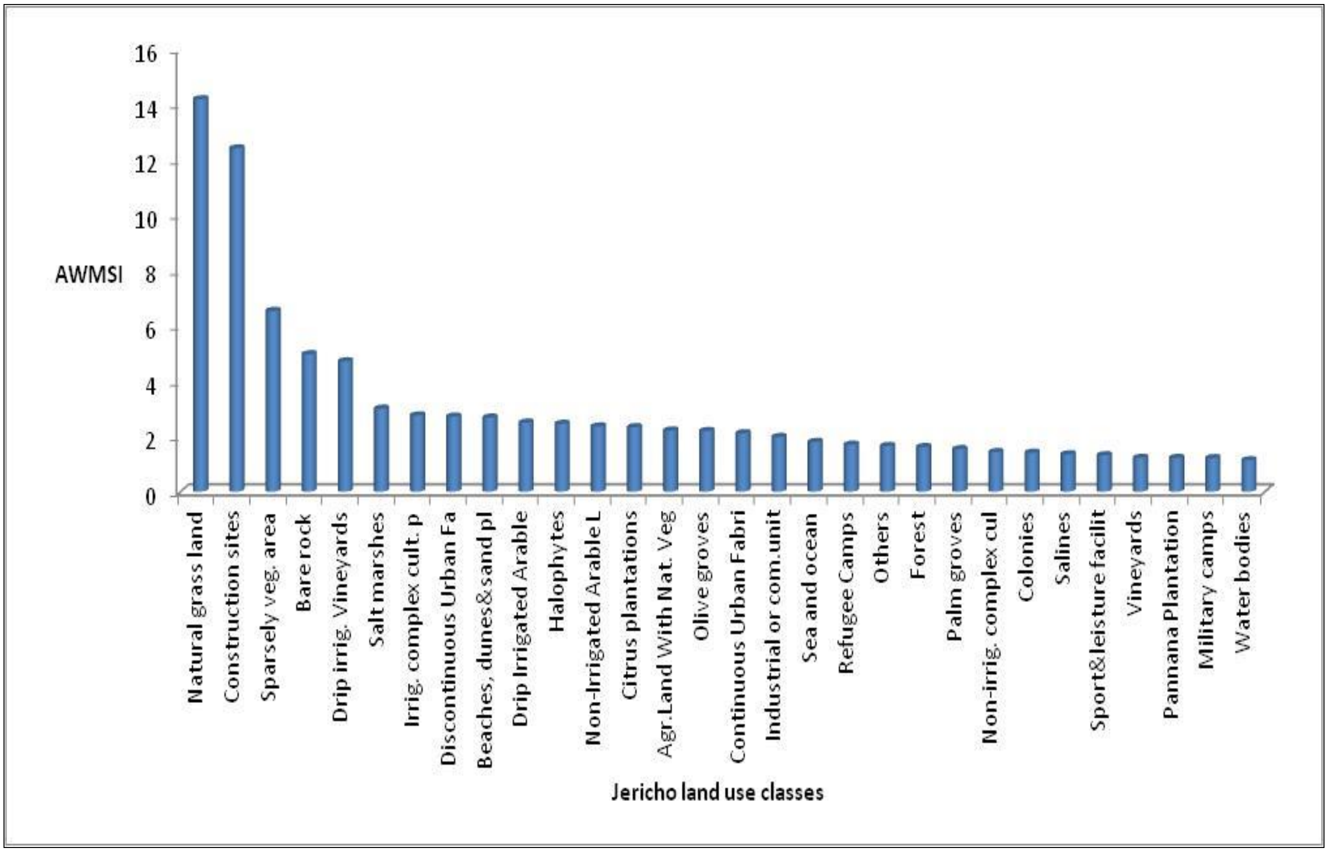


Figure (4.39) Area Weight Mean Shape index (AWMSI) for Jericho land use classes at class level

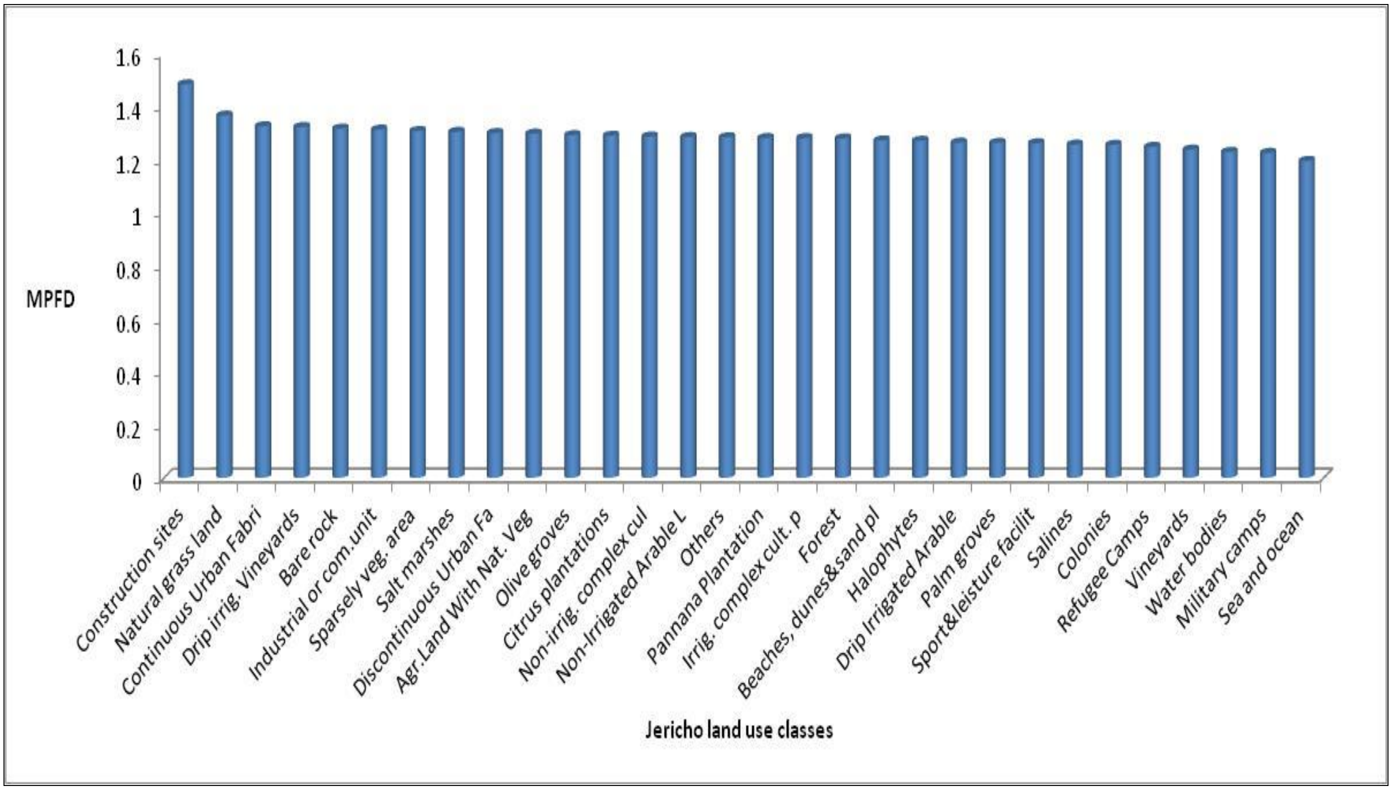


Figure (4.40) Mean patch fractal Dimension for Jericho landuse classes at class level

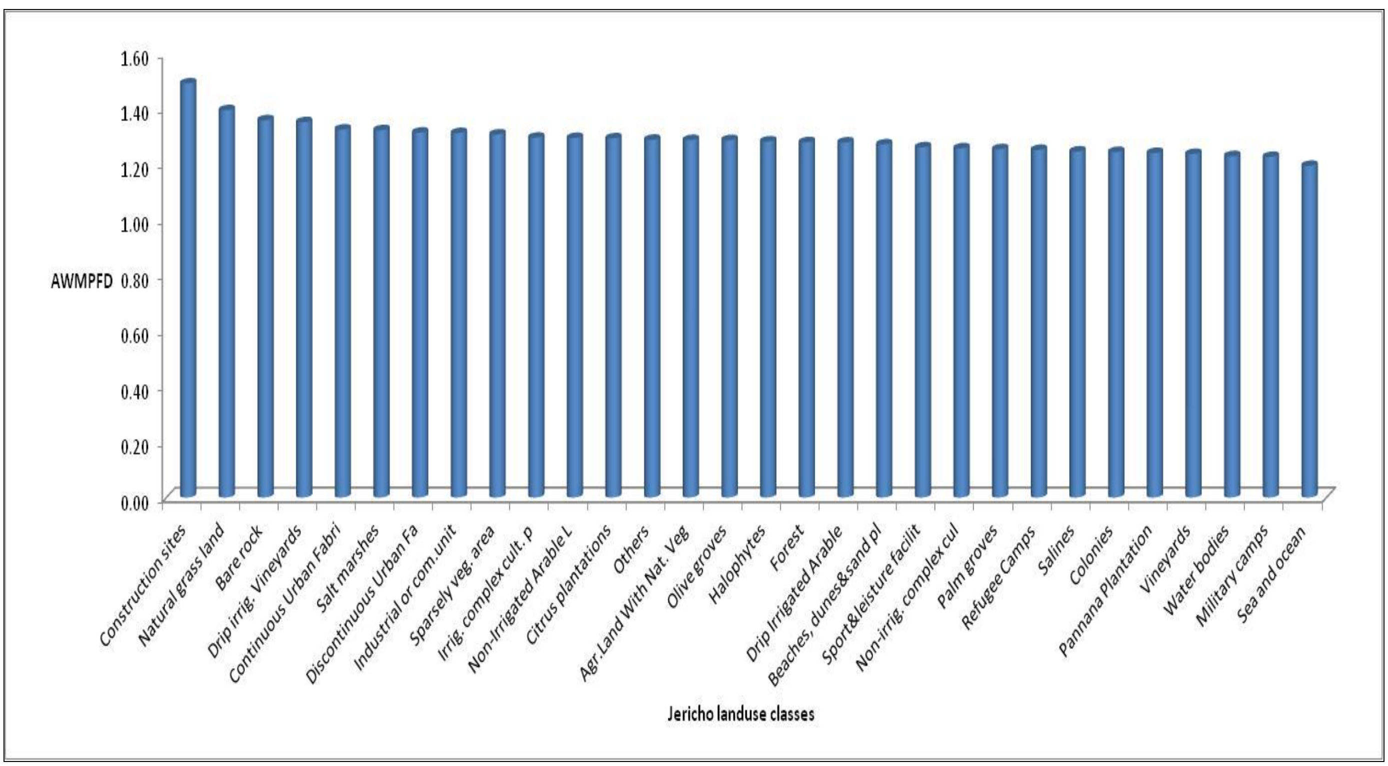
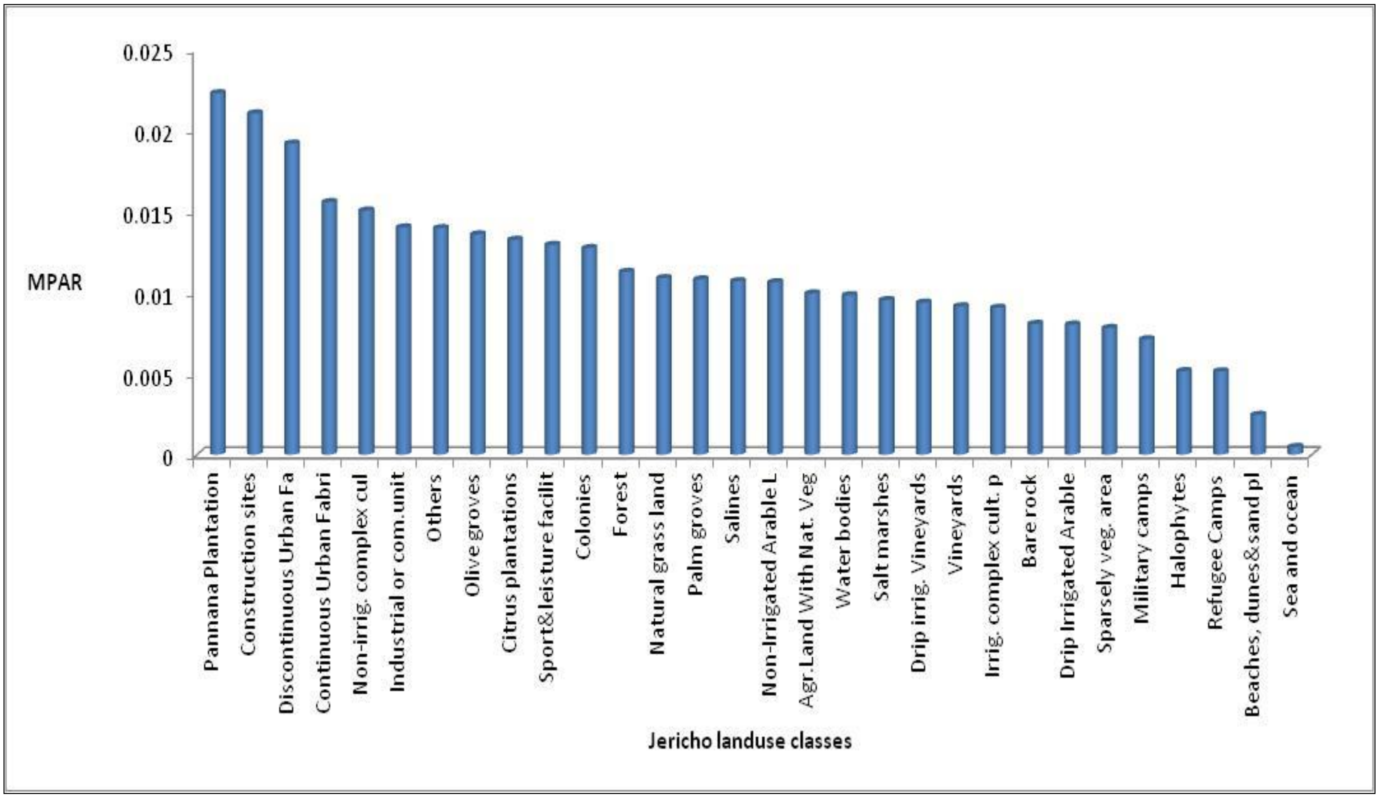


Figure (4.41) Area Weight Mean Patch fractal Dimension (AWMPFD) For Jericho landuse classes at class level



Figur (4.42) Mean Patch Area (MPA) for Jericho landuse classes at class level

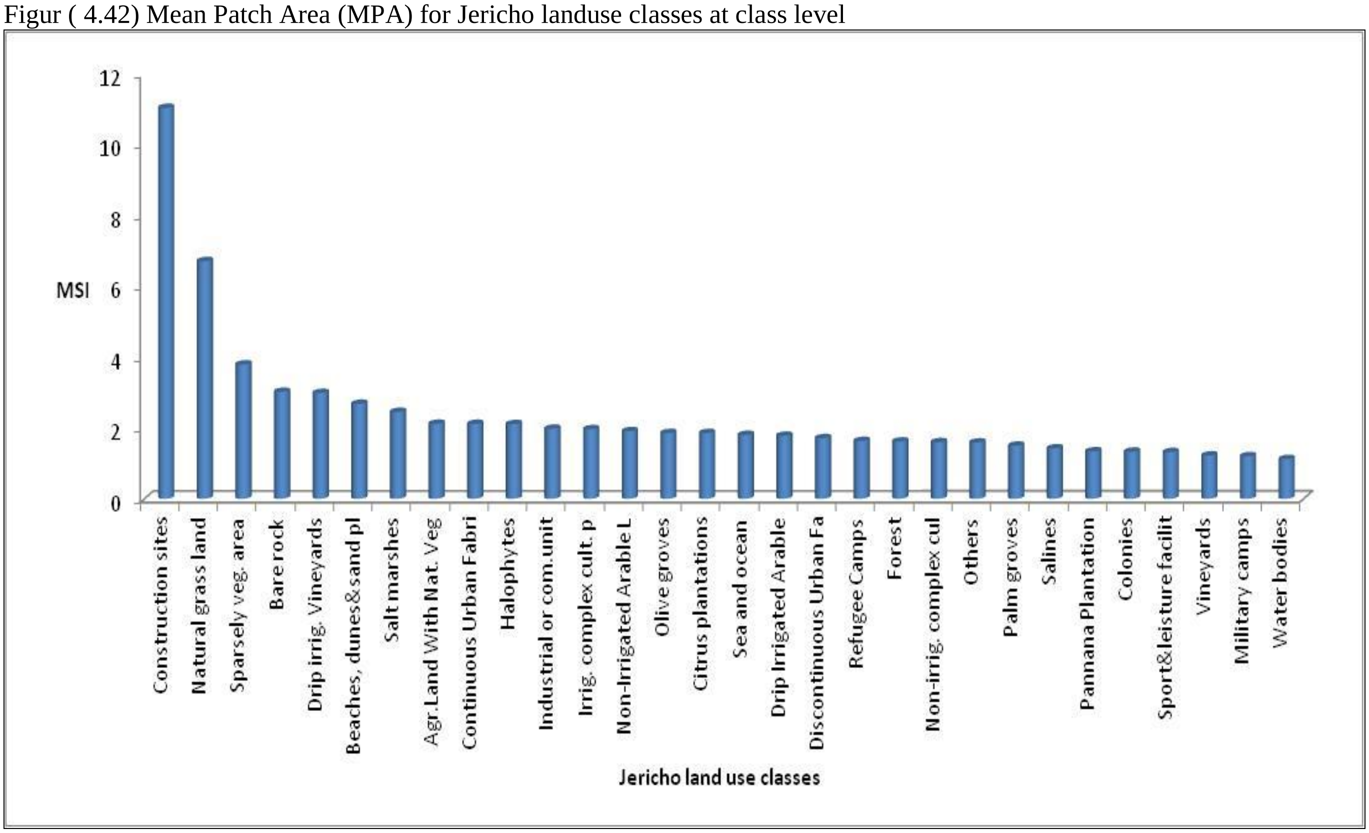


Figure (4.43) Mean shape index (MSI) for Jericho landuse classes at class level

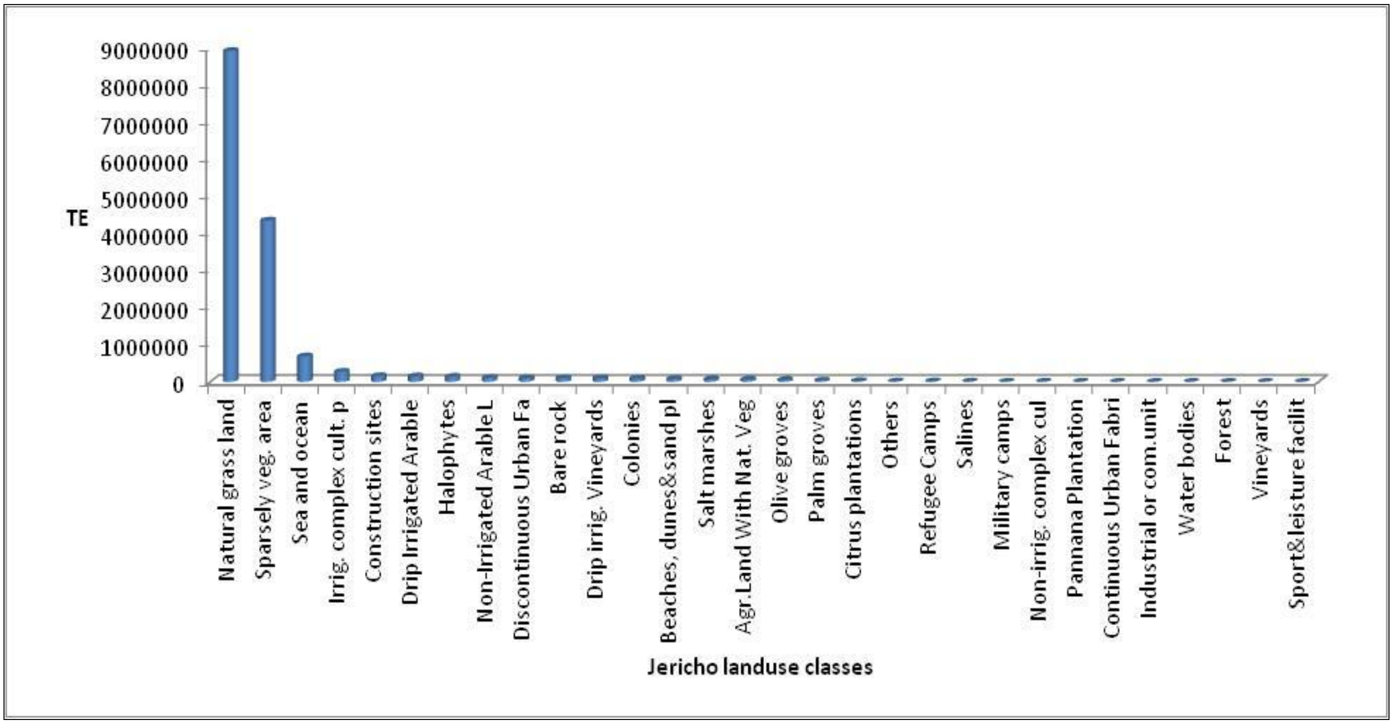


Figure (4.44) Total Edge (TE) for Jericho landuse classes at class level

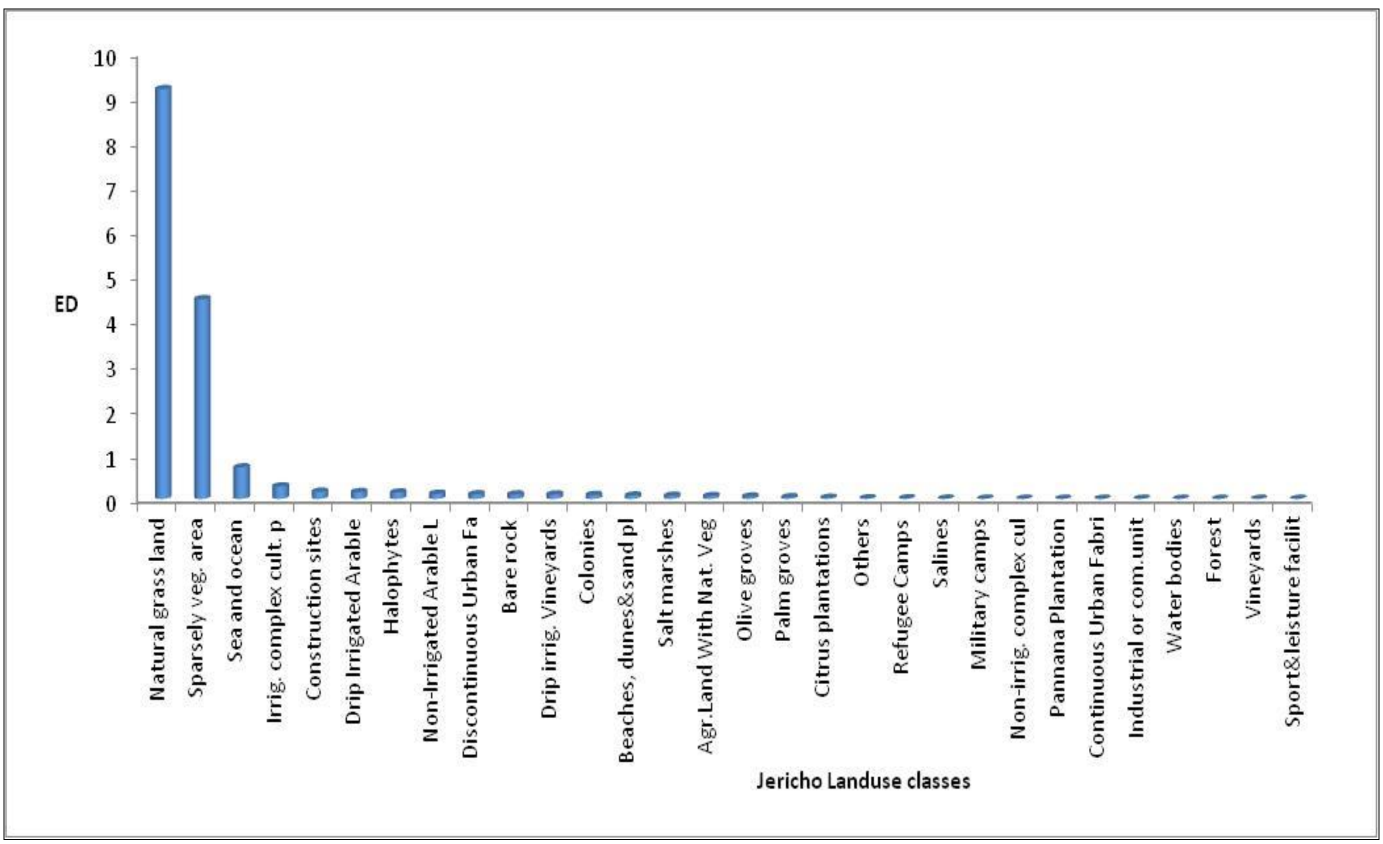


Figure (4.45) Edge Density (ED) For Jericho Landuse classes at class level

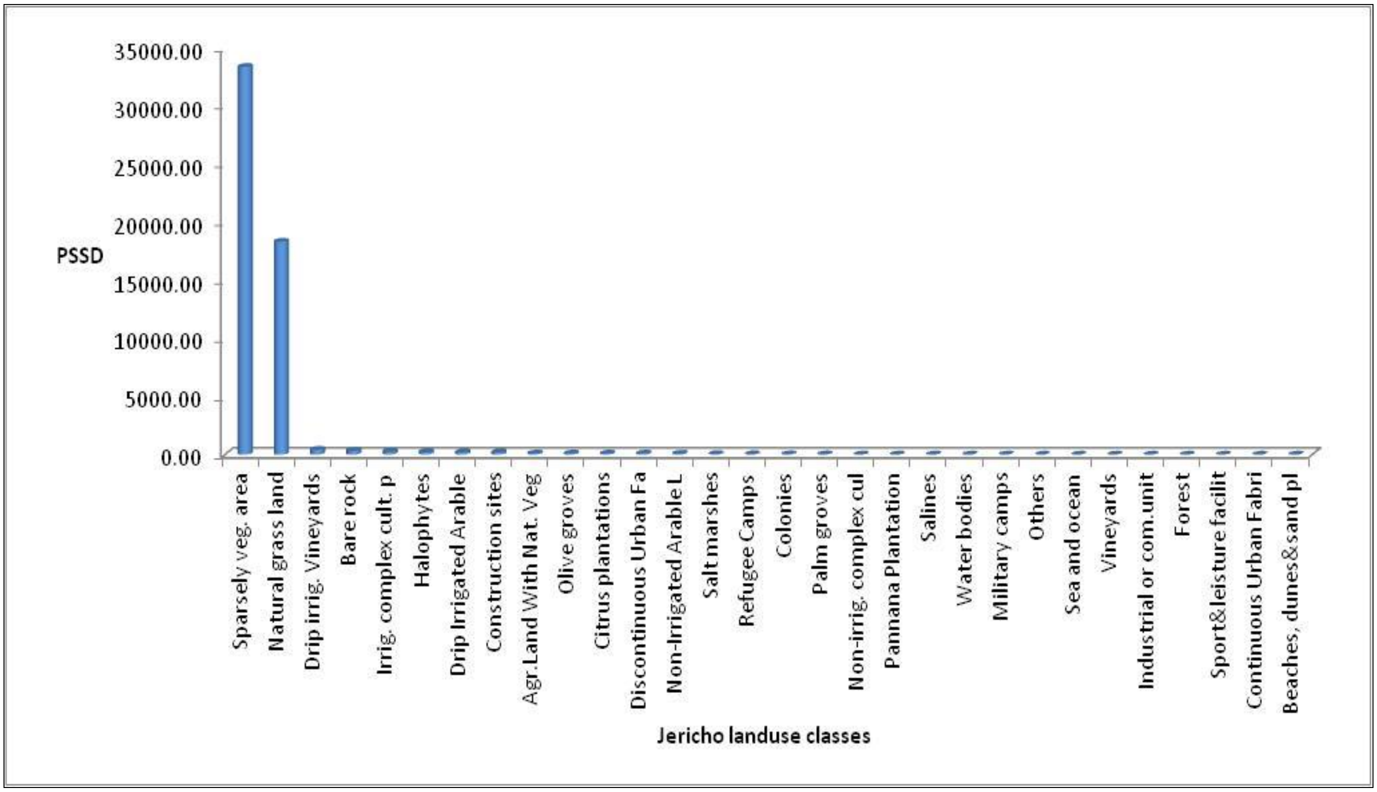


Figure (4.46) Patch size standard Deviation (PSSD) for Jericho landuse classes at class level

Jericho District land use map consist of 30 classes Sparsly veg .area represent the highest value 47.39 % with Area(460005 Ha)followed by Natural grass land represent 35.17% Area (341385Ha), Sea and ocean represent 14.86 % Area (144249 Ha)while forest represent 0.0026 % Area(25 Ha) ,While vineyard 0.0023% with area (22 Ha) sport & leisture facility (0.0013 %) Area (13 Ha) represent the lowest value.

Area Weight Mean Shape Index: The Highest class value Natural Grass Land 14.20 followed by Construction sites 12:42 and sparsely veg .area 6.54 , Forest value 1.61 while the lowest value for the classes Military camps 1.21 and Water bodies 1.13 all calculated index values are greater than one which serve as benchmarks value for patches having complex and irregular shape .

Mean Shape Index: The highest class value was Construction sites 11.04 followed by Natural grassland class with Value 6.71 and sparsely veg .area 3.79 Forest value 1.61 while the lowest value for Military Camps 1.20 and water bodies 1.12 It can be observed that the values for all classes greater than one indicate that the patch shape had increasing irregularity and complexity. This indicates a more fragmented and more heterogeneous landscape.

Mean Patch Fractal Dimension (MPFD): The Highest Value for the construction site class 1.48 followed by Natural grass land 1.36 and Continuous Urban Fabri 1.32

Forest 1.28 and the lowest value for Military camps 1.22 and Sea and ocean 1.19 .

It was observed that the value for classes was greater than one, suggesting a more complex shape, high patch shape irregularity, and a highly fragmented landscape.

4.10 Landscape level metric value for Hebron , Jenin , Jericho and Sulfit

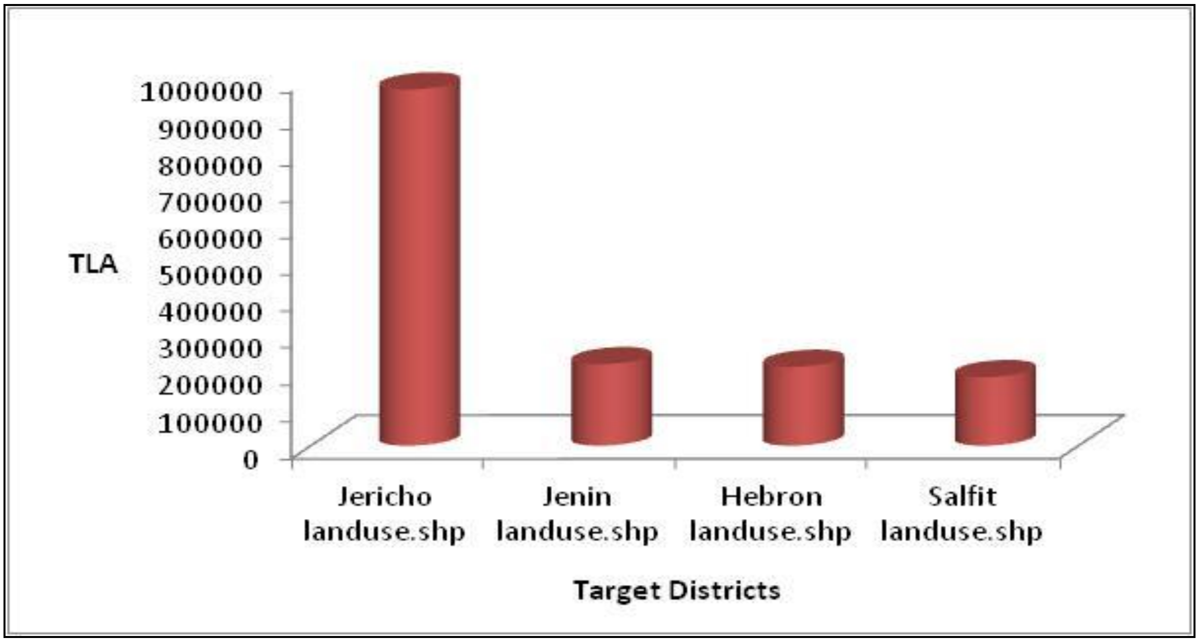


Figure (4.47) Total land area of (Jericho , Jenin , Hebron , Salfit)

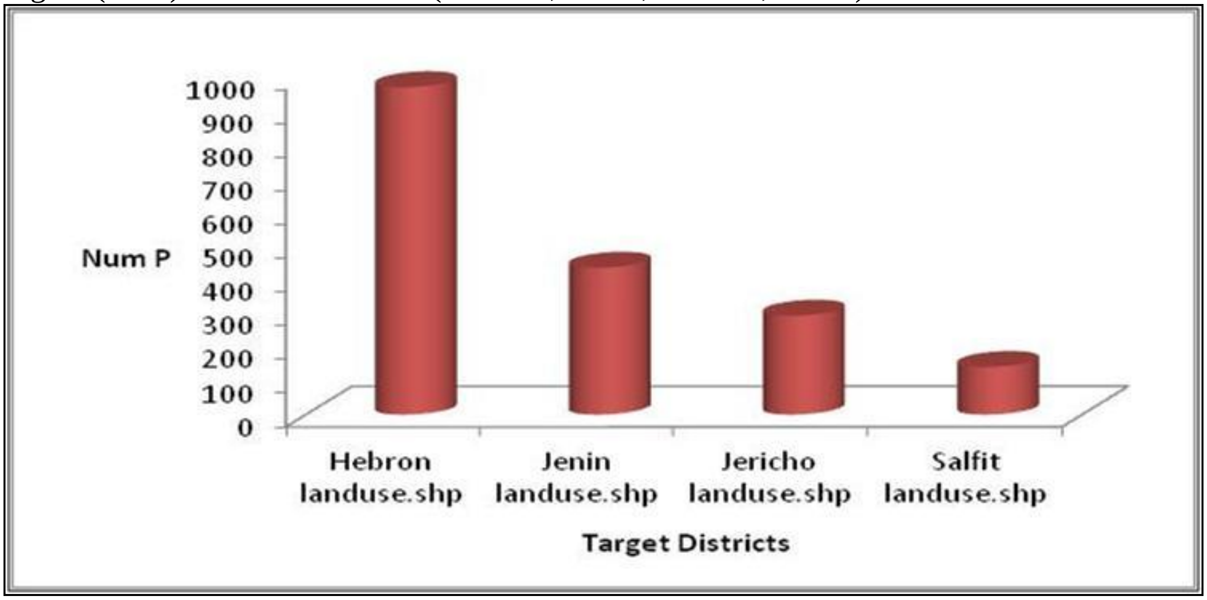


Figure (4.48)Number of Patches for (Hebron , Jenin , Jericho , Salfit)

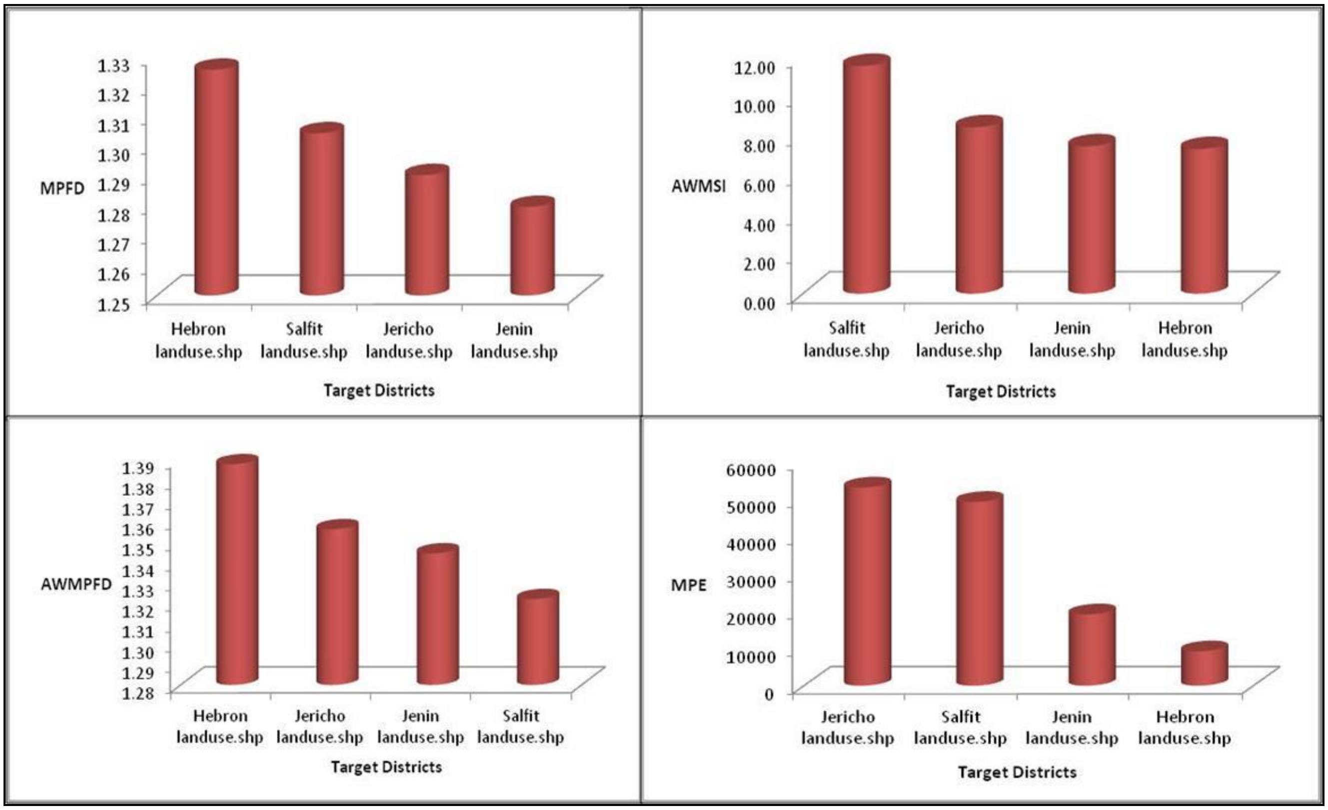
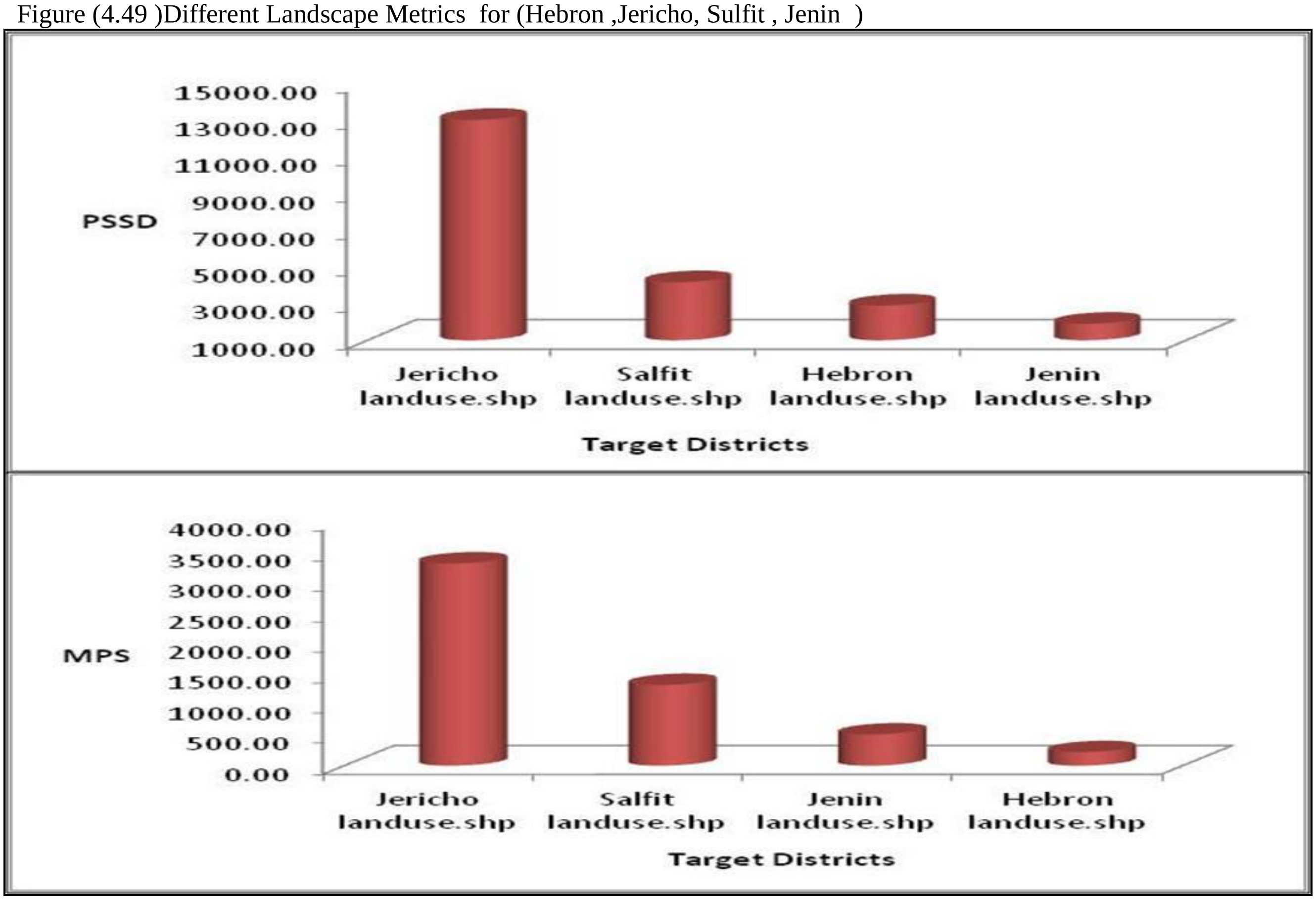


Figure (4.49)Different Landscape Metrics for (Hebron ,Jericho, Sulfit , Jenin)



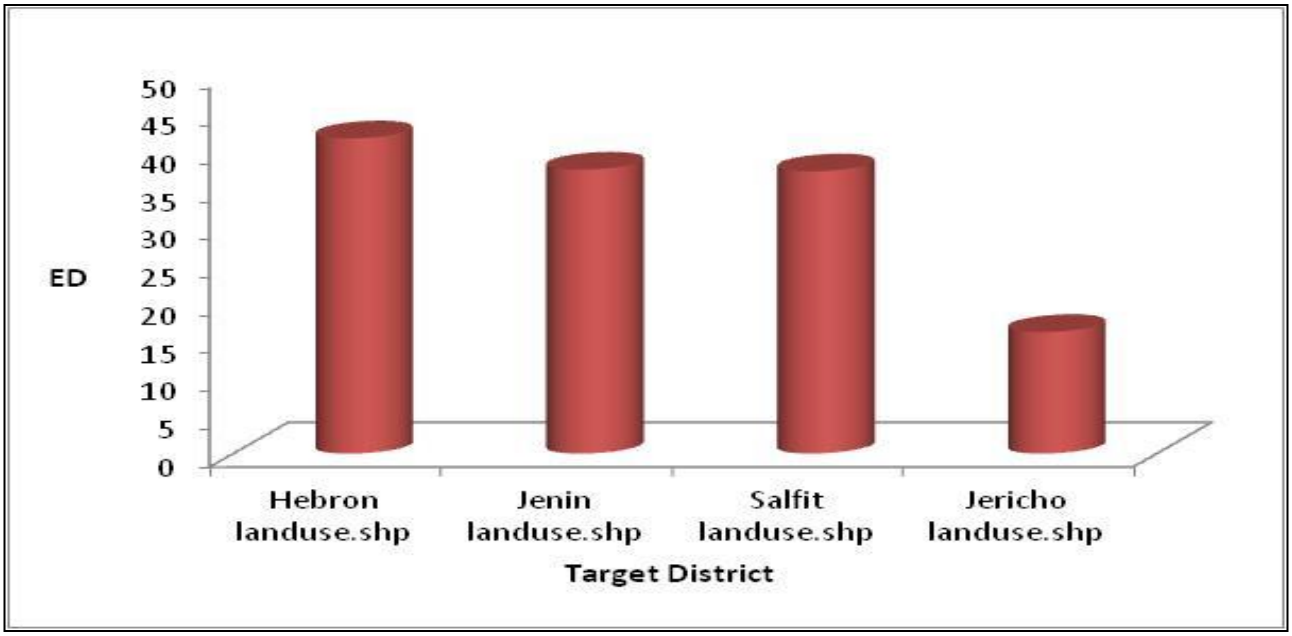


Figure (4.50) Edge Density at landscape level for (Hebron ,Jericho,Salfit , Jenin)

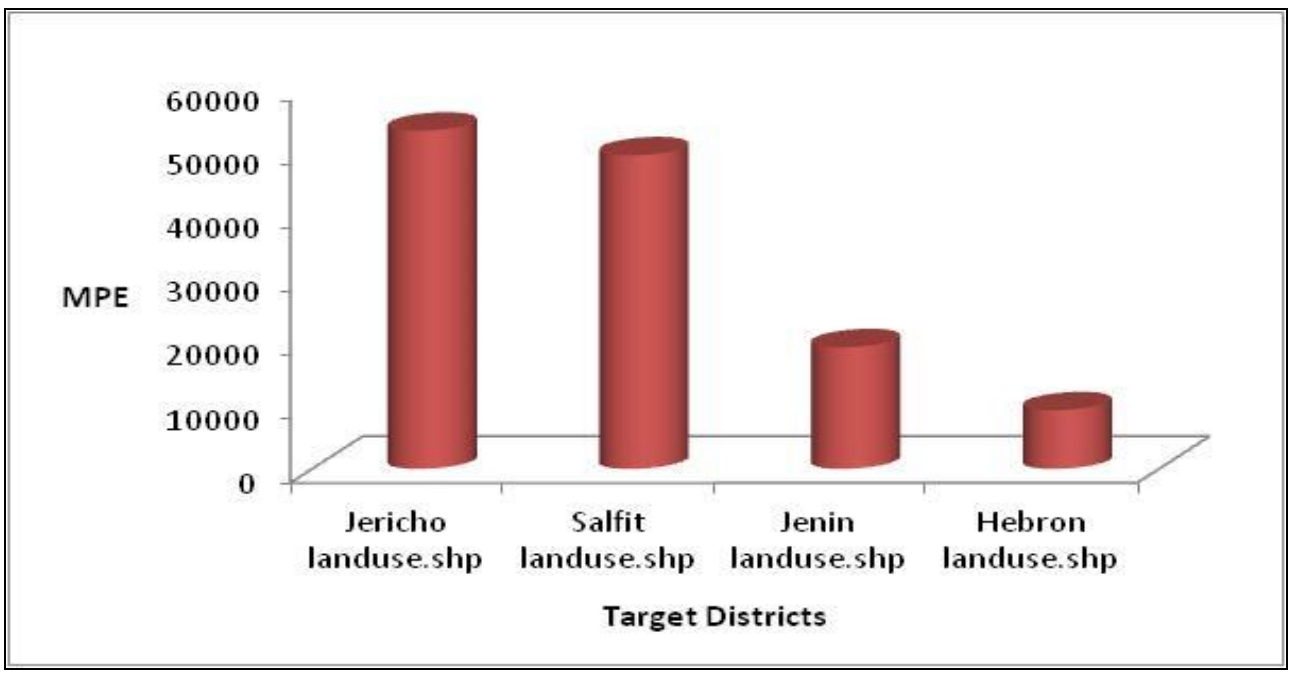


Figure (4.51) Mean patch edge (MPE) at landscape level for (Hebron , Jericho, Jenin, Salfit)

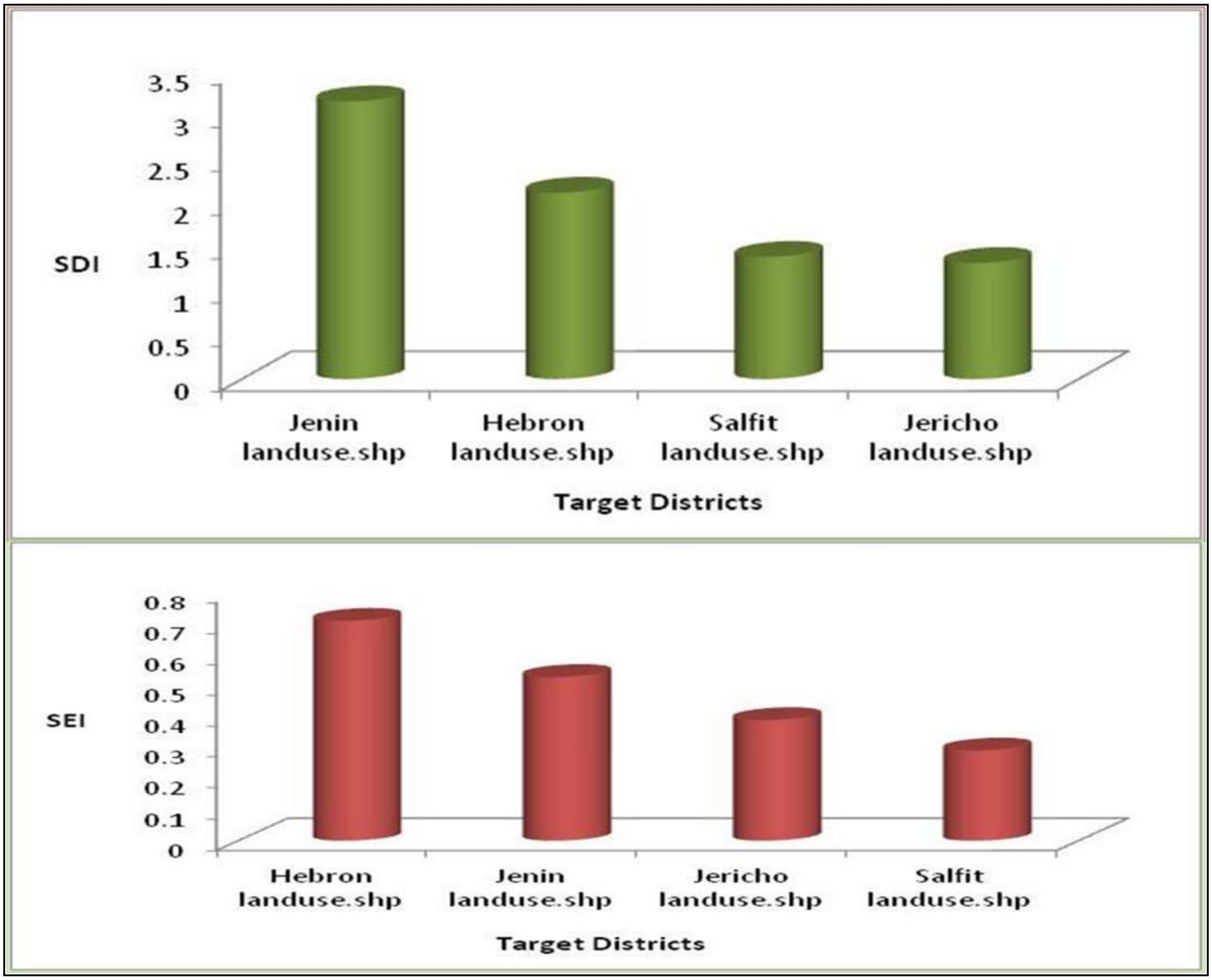


Figure (4.52)Shanon Diversity Index (SDI) and Shannon Evenness Index (SEI)for(Hebron , Jericho,Salfit , Jenin)

Shannon Diversity Index increases as the number of different patch types (=classes) increases and/or the proportional distribution of the area among patch types becomes more equitable. For a given number of classes, the maximum value of the Shannon Index is reached when all classes have the same area.

The formation of many smaller patches than the mosaic habitat lead to formation of habitat edges that subsequently lead to adecrease of acore area for each habitat type and create stress from external factors to native plant and animal communities (Colling ,996 ; Ries et al., 2004;Antwi et al., 2008; Fetene et al,2014).

Mean patch fractal Dimention (MPFD) measure the shape complexity which is computed based on perimeter area relationship of the same patch . in this study all values of MPFD More than one approach to two which reflect shapes more complex (MCGarigal et al ., 2012).

The shape of Habitat coupled with the patch size can influence important ecological processes in the landscape such as small mammal migration between and within inter-patches (Buechner ,1989 ; Fetene et al ,2014) and woody plant colonization (Hardt and forman, 1989) as well as influencing animal foraging stratigies (Forman and Jordon ,1986).The ability to Quatitatively describe landscape structure is prerequisite to the study of landscape function and change and various metrics have emerged from landscape ecology for this purpose Landscape metrics describe the spatial structure of a landscape at a set point in time . they provide information about the contents of the mosaic e.g . the proportion of each landscape type or category present in the study area , or the shape of the component landscape elements .

It is important to establish the difference between spatial statistics and landscape metrics .Spatial statistics are tools that characterize the geometric and spatial properties of a patch or of a mosaic of patches . While landscape metrics have been widely used in research .Some landscape metrics such as dominance , fractal dimension , and contagion have been proposed in the US as indicators for watershed integrity , landscape stability and resilience , biotic integrity and diversity (EPA , 1994 ,1995) .Recently in Europe metrics –based approaches have been suggested by the Joint Research Center of the European community to develop biodiversity indicators at the landscape level based on Remote sensing images .Despite the desired efficiency that could be realized from having and using a single means to measure and analyse landscape fragmentation, it is widely accepted that no single index can measure all aspects of landscape fragmentation (Hargis et al. 1998,Gustafson 1998, Recanatesi 2014, McGarigal and Marks 2002). One attempt has been made to mathematically combine several important aspects of fragmentation measures into one single tool (Bogaert et al. 2000). In their proposed measure, however, Bogaert et al. (2000) found that other aspects of landscape fragmentation,such as interior habitat and spatial connectivity, were then neglected. The majority of the literature suggested the use of a suite of indices in order to tell the whole story across a given landscape (Hargis et al. 1998, Gustafson 1998, McGarigal and Marks 2002). Bissonette and Storch (2003) indicate that the total amounts of habitats, and their spatial arrangement, were both important landscape characteristics that need to be measured as part of any landscape fragmentation analysis.

Connectivity provides a good example for the application of landscape ecological concepts and metrics .it an important , and measurable landscape characteristics , a parameter of landscape function and an important issue when assessing , or planning for biodiversity (Bennett , 1998) A growing body of literature suggest that habitat connectivity is important to the persistence of both plant and animal populations in fragmented landscape . several benefits can be associated with networks of biotope systems namely in connecting isolated patches and helping to counter the effects of fragmentation . Landscape Metrics are also useful and essential tools for applying landscape ecological concepts planning. They are understood as fundamental ecological planning tools and offer great promise to land planner and managers because they can measure the arrangement of landscape element in both time and space . there are literally hundreds of metrics developed to analyze the landscape structure according to several comparative studies and reviews (Riitters et al., 1995;Li and Reynold ,1995 cited in Gustafson, 1998 ; Tinker et al .,1998) landscape Metrics are frequently strongly correlated , and can be confounded . Either through theoretical considerations or more objective criteria such as statistical analyses i.e . principal component analysis (PCA) and correlation matrices , the aforementioned authors have considered the independence of selected metrics . (Botequilha Leitão and Ahern., 2002)

Landscape analysis describes a study area and its context in several dimensions i.e environmental , economic and social . It identifies the processes of interest that determine landscape functions and how they are influenced by the different elements that form the physical landscape because they describe composition and configuration aspects of landscape structure , landscape metrics are useful for providing a first characterization of a landscape . According to Forman1995 the matrix is the land use or land cover class that occupies at least 50% of the total landscape . Area metrics can also be useful to identify the largest patches in a land scape , which represent potentially significant core areas for biodiversity .

4.11 Third step in the work : Planning for reducing the fragmentation by achieving connection between fragmented habitat by introduce ecological corridor

In ecology, connectivity has two components: the physical links between elements of the spatial structure of a landscape (connectedness) and the functional connectivity, depending on species and research opportunities. The later has been measured as the distance between sites, structure and composition of landscape, dispersal success between sites and search time travelling from one to another site. Connectivity is thus a combined product of structural and functional connectivity, *i.e.* the effect of physical landscape structure and the actual species use of the landscape (Tischendorf and Fahrig, 2000a,b). When applied to protected areas, measures should not necessarily be to link individual patches with physical structures (such as corridors of similar habitat), but to ensure the existence of required functional connections between sites (*e.g.* inter-site distances or/and landscape permeability).

4.12 Target species of plant ecological corridor planning

five species have been selected as target species ,they grow naturally in the selected sites mentioned before and they have alot of Cultural , Medical and economical value in the palestinian communities and play important factors in there traditional and customes since hundreds of years the table below show some of those traditional uses and there importance in different values .

4.13 Importance of the target Species in traditional food and other ecological and economic

Scientific name	Family	Arabic Name	Food use category	Part used , way of consumption
Pistacia Palaestina Boiss	Anacardaceae	Butum Falastini	Fruits	Stewed and eaten
Rhus coriaria L.	Rosaceae	Summak	Seasoning	Fruit , used as condiment on food and thyme
Ceratonia siliqua l.	Fabaceae	Karoob	Fruits	Fruits , eaten raw , prepared as jam
Quercus calliprinos webb	Fabaceae	Sendian	Herbal tea	Fruits , dried and grounded then added to coffee
Amygdalus Korschinskii Hand.-Mazz.Bornm	Rosaceae	Louz Barri	the seeds of wild almond trees	Oil is a future weapon in the battle against obesity and diabetes

(Ali-Shtayeh et al. 2008)

- The carob tree is an important component of the Mediterranean vegetation

- its cultivation in marginal and prevailing calcareous soils of the Mediterranean region is important environmentally and economically
- Traditionally, grafted carob trees have been interplanted with olives, grapes, almonds.
- Carob pods with their sugary pulp are a staple in the diet of farm animals and are eaten by children as snacks or by people in times of famine.
- Currently the main interest is seed production for gum extraction.
- The carob tree is suitable for part-time farming because of low orchard management requirements and shows potential for planting in semi-arid Mediterranean or subtropical regions.
- The trees are also useful as ornamentals and for landscaping, windbreaks and afforestation .
- Cattle can browse on leaves and the wood is suitable for fuel
- carob tree is often recommended for reforestation of degraded coastal zones threatened by soil erosion and desertification.
- Carob thrive together with a number of other species of the maquis (Pistacia , olea , Quercus , etc)

- Carob is frequently used as a substitute for chocolate because it can be made to taste and look similar to chocolate. Additionally, carob is often touted for its high nutrient content. However, closer examination reveals that both carob and chocolate both are quite nutritious, as long as they do not contain large amounts of added fat or sugar.

Pistacia palaestina L.

- Attempts to graft Pistacia vera (pistachio) on Pistacia palaestina have been successful
- Pistacia palaestina grows in the mountain regions
- Pistacia is mentioned in the Bible as a place of worship .
- The common arborous plant association that is common in the Mediterranean mountain ranges of Israel is Quercus calliprinos and Pistacia palaestina.
- In folk medicine the chewed fruits are used as medicine for heartburn, peptic ulcer, toothache, stomachache
- The bark of the tree, after being boiled in water, is used for treatment of eczema and hemorrhage.
- Turpentine is extracted from the trunk after scarifying its bark.
- Curing materials are prepared from its galls. Its wood is carved, among others for making decorated mortars for crushing coffee beans.

- The Almond is cultivated in orchards, but trees can also be found growing in the wild, in forests and woodlands, in abandoned orchards, in open shrub lands, between rocks, and on dry limestone slopes.
- The trees that grow in the wild produce bitter or semi-sweet almond seeds. Their bitterness comes from a compound that turns into the poison cyanide when it comes into contact with water.
- This economically important tree has a spreading crown and can grow up to eight meters high. Its leaves are Elongated , toothed, and egg-shaped, and they grow in clusters from short stubs on the branches.
- Its frost , heat and drought tolerance , its tolerance to salt is moderate
- Its grow in clay , sand soil type with pH alkaline , neutral
- Its requirement of water is moderate to low
- Full need for light
- Life span extend from 25-50 years
- Plant propagation by seed , grafting method
- Need cross pollination for fruit production.
- Almonds are pollinated by bees
- Almonds are mature at three years and begin bearing. They are five or six years old before they bear a full crop.

- Oaks are the most important source of hard wood. Its wood is used in art for sculpting statues and ornamentation, for furniture, construction, industry and for the production of coal.

- oak branches used to make a shank for the plough, a yoke for the ox and a cane for the elderly.

- Materials for curing leather are extracted from the oak

- The thick bark of a west Mediterranean species of oak is the source for the cork used for production of bottle stoppers

- Different species of oak are used in folk medicine.

- The acorns of some species are eaten in times of need as "poor-men's bread" after roasting.

- Oaks are also known as important ornamental trees.

- Ecological importance as a habitat and food (they have edible acorns, although with a very bitter taste) for nesting birds, foxes, rodents and wild boars.

Rhus coriaria L.

- Sauce, appetizer, drink, and as a souring agent in food recipes .
- Recently, the consumption of sumac fruits has been increasing around the world as an important economic crop.
- In folk medicine and traditional Arabic Palestinian herbal medicine .
- Among 56 Palestinian plants tested, sumac was found to have the greatest antimicrobial effect .
- The finely ground leaves and stems provide the dyeing and tanning agent 'sumac‘. The shoots are cut down annually, near to the root, for this purpose.

4.14 Geographical Distribution of the Target species in Palestine

Rhus coriaria L.

Ceratonia Siliqua L.

Amygdalus Korschinskii Hand.-Mazz.Bornm

Quercus calliprinos

Pistacia palaestina L.

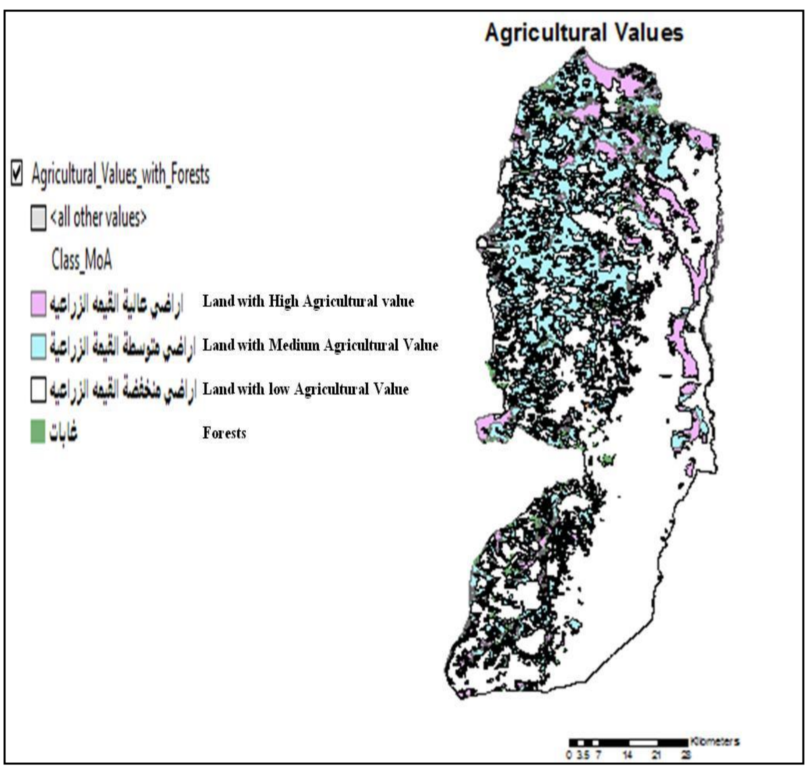
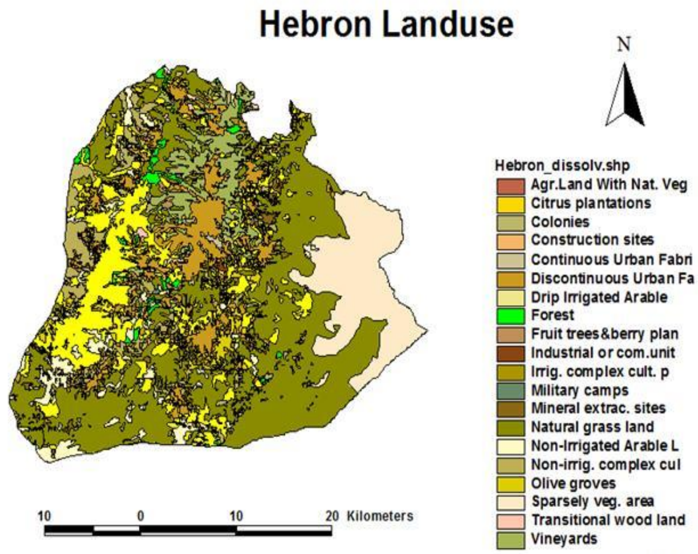
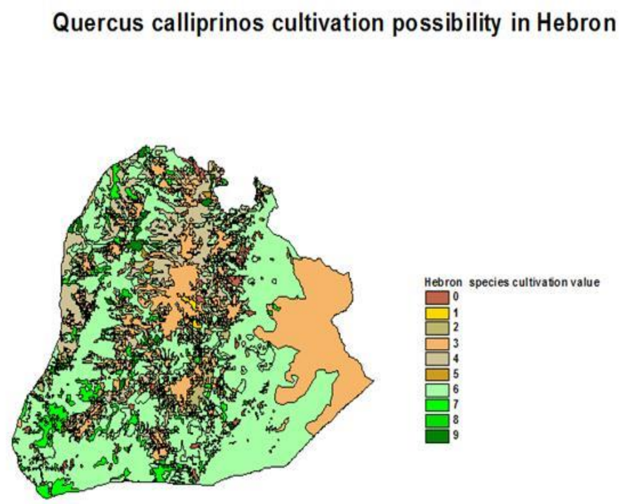


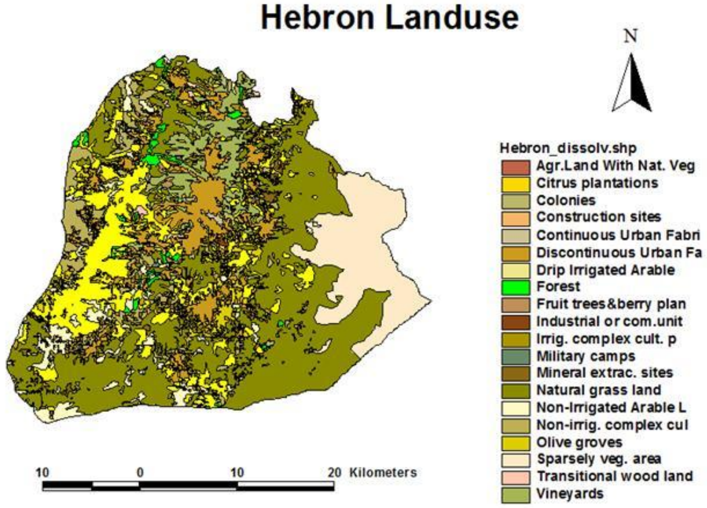
Figure (4.53) Agricultural values for WestBank lands

4.15 Cultivation possibilities of the target species in Hebron , Jenin , Sulfit , Jericho

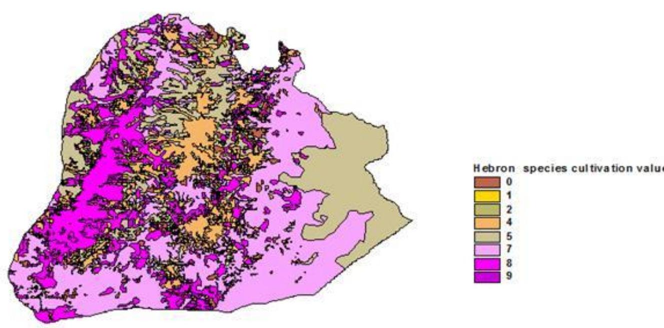


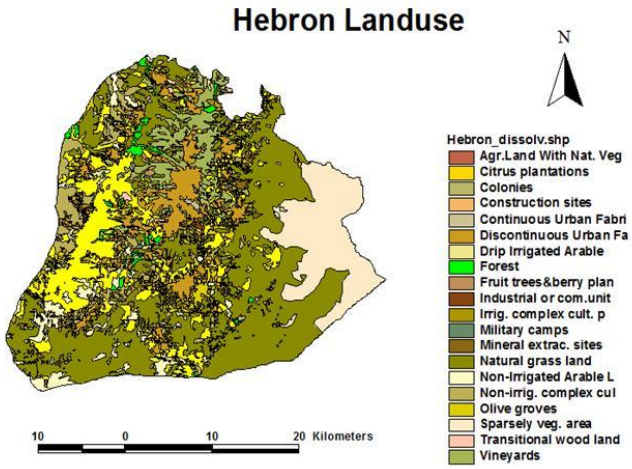


Hebron Landuse



Rhus coriaria cultivation possibility in Hebron




Hebron Landuse
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Agr.Land With Nat. Veg
Citrus plantations
Colonies
Construction sites
Continuous Urban Fabri
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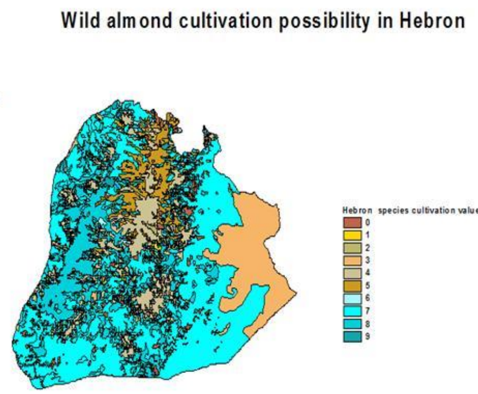
Wild almond cultivation possibility in Hebron
Hebron species cultivation value
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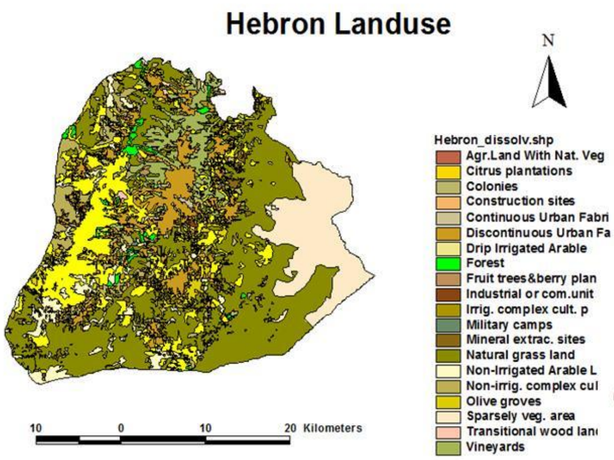
Hebron Landuse
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Agr.Land With Nat. Veg
Citrus plantations
Colonies
Construction sites
Continuous Urban Fabri
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Fruit trees&berry plan
Industrial or com.unit
Irrig. complex cult. p
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Mineral extrac. sites
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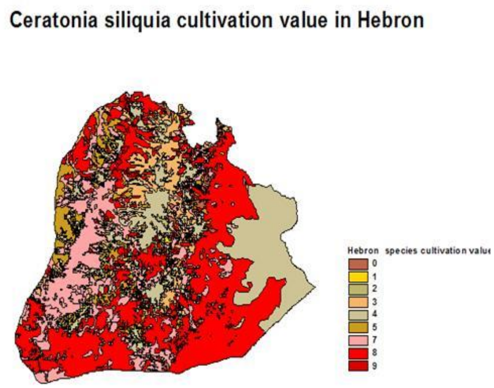
Ceratonia siliquia cultivation value in Hebron
Hebron species cultivation valu
0
1
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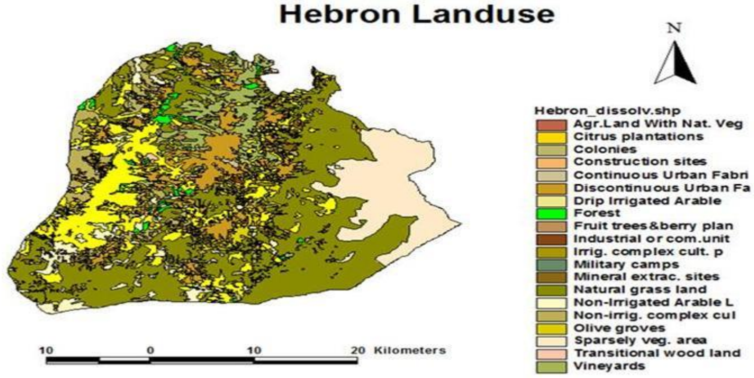
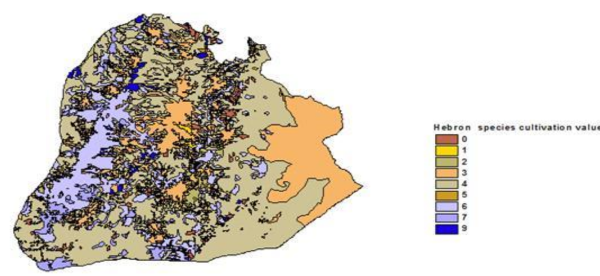
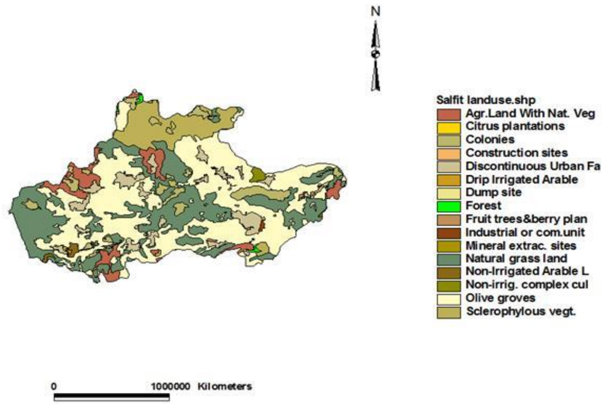
Hebron Landuse



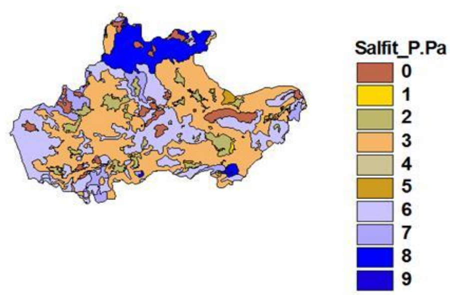
Pistacia palaestina cultivation possibility in Hebron



Sulfit landuse map



Pistacia palaestina Cultivation Possibility



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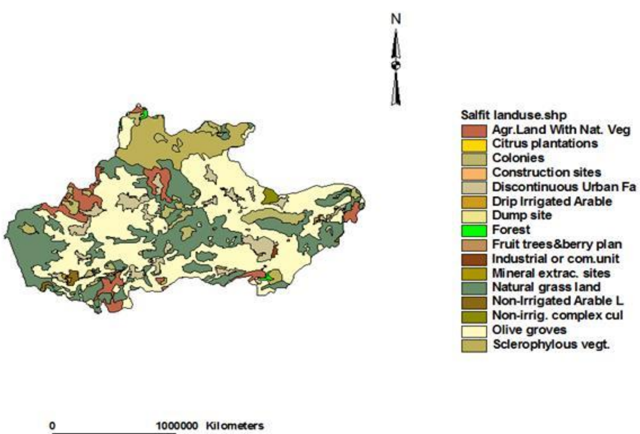
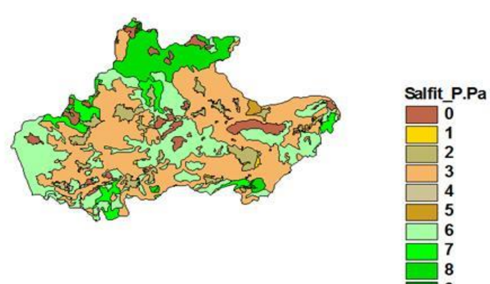


Quercus calliprinos cultivation possibility



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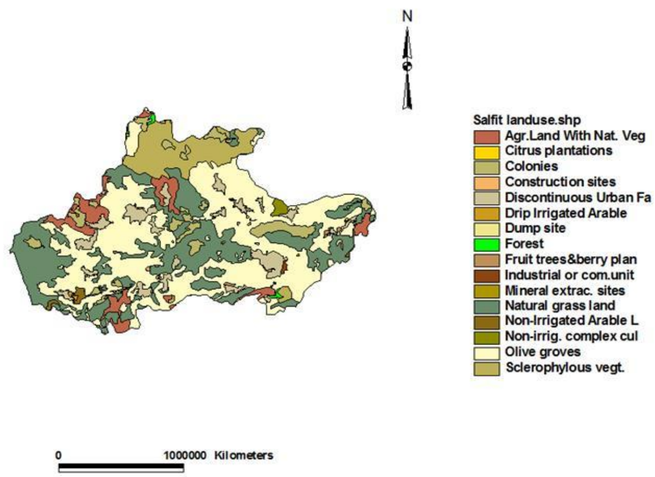
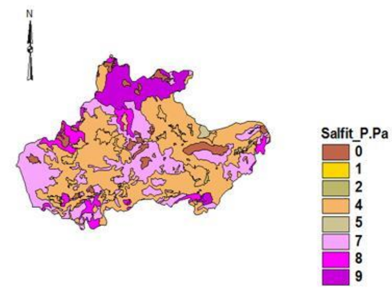


Rhus coriaria cultivation possibility in Sulfit



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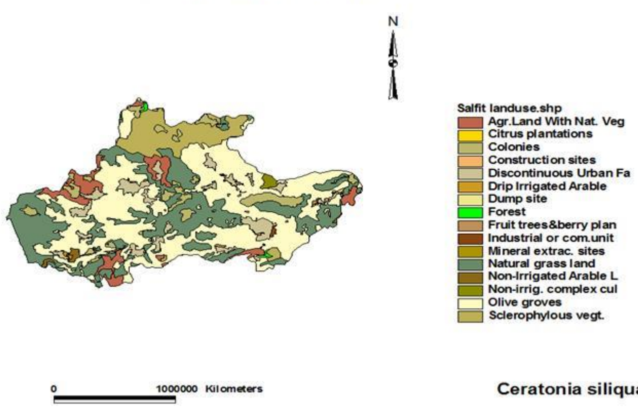
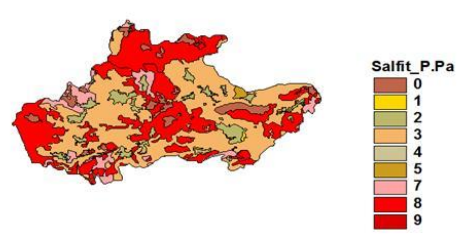


Ceratonia siliqua cultivation possibility



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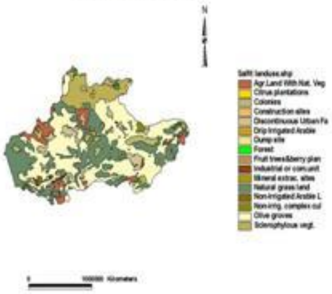
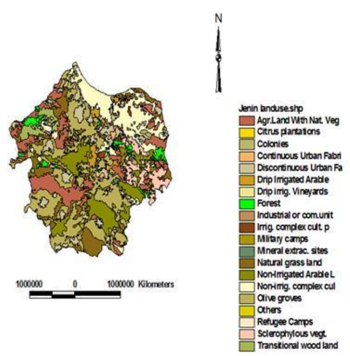
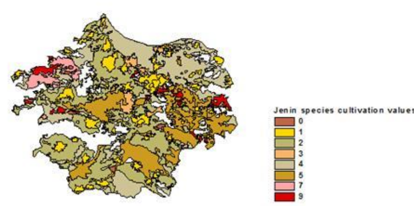


Wild almond Cultivation possibilty in Sulfit

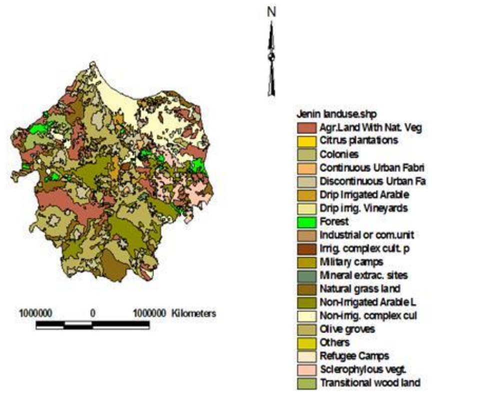
land use map for Jenin



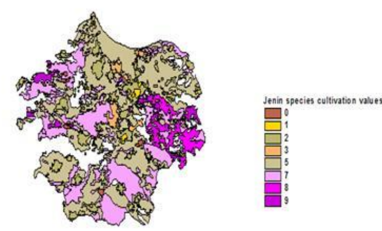
Ceratonia siliquia cultivation possibility in Jenin



land use map for Jenin



Jenin Rhus coriaria cultivation possibility



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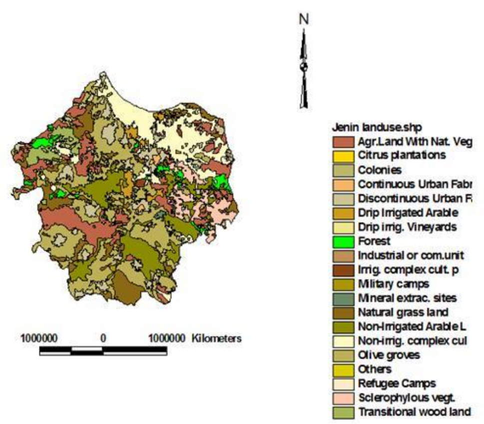
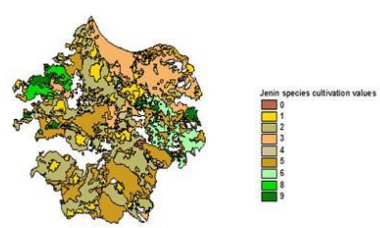
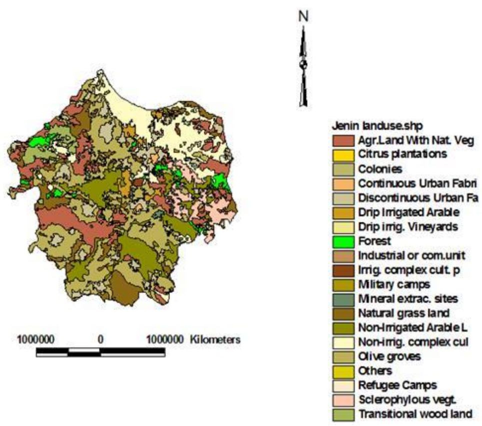


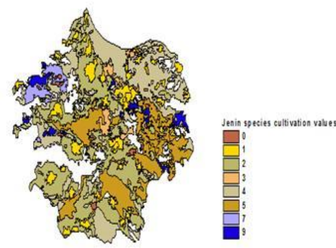
Quercus calliprinos cultivation possibility in Jenin



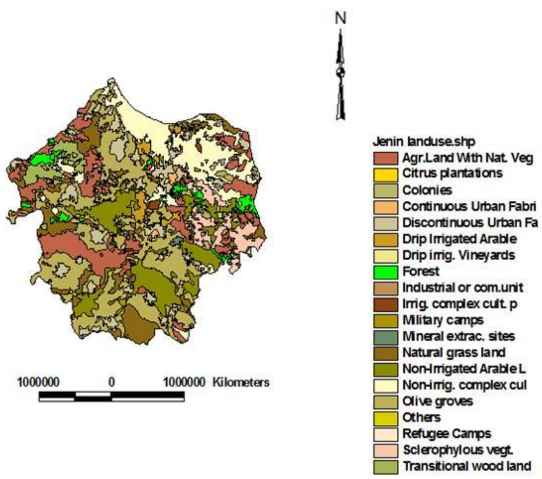
land use map for Jenin



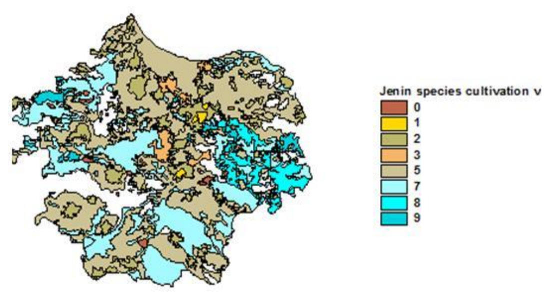
pistacia palaestina cultivation possibility in Jenin

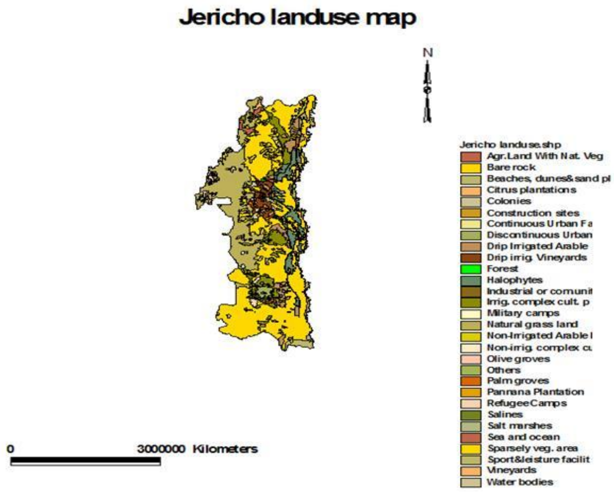


land use map for Jenin



Jenin wild almond cultivation possibility

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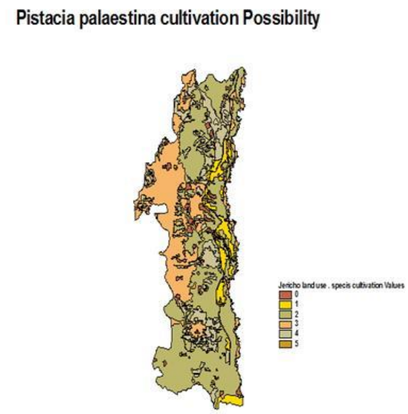
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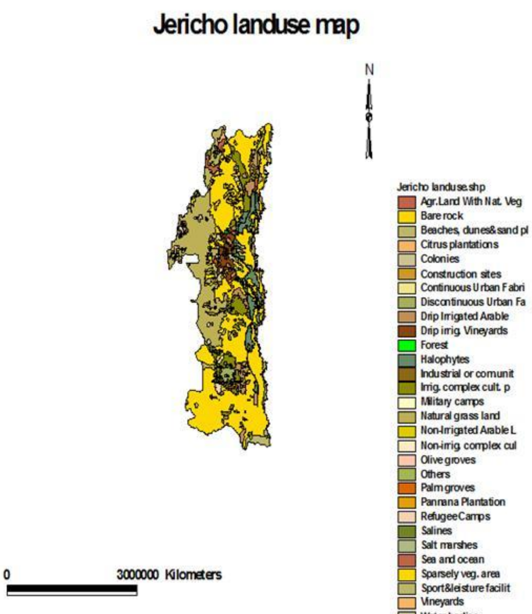
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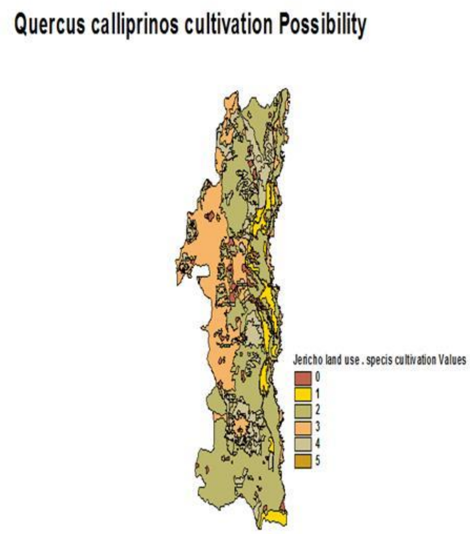
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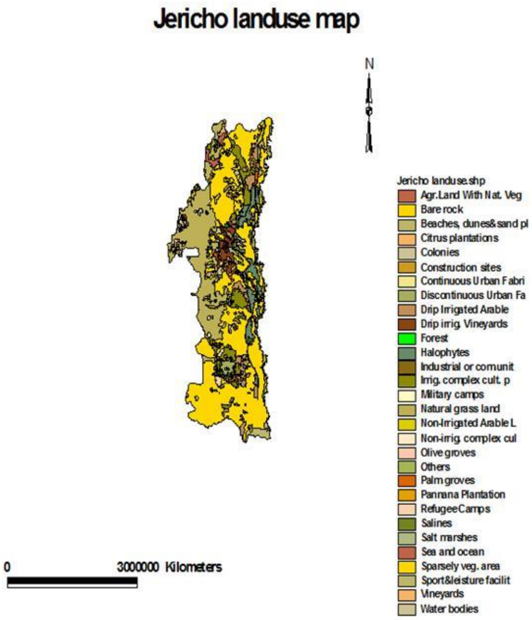
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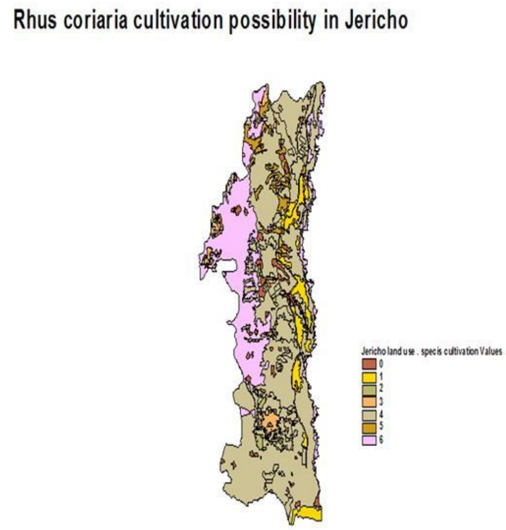
Rhus coriaria cultivation possibility in Jericho
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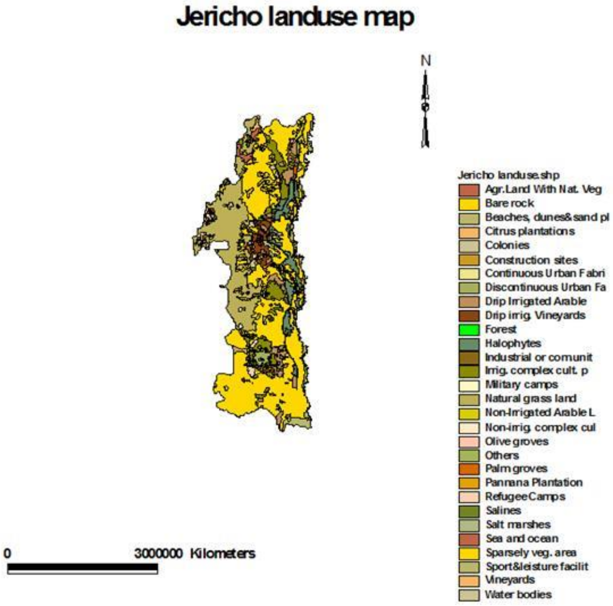
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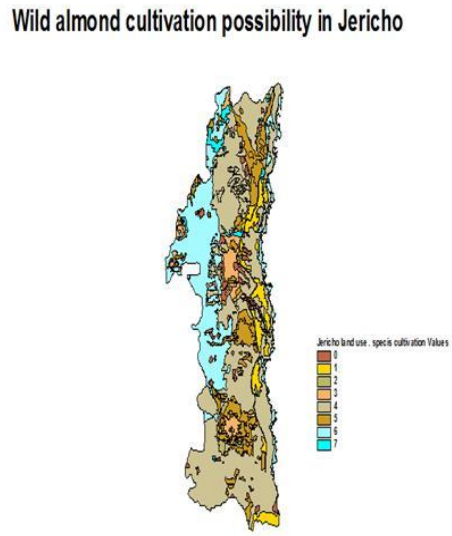
Wild almond cultivation possibility in Jericho
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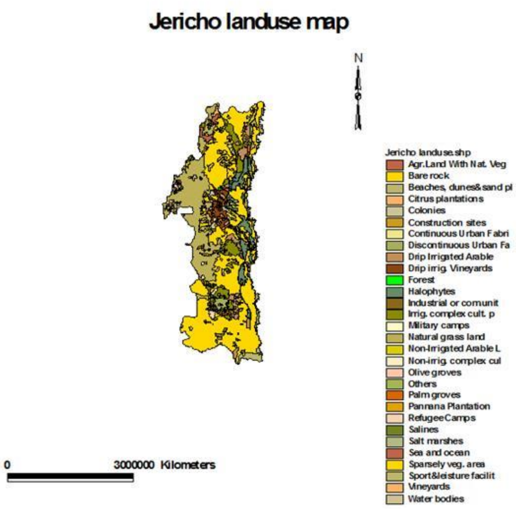
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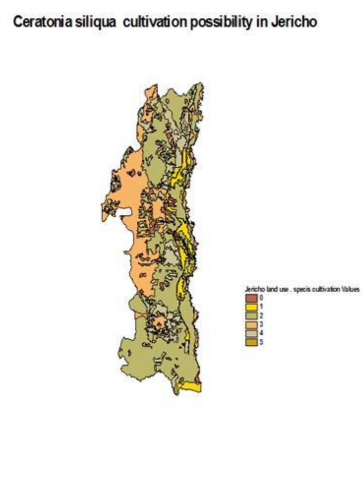
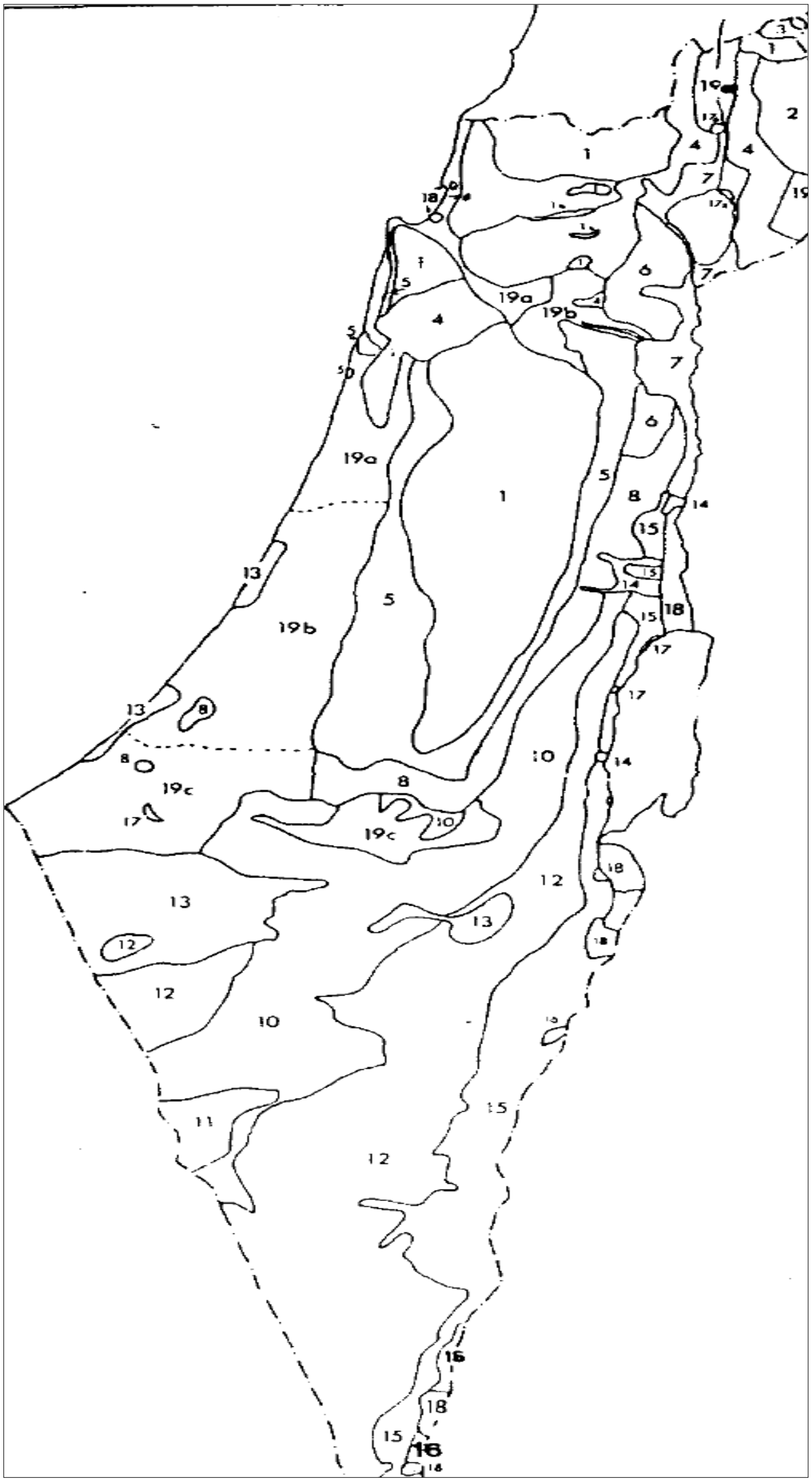

Ceratonia siliqua cultivation possibility in Jericho



Maquis and Forest

1. Quercus calliprinos woodlands
2. Montane forest
3. Park forest of Quercus Ithaburensis
4. Park forest of Ceratonia siliqua and pistacia lentiscus
5. Ziziphus lotus with Herbacious vegetation
6. Savannoid Mediterranean vegetation
7. Semisteppe batha
8. Tragacanth vegetation
9. Steppe vegetation
10. Steppe with trees of pistacia atlantica
11. Desert Vegetation
12. Sand Vegetation
13. Oasis with Sudanian trees
14. Desert Savannoid Vegetation
15. Haloxylon Periscum on sands
16. Swamps and reed thickets
17. Wet Salines
18. Synanthropic Vegetation

a.with remnant Quercus Ithaburensis

b. With ziziphus spina- christi

c. With ziziphus spina- christi and Acacia raddiana trees

Figure(4.54) Vegetation Units of Israel , Jordan & Sinai

Chapter Five :

5. analysis for the necessity of ecological corridor(Case study Ramat Hanadiv)

Biological diversity is highly dependent on the quality, quantity, and spatial cohesion of natural areas. Fragmentation of natural habitats severely affects the abundance of species. A solution to this problem is the development of ecological networks, linking core areas of nature by means of corridors and small habitat patches. I would like to give an example as acase study from Israel for the results of the necessity of an analysis of the ecological network for Ramat Hanadiv (Umm el-'Aleq ["Mother of leeches"] in Arabic), Historically Umm el-'Aleq was a small Palestinian Arab village where in the nineteenth century a farmstead (Beit Khouri) was constructed by the Palestinian Arab Christian family of el- Khouri from Haifa. Ramat Hanadiv is located on the coast north of Tel Aviv, at the southern end of Mount Carmel (Figure 1). The area measures some 400 ha. Ramat Hanadiv Nature Park features a mosaic of different landscapes and habitats, both natural and manmade, like (planted) groves, dense maquis, open grassland, and rocky slopes. Nature management is intended to ensure the continued existence of the Nature Park's flora, fauna, and characteristic landscape. Thousands of visitors are attracted to the Memorial Gardens, the Nature Park, and the Visitors Pavilion. Ramat Hanadiv has high biodiversity. The area has some 80 species of mushrooms (out of a total of 270 found in Israel); 47 species of butterflies (out of a total of 141 found in Israel); 37 species of birds (out of a total of 540 found in Israel); and over 620 plant species (out of a total of about 2,800 found in Israel). The species richness is particularly great considering the size of the area. Some of these include Cyclamen, Irises, Anemones, rare Allium species, Wild boars, Indian crested porcupines, Roe deer, Hyrax, and Jackals, to mention just a few.

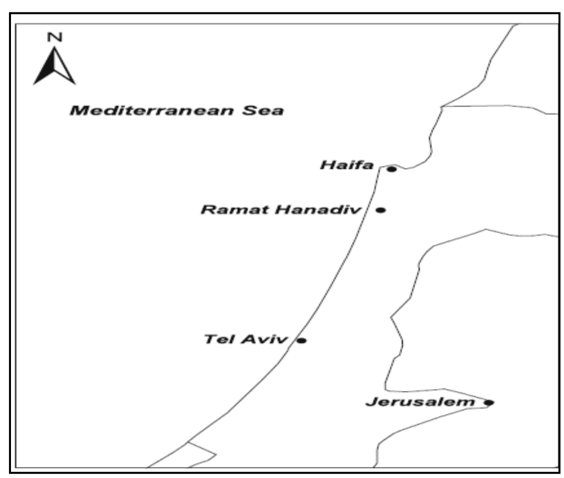


Figure (5.1) Ramat Hanadiv Location

LARCH Landscape ecological model was used to assess, first, the long-term viability of the wildlife populations of Ramat Hanadiv, and secondly, to identify where the most important landscape connections or corridors are situated. For this purpose, some species which are indicative of Ramat Hanadiv, and may be affected by fragmentation were selected ; six mammal species, one bird species, one reptile, and one butterfly species. For these species, ecological information was collected and parameters required for modelling such as habitat preference, home range, and dispersal distance were derived where possible from existing local literature. In some cases data from other areas or from the LARCH database was used. Parameters were adjusted for the local conditions based on expert input. A land cover map was prepared in GIS based on a land-use map. This map combined with the vegetation map for Ramat Hanadiv, a forest cover map, and remote sensing data for the wider region, is considered of sufficient quality for species modelling. Of the nine species initially selected, seven species provide meaningful results on the landscape scale, for these habitats. Analysis shows, that only three species are viable in Ramat Hanadiv alone and that almost all require some exchange with surrounding populations. The exchange with surrounding areas is therefore essential for biodiversity in Ramat Hanadiv. In particular, the large mammal species, Roe deer and Mountain gazelle, are vulnerable to fragmentation and are likely to disappear in the long term. However, almost all species will decrease as a result of the scenario of industrial development. Specific defragmentation measures are important for Roe deer and Mountain gazelle, but will benefit all other species as well. The best measure to improve viability will be to ensure that corridors eastward are maintained as these are the true ‘lifelines’ for Ramat Hanadiv. The best location for the corridor would be northeast of Ramat Hanadiv, through the industrial zone. Another possible corridor exists in regional plans along the Taninim River, but this possibility has not been studied in detail. This corridor would require further analysis and likely significantly more resources would be required considering the length of the corridor and the current land-use (a much wider corridor would be necessary if the length were to increase). As such, this possibility has not been assessed in this study. The width of the planned corridor (50 m) is insufficient for the important species as the corridor should be at least 100-150 metres wide. Also, the corridor requires that a safe and functional crossing of the main road is developed. This should still be addressed in greater detail. Additional recommendations for Ramat Hanadiv include involvement of stakeholders in the planning process, development of the quarry, and specific measures to develop a ‘green business site’. Stakeholders are an essential part of a harmonised development plan. The quarry south of Ramat Hanadiv can add crucial habitat, which can also support wetlands in the region. A green business site can support the environmental goals of Ramat Hanadiv.The best measure to improve the landscape connectivity will be to ensure that corridors eastward are maintained. These are true ‘lifelines’ for Ramat Hanadiv. The best location for the corridor would be northeast of Ramat Hanadiv, through the industrial zone. The width of the planned corridor (50 metres, according to the planning map) is insufficient for the important species. The landscape connectivity analysis shows that the corridor should be at least 100-150 metres wide In addition, the corridor assumes that a crossing for the main road, that is both safe and functional for the selected species, is developed that. The effectiveness of a wildlife crossing depends very much on the species for which it is intended and the specific design of the crossing (Grift et al. 2013). This should still be addressed in greater detail, as is planned for the next phase. A potential corridor exists in regional plans along the Taninim River, but is not yet worked out in any detail. This corridor would require further analysis and likely a significantly greater investment of resources, considering the length of the corridor and the current land-use along the river. A much wider corridor would be necessary if the length of the corridor increases significantly, since species will be deterred if they have to pass through corridors over longer distances. Additional measures which must be considered in the design phase are the fences to stop wildlife from entering the roads, and traffic regulating systems to avoid car collisions. Also, the vegetation should provide sufficient cover for animals so they can make effective use of corridors. Animals can be guided towards the entrance of a road crossing through effective use of the vegetation and morphology of the terrain. The corridors considered and studied are terrestrial corridors, aimed for species from forests or grasslands. The functionality of such an aquatic corridor has not been assessed, but the river is important as well, for connecting wetland areas situated west of Ramat Hanadiv. In particular, if the quarry south of Ramat Hanadiv is developed and restored, it could form an important wetland area and stepping stone for aquatic species. At the same time, ponds in the quarry would provide additional water for wildlife populations.The function of a landscape as a network can be tested on the basis of a number of species, which can be attributed to an ecosystem type. The ecosystems that are evaluated, in fact, combine to form the landscape. To evaluate the functioning of the landscape for sustainable wildlife populations, the LARCH model is used.The landscape-ecological model, LARCH (Landscape ecological Analysis and Rules for the Configuration of Habitat), developed at ALTERRA, is a tool to visualise the persistence of metapopulations in a fragmented environment.LARCH provides information on the metapopulation structure and population persistence in relation to habitat distribution and carrying capacity. LARCH-SCAN assesses spatial cohesion of a potential habitat, and provides information on the best ecological corridors in the landscape. The LARCH model is run with a land-use map or vegetation map as input , the principles of LARCH are simple. A species, relevant for nature conservation or an indicator species representing a suite of species is selected, to assess the natural areas. The size of a natural area (habitat patch) and vegetation structure determine the potential number of individuals of a specific species it can contain. The distance to neighbouring areas determines whether it belongs to a network of the species. All areas in a network contribute to the population and depending on species characteristics, the size of the network population is determined. Based on that it is determined if the network population is persistent or sustainable for the species. LARCH requires input in the form of habitat data (e.g., a vegetation or land-use map) and ecological parameters (e.g., home range, dispersal distance, and carrying capacity for all habitat types). LARCH parameters are based on literature and empirical studies. Simulations with the dynamic population model METAPHOR have been carried out to validate parameters and standards for the model (Chardon and Verboom 2001; Foppen et al. 1999; Opdam et al. 2002; Van der Sluis et al. 2003a; Verboom et al. 2001; Verboom et al. 1991; Vos et al. 2001). Actual species distribution or abundance data are not required for LARCH since the assessment is based on the potential for an ecological network of a species. It should be kept in mind that the results from LARCH present the potential distribution of a species, i.e., disregarding the quality of an area.

LARCH-SCAN

Beside surface area, the landscape connectivity or spatial cohesion is also important ((Hanski et al. 1997; Verboom and Pouwels 2004). The surface area determines the expected number of individuals in an area, while the connectivity primarily depends upon the carrying capacity of a patch and the dispersal capacity of a species. The dispersal distance of a frog is much smaller than that of a large mammal, such as the red deer. In effect, this dispersal distance defines whether or not habitat patches will form part of a network for a species. A red deer might utilise forest areas within a radius of 50 kilometres, whereas a frog only utilises habitat within a radius of 300 metres from its breeding site.LARCH-SCAN works with grid maps or square grid cells, for calculation purposes. The dispersal range of a species in a landscape can be described by a function in which alpha is the key parameter, describing the distance over which potential source patches can still deliver immigrating individuals

(Hanski et al. 1997). The extent of potential habitat surrounding a cell that contributes to this measure of connectivity is determined for each grid cell. Here, the value of the potential habitat for a grid cell depends upon the carrying capacity (or the size) of the habitat. Because the method examines each individual grid cell, the degree of connection between habitats is considered in this measure, as are the surface areas of the habitats themselves. After all, a grid cell located in the middle of a very large habitat patch will have a high connectivity value. The spatial cohesion provides an insight into the degree to which areas are connected and to the potential for an area to function as a corridor for species. Roads (and barriers) have been taken into account in defining the spatial cohesion.

The analysed ecosystems are woodlands, shrubland / maquis, and grasslands. The viability for a number of representative species for these ecosystems which are sensitive to fragmentation was assessed. A list was prepared with potential species for analyses with the LARCH model. These species were discussed with a group of local experts including the park manager, species specialists, the park technical advisor, and a ranger from the National Parks Authority (NPA). Based on this discussion, nine species were selected which is a broader selection than the five originally selected species.

The selected species are:

- Large mammal: Mountain gazelle, Roe deer
- Medium-sized mammal: Badger, Fox, Indian crested porcupine
- Small mammal: Yellow-necked mouse
- Butterflies: False apollo/Eastern festoon
- Birds: Chukar partridge
- Reptile: Armoured glass lizard

The species data/parameters for modelling are derived from literature on the region. These parameters are critically compared with literature from elsewhere. If no specific parameters are available, data from the LARCH database is used. If this is not available, e.g., for Armoured glass lizard, information from a similar species is used. The reliability of the data is indicated in the results.The selected species differ in their dispersal range and habitat requirements. The range of species varies from less than one kilometre to a range of 15 kilometre or more.

Similarly the habitat requirements for a key population differ e.g., the Yellow-necked mouse will persist in a relatively small area of a few hectares, whereas a Badger requires extended areas for foraging. In the table(5.1) the position of the species is indicated.

Species and Ecosystem

Table 5.1 Selected Species and their ecosystem for the case study of ecological corridor necessity

Scientific Name	English Name	Forest	Shrub land	Grassland
Capreolus capreolus	Roe Deer	**X**	**X**	
Meles meles	Badger	**X**	**X**	**x**
Vulpes vulpes	Fox	**X**	**X**	
Hystrix Cristata	Indian porcupin	**X**	**X**	**x**
Apodemus flavicollis	Yellow –necked mouse	**X**	**X**	
Gazella gazella	Mountain gazelle	**X**	**X**	**x**
Ophisaurus apodus	Armoured glass lizard		**X**	**x**
Alectoris chukar	Chukar Partridge		**X**	**x**
Archon apollinus	False Apollo /Eastern Festoon			**x**

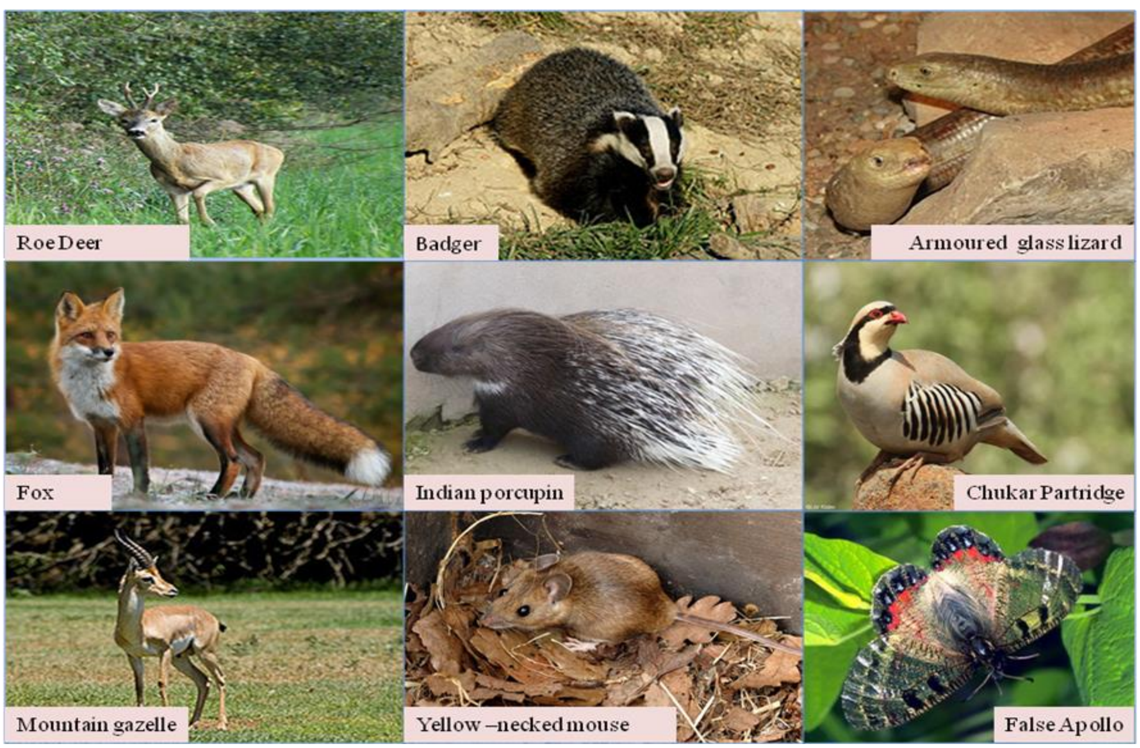


Figure (5.2) the selected specis in Ramat Hanadiv case study

5.2Maquis –shrubland

Mountain Gazelle

The gazelle is both a grazer and a browser, depending on the season (Dijkstra et al. 1987; Geffen et al. 1999) but also adjusts its behaviour as a result of hunting pressure (Levins 1970). Female groups of gazelles are open units, moving freely over territories of male gazelles. The females make up the majority and only some 20% of males maintain their own territory. The reproductive units are therefore defined by female gazelles. The gazelle's main predators are the golden jackal and feral dogs. Also, road kills may have some impact at Ramat Hanadiv. Under natural conditions, density of gazelles is some 13/km² (Ramat Qedesh, in Dijkstra et al .1987). Baharav estimated 14-16/km², and Professor Mendelssohn estimated 10-15/km² (personal communication) Under more arid conditions, for example in Arabia, densities can be much lower, ranging from 0.935 to 1.935 gazelles/km² (Wronski 2010). Specific studies were done for Ramat Hanadiv, indicating an average home range size for female gazelles of 16.5 ha or 6 RU/100 ha (with a range of 10.9-24.3 ha) (Geffen et al. 1999). The gazelle population was some 60 animals on 4.5 km², which equals a density of 10 RU/100 ha, but now there are probably at most 40 (Ramat Hanadiv- staff information).

Table (5.2) Sumarry Data for modelling for selected species in Ramat Hanadiv

Species	Local distance (m)	Network distance (m)	Density (RU/100 Ha)
Roe deer	500	2.000	6.0
Badger	400	1.200	4.0
Crested porcupine	250	2.500	5.0
Gazelle	400	1.000	10.0
Fox	500	2.500	2.5
Yellow-necked mouse	150	1.000	50
False apollo / Eastern festoon	150	750	150
Chukar partridge	1.000	15.000	40
Armoured glass lizard	50	200	75

The LARCH analysis focuses on the development and sustainability of viable populations. This is based on species-specific parameters or characteristics, as well as empirically defined parameters (Verboom et al. 2001). The most viable situation for a species population is one large area of optimal habitat, large enough for a Minimum Viable Population (MVP). A MVP is defined as a population for which the chance of extinction is less than 5% in 100 years. Such a population is considered to be 'viable' in the long term. Slightly less viable is a key population, which is defined as a population which is viable under the condition of one immigrant per year. Otherwise, we consider an area a 'small population' if the area within the home range of a species is large enough for at least one breeding pair (Verboom et al. 2001).

A fragmented population occupies different habitat patches that can still be viable. Viability norms in LARCH are dependent on the presence of a key population and the total size of the population as shown in Table (5.3). Exchange between populations implies that areas are somehow connected (often through corridors) and form a metapopulation.

In principle, one larger and connected habitat is more viable than smaller fragmented habitats of the same size. In order to achieve viability, more habitat is required in a situation that is very fragmented and less habitat is needed in the case that one extensive natural area exists which is large enough for a MVP .

Mountain gazelle

Populations

Ramat Hanadiv has a small population of gazelles. It is likely simply too small for a key population. However, it is very likely that there is exchange with the larger key population further to the Northeast, in the Alona Forest and the Carmel area. The impact of the scenario on the population size is limited as only some small area is lost.

Viability of the Network

The population of Mountain gazelle at Ramat Hanadiv alone is not viable. The local population of gazelles in Ramat Hanadiv forms part of a larger network of gazelles in the region. It is connected with the larger population inland through agricultural fields, orchards and semi-natural areas. However, because the road and industrial zone will cut off Ramat Hanadiv from the hinterland, the population will not be viable anymore, and no exchange with the larger key population will be possible. As a result, it is probable that the species in the long term will go (locally) extinct and that it will not persist in Ramat Hanadiv. The development of the industrial zone is critical for the long term survival chances of the Mountain gazelle. In the scenario with an upgraded road and an expanded industrial zone, the population of gazelles in Ramat Hanadiv will be isolated from the rest of the region. In the long term, a well-functioning corridor is essential for the survival of the species in Ramat Hanadiv. Considering the ecological knowledge of the species and the spatial data, the modelling is considered reliable.

Table (5.3)LARCH analysis results for the Mountain gazelle.

Species	**Local population**		**Current –Ramat Hanadiv in Region**	**Viability of population Scenario Industry RH**	**RH isolated as an Island**
	Current	scenario			
Mountain gazelle	Small	small	Viable	Not viable	Not Viable

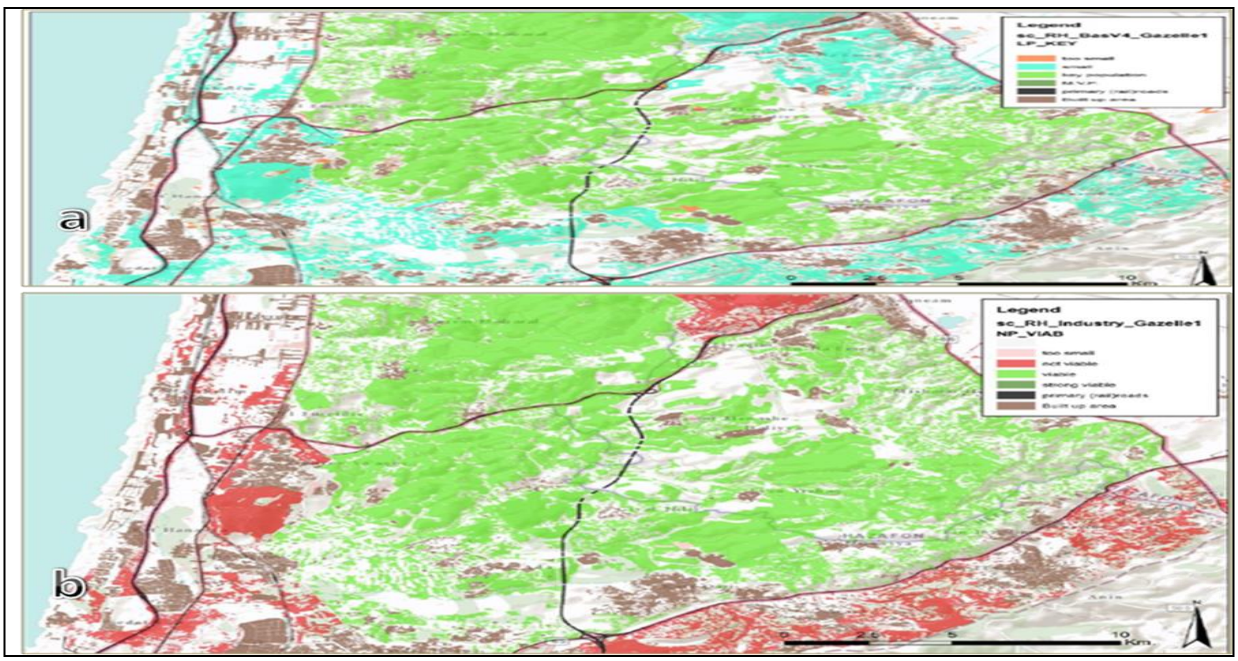


Figure (5.3) LARCH model results for the Mountain gazelle. Map (a) shows the size of the local populations for the current situation.Map(b) shows the viability of the metapopulation if the industrial zone is developed.

Larch model results for the Mountain gazelle map shows the size of the local populations for the current situation , map below shows the viability of the metapopulation if the industrial zone is developed

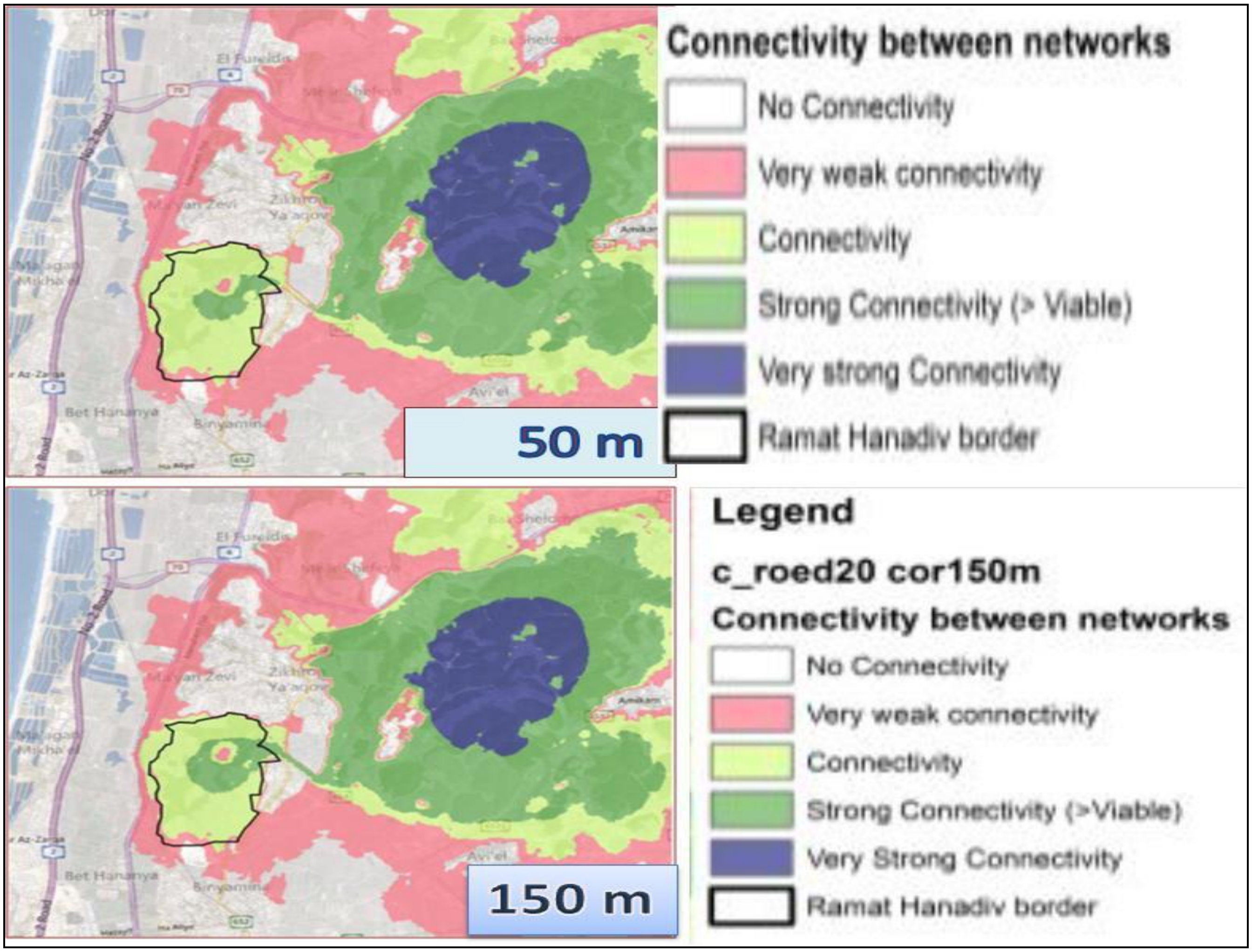


Figure (5.4) Landscape connectivity for Ramat Hanadiv (black outlined area) with direct surrounding areas for the Roe deer.. Map above show a corridor of 50 m wide. While Map below show the improved connectivity in the case of a 150 m wide corridor.

To maintain viable populations and landscapes with rich natural flora and fauna, it is essential that the area is embedded in a wider ecological network. The connecting corridors will ensure sufficient landscape connectivity. This is especially important for less mobile species, i.e., in the case of relatively small areas in fragmented (often urbanised) situations, like Ramat Hanadiv. The landscape connectivity analysis shows that best connectivity is northeast of Ramat Hanadiv. However, it is important that all corridors for various ecosystems (terrestrial and aquatic corridors) are protected and restored as much as possible.

The best measure to improve the landscape connectivity will be to ensure that corridors eastward are maintained. These are true 'lifelines' for Ramat Hanadiv. The best location for the corridor would be northeast of Ramat Hanadiv, through the industrial zone. The width of the planned corridor (50 metres, according to the planning map) is insufficient for the important species. The landscape connectivity analysis shows that the corridor should be at least 100-150 metres wide. In addition, the corridor assumes that a crossing for the main road, that is both safe and functional for the selected species, is developed that. The effectiveness of a wildlife crossing depends very much on the species for which it is intended and the specific design of the crossing (Grift et al. 2013). This should still be addressed in greater detail, as is planned for the next phase. A potential corridor exists in regional plans along the Taninim River, but is not yet worked out in any detail. This corridor would require further analysis and likely a significantly greater investment of resources, considering the length of the corridor and the current land-use along the river. A much wider corridor would be necessary if the length of the corridor increases significantly, since species will be deterred if they have to pass through corridors over longer distances. Therefore, this has not been assessed in this study. Additional measures which must be considered in the design phase are the fences to stop wildlife from entering the roads, and traffic regulating systems to avoid car collisions. Also, the vegetation should provide sufficient cover for animals so they can make effective use of corridors. Animals can be guided towards the entrance of a road crossing through effective use of the vegetation and morphology of the terrain. The corridors considered and studied are terrestrial corridors, aimed for species from forests or grasslands. Aquatic or riverine species have not been taken into account. The functionality of such an aquatic corridor has not been assessed, but the river is important as well, for connecting wetland areas situated west of Ramat Hanadiv, along the coast near Ma'agan Michael. In particular, if the quarry south of Ramat Hanadiv is developed and restored, it could form an important wetland area and stepping stone for aquatic species. At the same time, ponds in the quarry would provide additional water for wildlife populations.

The modelling clearly shows that the landscape connectivity may be the 'tipping point' for most of the modelled species, particularly the vulnerable Roe deer and Mountain gazelle which depend on the connection with other natural areas. The affected species are representative for medium and large mammals, reptiles, and less mobile invertebrates. The Taninim River may function as a corridor for some species. The actual value of the river corridor is low, since the surrounding area is mostly used for intensive farming. The landscape resistance of farmland is much higher than areas with natural vegetation. The total length of this corridor, some five kilometres from Ramat Hanadiv to the Alona Forest, just north of the village of Avi’el, would require many landscaping measures to ensure that it would function as a corridor. According to planning regulations from the river authorities, 25 metres along the river should be protected. If that would in fact happen, the value would increase for wildlife and the Taninim River could form a more effective corridor. The assessment of landscape connectivity shows the clear impact of the corridors, and also the effect of the width of the corridor. A relatively narrow corridor of 50 metres wide shows a barrier-effect which decreases the modelled connectivity around Ramat Hanadiv. A corridor with a width of some 150 metres creates a strong connection to and from the Eastern nature areas. This clearly has a positive effect on the landscape connectivity so; the corridor has a positive effect on landscape connectivity. However, the width of a corridor should be defined based on local conditions and possibilities for relevant species. This should be addressed in the next phase of the project.

Analysis shows that few species are viable in Ramat Hanadiv alone. Almost all require some exchange with surrounding populations. The exchange with surrounding areas is therefore essential for biodiversity in Ramat Hanadiv. In particular, the large mammal species are vulnerable to fragmentation i.e., the Roe deer, and Mountain gazelle. Reptiles and a vulnerable species like butterflies will decrease as a result of the analysed scenario. Those species may disappear in the long term. This underlines the importance of the establishment and protection of natural corridors for wildlife species and of connecting Ramat Hanadiv with areas like the Alona Forest. The corridors are truly lifelines for Ramat Hanadiv and are essential to maintain long-term biodiversity.Corridors are Essential for the perpetuation of wildlife in Ramat Hanadiv Analysis shows that almost no species are viable in Ramat Hanadiv alone and that almost all require some exchange with surrounding populations. The exchange with neighbouring areas is therefore essential for biodiversity in Ramat Hanadiv and its surroundings. This underlines the importance of the establishment and protection of natural corridors for wildlife species that will connect Ramat Hanadiv with other natural areas.

The figure below shows the natural reserves and their location in the WestBank
We can follow this scientific case study .

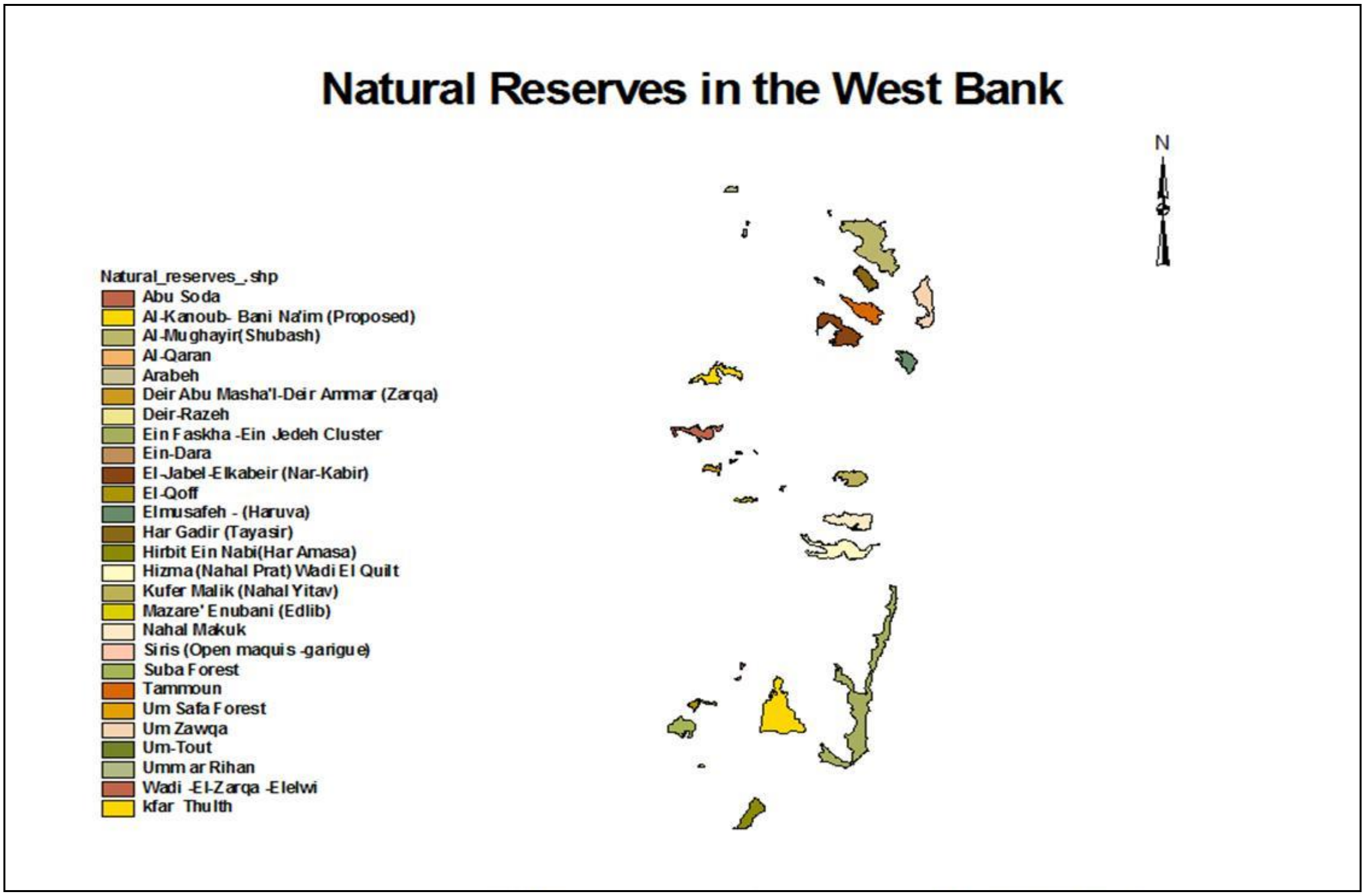


Figure (5.5) Natural Reserves in the WestBank

According to the situation in west bank related to many factors i suggest to start make acase study for the necessity of ecological corridor in Jenin between the selected site shobash and the Natural reserve Tayasir in Tubas District .

Conclusion :

Our preliminary, cursory approach may help increase knowledge and facilitate conservation strategies both at the site and network levels (for ecological network planning and connectivity conservation) in critical circumstances where there is a lack of sufficient data and information to fully evaluate the biological resources and ecological functions and in areas where urgent protection is needed , our research serves as a first-step pilot study for additional, more in-depth surveys, the ability to Quantitatively describe landscape structure is prerequisite to the study of landscape function and change and various metrics have emerged from landscape ecology for this purpose, the landscape metrics used in this research showed that the landscape for the four district is fragmented and their shape is complex and more heterogeneous this was clear from the values of Different Metrics especially Area Weight Mean patch fractal dimension (AWMPFD) which was higher than one and very close to two in all the Districts depending on the use of land use maps for the year 2000 . All Results from this research show that the state of Palestine biodiversity is in critical Situation at small sites levels (depending on the selected sites) and at Landscape level results shown from this study .

Shifting our research focus from local to landscape-moderated effects on biodiversity will be critical to developing solutions for future biodiversity and ecosystem service management.

Recommendation:

- More analytical approach using specific metrics of diversity as indicators of stress, pressure and impact of local threats may also be required to inform management priorities.
- Study for necessity of ecological corridor in Jenin District between shobash one of our selected site in this research and AL Mughair that I suggest to do according to many factors.
- Urgent monitoring programs for the most threatened site in this research and continue researches about the less knowledge threats according to our study.
- Establish with the Ministry of Agriculture , Palestinian Environmental Authority , Wildlife protecting society , Universities and other societies interested in biodiversity conservation Monitoring programs for endangered sites and start from our threaten sites as a priority for protect Palestine biodiversity .
- Another study continue this work , using patch analysis method is very important to compare the results of this study and others depend on recent land use map for the same district.
- International support should be achieved to protect Palestinian landscapes from different levels for increase the abilities of youths scientifically to protect their Environment.

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