LAND DEGRADATION IN PALESTINE
Main Factors, Present Status and Trends, Recommended Actions

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Introduction:

Palestine, represented currently in the West Bank and Gaza Strip, has a unique geographic location at the intersection between three continents, Africa, Asia and Europe and between very different ecological zones (Irano-Turanian, Mediterranean, Saharo Arabian and Sudanian), which results in a variety of ecosystems.

The West Bank and Gaza Strip (W&G) are located east to the Mediterranean Sea between 29° and 33° North Latitude and between 35° and 39° Longitude. The total area of Palestine (including the Palestinian part of the Dead Sea) is about 6245 km^2 (365 km^2 in Gaza Strip). It is populated by more than 3.5 million Palestinians, according to the Palestinian Central Bureau of Statistics 1997 survey. The Gross Domestic Product was estimated at around 4173 million US($) dollars, and the income per capital is estimated at 1500 $. It is an Israeli-occupied area with current status subject to the Israeli-Palestinian Interim Agreement; permanent status has to be determined through further negotiation between Israel and the Palestinian National Authority (PNA).

Map1: West Bank and Gaza Strip – Palestine.

As a result of absence of management for Palestinian natural resources for the last 36 years, in addition to the high population growth rate (3.5-5.0%), centralization of peoples in smaller spots of land – as a result of the Israeli occupation, Israeli colonizing activities like colonies construction, bypass roads and military bases, all the above mentioned increased the pressure on soil in particular, and natural resources in general. This is resulted in a comparatively high rate of soil degradation. However, this paper concentrates only on physical, geographic and national human impacts on soil degradation. This trial is made while adhering to the optimistic forecast for a justice and lasting peace in this region.

Palestine is an area with very limited natural resources. The geographic, political and socioeconomic uniqueness of this area imposes additional pressure on these resources. Although there is a deep understanding and appreciation of the extent of soil degradation in Palestine, there are hardly any available records or rates of soil degradation, nor are significant parameters systematically monitored. The few existing published work is unconnected and mainly descriptive and qualitative.

Factors Inducing Land Degradation:

The technical description will be applied to the West Bank as it represents about 95 of the whole area. Gaza Strip will be briefly described in a special section. The scale of interest is the national scale, however, some regional scale would be highlighted to help in setting priorities. Maps were highlighted since they are useful to inform people and decision makers about the general status of land degradation. There are neither off-site nor on-site estimation of the costs of land degradation and its impacts would be mainly described in qualitative terms.

The driving forces or factors inducing land degradation can be classified into human activities and natural factors. These factors would be described as follows:

I. Human Induced Factors:

I.1. Historical Aspects:

It is beyond the scope of the present paper to describe in detail the history of Palestine. However, this land represents a unique area in terms of its history. The oldest city inhabited in the world is located in Palestine (Jericho). The successive civilizations and wars put certain degree of pressure on land resources. Wars throughout the history of Palestine led to severe vegetation destruction. At the same time, the positive impact of Romans management of land to prevent soil degradation should be noted. Roman agricultural stone walls for soil protection are still alive in many parts of the country.

I.2. Political Aspects:

Israeli occupation and absence of control over land is the main factor affecting the state of land degradation in Palestine. This situation affected all aspects related to land conservation and land use planning.

According to the agreements between Israelis and Palestinians, W&G land is divided into A, B and C classified areas with different control authorities and regulations (map 2). Area A should be under full Palestinian control, area B is under Palestinian civilian control and Israeli security control, area C is under full Israeli control. The estimated area of A land is 722 km^2 (12%); B land is about 1318 km^2 (22.6%). Also, there is about 3% of the land assigned as a nature reserve extending over Hebron and Bethlehem Districts. The total land area that the Palestinians can control is about 38% of the area of the West Bank. The remaining 62% (C area) is under full Israeli control. This area is mainly occupied by colonies, closed military zones, military camps or declared as nature reserves (52%). The remaining 10% of the area C is occupied by Palestinian villages and hamlets but under Israeli full control. It is evident according to this situation how difficult is managing the natural resources taking in consideration that the Palestinian controlled area is mainly urban with small area of agricultural use. This restriction has led to urban sprawl on agricultural land.

Map 2: Classification of the West Bank according to authority control.

1.3. Socioeconomic Aspects.

The special socioeconomic facts in Palestine affected negatively soil conservation. Land tenure system and ambiguity of land ownership, the inaccessibility of land due to the lack of rural and agricultural roads, lack of liquidity and cash, lack of economic motivations, limited education to farmers, lack of credit and marketing facilities and simple technology used in agriculture are important social and economic factors led to less utilization of land and hence more land

degradation. Also, with population growing at around 4% a year, and the population density in some of the most vulnerable rural areas increasing even faster, the dangers posed by this cycle of increasing poverty and accelerating land degradation are readily apparent.

Lack of awareness of environmental, social and economic values of land degradation is a serious factor of land degradation. For example, over-grazing of the available pastures, branches of evergreen trees are often lopped off to provide fodder for livestock. There is an intensive exploitation of the scanty vegetation to meet the ever-increasing demand for firewood, fencing and feeding animals. The change of the type of Palestinian agriculture in addition to the use of vegetation for the manufacture of charcoal and the burning of lime have an adverse effects on the amount of vegetation. Another important reason for soil erosion is the significant disappearance of terrace culture. However, people are willing to participate taking in consideration that historical background culture and religion encourages land protection and agricultural work.

I.4. Absence of Land Use Planning (mismanagement of land).

Effective land management is negatively affected by the absence of land use planning. W&G have been under Israeli occupation since 1967. This occupation restricted the use of land for various purposes mainly due to security reasons. Urbanization and even wells construction are prohibited without an Israeli permission. Currently, land reclamation projects are confined to A and B zones which are either urbanized or agricultural areas. From the land cover / use table shown below, the artificial surfaces represent 7.4% of the West Bank Area; agricultural areas represent 36.1%; forests and semi natural bodies represent 53.3% and the water bodies (Dead Sea) represent 3.1%.

From the above-mentioned figures for land use, it is evident that more than half the area of the West Bank is non-agricultural. This area is concentrated at the eastern part of the West Bank that is mainly non-urbanized. The agricultural area as shown in the map, is distributed adjacent to the artificial surfaces that are mainly urbanized areas. This fact indicates that the future urban expansion will be at the expense of the agricultural land taking in consideration that the Palestinians do not have the access to the semi natural areas to utilize it for urbanization. Also, leaving vast areas of the semi natural land away from the management services to combat erosion and desertification means more land degradation in these parts.

At the farm level, the cultural and conservation practices are important factors leading to land degradation. Of these practices are soil tillage and seedbed preparation, management of harvest residues, plantation density, fertilization, uncontrolled spread of industrial plantations and mechanized agriculture, control of pests and diseases weeding, and combination of crops in time and in space. On the other hand, over the centuries Palestinian farmers and grazers developed farming systems that were compatible with their environment. These systems permitted a steady, if rather low, level of production that did not entail land degradation.

Map 3: General land use of the West Bank.

Vast areas in Palestine are being threatened by wildly over-zealous plans for expanding heavy industry, tourism initiatives, and unnecessary transportation infrastructure without land use plan

of action. For example, land surrounding the Dead Sea that are mainly pristine nature reserves, are threatened by such activities.

The land cover/use in the West Bank would be classified as follows according to CORINE first, second, third and fourth levels:

CORINE 1st Level	**CORINE 2nd, 3rd and 4th levels**	**Area (dunum)***	**Total Area (dunum)**
Artificial Surfaces	Continuous urban fabric	10042	**429802**
	Refugee camps	5833	
	Discontinuous urban fabric	306223	
	Colonies	70364	
	Industrial or commercial units	4440	
	Military camps	7158	
	Airports	1140	
	Mineral extraction sites	11871	
	Construction sites	7904	
	Green urban fabric	1144	
	Sports and leisure facilities	3683	
Agricultural Areas	Non-irrigated arable land	312158	**2108916**
	Drip irrigated arable land	85125	
	Non-irrigated vineyards	94984	
	Drip irrigated vineyards	4326	
	Palm groves	4242	
	Citrus plantations	6724	
	Other fruit trees	5232	
	Olive groves	748822	
	Non-irrigated complex cultivation pattern	163741	
	Irrigated complex cultivation pattern	104286	
	Agricultural land with significant area of natural vegetation	577376	
Forest and Semi Natural Bodies	Broad leave forest	2472	**3114962**
	Coniferous forest	48515	
	Mixed forest	333	
	Natural grassland	1673537	
	Sclerophyllous vegetation	88766	
	Transitional woodland shrub	55313	
	Beaches, dune and sand plains	16074	
	Bare rock	25739	
	Sparsely vegetated area	1171067	
	Halophytes	33146	
Water Bodies	Sea (Dead Sea)	191184	**191184**

1 ha = 10 dunums

II. Natural Factors:

II.1. Climate.

The climate of the West Bank is traditionally described as Mediterranean, which is characterized by winter rain and summer drought. However, there is a great diversity in this climate as shown in map4. This diversity ranges from extremely arid to humid according to De Martonne aridity index classification for arid areas.

The total area of extremely arid, hyper arid and arid climates is 2461 km^2 which comprising about 44% of the land area of the West Bank; the area of the semi arid part is 1682 km^2 (about 30%); the sub humid area is 1435 km^2 (25%) and the humid area is 67 km^2 (1%).
Map 4: Climate classification of the West Bank.

The area suffering from the severe aridity (44%) is located at the eastern and far southern part of the West Bank. This area, which is lightly populated, should form the strategic reserve of agricultural land for Palestinians. However, this degree of aridity imposes hard restrictions on utilizing this land for agriculture use in the absence of control on it. The semi arid area, which is promising agricultural land is unfortunately suffering from urbanization sprawl according the population distribution; the same situation is applicable to the sub humid and humid areas (26%) which is heavily populated. The vast area of arid climate provoked salinization process that is the main driving force to desertification in this area.

Considering the climate change, the assessment of its impact on soil properties and performance are mostly based on hypothetical scenarios and data obtained under controlled conditions. Thus predictions are rather more qualitative than quantitative and could contain significant bias.

Results correlated with historical data led to the conclusion that in the case of global warming, the Mediterranean region will become drier. This will involve the movement northward of the westerlies belt, while in the same time the Sahara belt will move northwards. Thus lower rates of precipitation and longer periods of droughts are the forecast for the countries bordering the Mediterranean, especially those in its southern domain. *Various expected climatic changes* in Palestine by 2020 like the mean temperature increase (0.3-0.4 ºC), reduction in precipitation (-2 to –1%), increase in evapotranspiration, increased rain intensity and shortened rain season, greater temperature variability, etc, would have a negative impacts on soil degradation. These changes will reduce plant productivity and microbial activity with a concomitant decrease in soil organic matter. Also, it will reduce water holding capacity and soil permeability. Soil salinity will also increase because of high evapotranspiration and lower leaching effect of the reduced rain.

II.2. Geomorphology.

Although it is a comparatively small area, the West Bank is characterized also by a large degree of variation in topography. Its topography in characterized by its hilly nature that also contribute to land degradation. The elevation ranges between 1022 m above sea level to 400 m below sea level.

The land system classification of the West Bank (see map5) displays the diversity in the geomorphology of this area blended with climate. From the DTM background data and landform pattern classification, the main topographic features (harsh topography) affecting soil degradation (erosion) at the system scale would be described as follows:

Map 5: Land system classification of the West Bank and Gaza Strip.

Jordan Valley (434 km^2), which is represented in one system, has badlands (91 km^2) and terraces (118 km^2).
Eastern Area (2060 km^2), which is represented in systems: Far and Mid Northeastern Heights and Jerusalem Desert have moderately steep (498 km^2) and steep hills (549 km^2).
Jerusalem Hills (818 km^2), which is represented in the systems: Jerusalem-Ramallah Heights and Jerusalem-Hebron Foothills have moderately steep hills (592 km^2) and steep hills (55 km^2).
Hebron Mountains, which is represented in systems: Hebron Heights and Aldahiriya Hills have moderately steep hills (291 km^2), steep hills (190 km^2) and steep low hills (83 km^2).
Nablus Hills and the Semi Coastal Zone (1484 km^2), which is represented in Nablus Heights, Qalqilya Hills, Tulkarm Hills and Jenin Plain, has moderately steep hills (262 km^2), steep hills (48 km^2).
Steep hills are considered the most landform pattern prone to soil degradation. The total area of these hills, in addition to the badlands and terraces in Jordan Valley, is 2514 km^2 which is about 44.5% of the West Bank land area. Most of this area is intersecting with the extremely arid, hyper arid and arid area (1474 km^2). This area (26% of the West Bank) is strongly exposed to water and wind erosion and salinization.

Also, geomorphology affects the functions of soil in some plains. For example, Sanur plain which has an area of about 24.5 km^2 is suffering from water flooding in winter which prevent utilizing this area for agriculture. The main reason is that there are no outlets for water from this plain.

II.3. Scarcity of Water.

The scarcity of water and the deterioration of its quality is a major driving force for land degradation in Palestine. Palestine is among the countries with the scarcest renewable water resources per capita due to both natural and artificial constraints, amounting to only 100 m^3 per capita per year. This is far below the per capita available in other countries in the Mediterranean and even in the world. At present water demands exceeds the available water supply.

Surface water resources in the West Bank are very limited. The only permanent river that would be considered as a source of surface water is Jordan River. However, the Palestinians currently have no access to its water.

The major source of fresh water supply in the West Bank and Gaza Strip is the groundwater. The West Bank has three aquifers: the western, northeastern and eastern. It is estimated that the total renewable groundwater resources in the West Bank is between 590 and 690 MCM/year.

Part of this potential is being exploited either naturally (springs) or artificially (wells). Palestinians are allowed to use only 246 MCM per year.

There are about 360 major wells in the West Bank mainly belonging to Palestinian and were drilled before 1967. The total annual groundwater abstraction in the West Bank is about 121 MCM. 64 MCM is pumped from 228 agricultural wells and 43 domestic wells; the remaining 57 MCM is pumped from 49 wells controlled by Israelis and utilized for both domestic and agriculture.

The Palestinian water supply has a constant value due to Israel's policy of maintaining the 1967 level of water supply. Restrictions were imposed on the amount withdrawn by Palestinians, while new wells were established to provide water to Israeli colonies. The major water problem in the West Bank is the unequal distribution of water between Palestinians and Israelis due to Israeli control over water resources.

The West Bank, as can be seen on the climate map, has abundant rain in its northern and western parts, while land resources are rather limited there. On the other hand it has a relative abundance of land in the southern and eastern where precipitation is low. Thus one of the first endeavors the Government of Palestine should undertake, immediately after the establishment of Palestine state, is to tackle the problem of water deficiency in its southern and eastern parts. Thus, with regard to the management of water resources in the region, new approaches will have to be examined, and if necessary, new water resource development and management plans will have to be developed.

Pressures on Land:

The above-mentioned driving forces, either human or natural, led to various types of pressures on land resulted in the degradation of its quality and quantity. The location and severity of each significant land degradation process is stressed. The following are the main soil degradation processes and aspects that is taking place in the West Bank:

I. Soil Erosion:

Soil erosion is the most destructive degradation process to soils in the West Bank. It is caused by the combination of climate, harsh topography (steep to very steep slopes), thin vegetation cover and poor agricultural practices. Almost all types of soil erosion are taking place in the West Bank and all these types are accelerated by human activities. Water erosion is the most important type taking place in all of its types (sheet, rill, gully and tunnel) depending on the geomorphology and rain intensity. Soil erosion assessment is a prerequisite for sound land use planning; therefore, soil erosion risk map using Wichmeier formula for rainfall erosion losses was prepared utilizing various climatic and topographic factors. It is severe, as shown in the maps, in the mountainous areas that are exposed to heavy rainfall. Also, soil erosion is clear in areas with very steep slopes and low vegetation cover as in the case of Eastern Heights. Areas with more than 1 tons/ha of soil loss are comprising more than 50% of the West Bank area.

Looking at the soil and soil erosion risk maps of the West Bank, it is clear that brown lithosols, regosols loessial arid brown soils are the most types of soil prone to erosion. These soil types are abundant in the Eastern Slopes and Jerusalem Wilderness where steep and moderately steep slopes are the determinant factor in addition to the absence or scarcity of vegetation cover. Soil texture also plays an important role in the erodibility, for example, the surface horizon texture of brown lithosols, regosols, loessial arid brown, and loessial serozems is comparatively coarse and thus more readily detached by raindrop splash. In the case of steep slopes with certain aspects,

even terra rossa and brown rendzina soils (which are clayey) are exposed to high degree of erosion.
Regarding wind erosion, there is no available data, however, it is certainly taking place in the dry and coarse textured eastern parts of the West Bank and the eastern and southern parts of Gaza Strip.
Map 6: Soil erosion risk of the West Bank.

Map 7: Soil associations of the West Bank.

II. Soil Salinization.

In general, there is a close relationship between the climate, the moisture regime and the soil salinity. Investigating the climate classification map of the West Bank, it indicates that the soil in vast areas, particularly the eastern part, would be saline. On the other hand, since the soils of the West Bank originate mainly from limestone they have comparatively high percentage of calcium. This fact leads to binding other monovalent ions such as sodium that helps in reducing soil salinity.
There are several causes for soil salinity in the West Bank. The main causes are the extremely arid to semi arid climate in most areas; the bad irrigation management and practices and the water quality.
Soils in the Jordan Valley and adjacent slopes (extremely arid and hyper arid climate) exhibit high degree of salinity. Soil associations in this area have variable degree of salinity such as solonchacks, calcareous and loessial serozems, regosols and alluvial brown soils. Irrigation practices in the irrigated arable land of Jordan Valley have magnified the already existing soil salinity.
In areas where the depth of ground water is shallow, soils exhibit and have problems of salinity resulted from the accumulation of salts due to limited leaching capabilities. Even heavy textured soils have this problem such as the grumosols at the plain of Jenin and the southeastern parts of Nablus District.
Other areas of the West Bank are suffering from fluctuating soil salinity due to irrigation practices and soil quality. Salinity in these areas is fortunately reduced by rainfall that led to salt leaching. Also, soil types in these areas (terra rossa, brown and pale rendzina and grumosols) which have a considerable area of irrigated arable land, are not susceptible to soil salinity as those in Jordan Valley due to their heavy texture.

III. Soil Contamination.

One of the degradation processes that have severe impacts on the soil quality is soil pollution with different types of contaminants. One of the dramatic conclusions drawn is that may be there is a strong correlation between soil contamination with the fact that the West Bank and Gaza Strip have one of the highest percentage of cancer in the world according to the World Health Organization reports. Hebron District has the highest percentage in cancer in the world.

There are several causes for soil contamination in the West Bank. Pesticides and insecticides are the main soil contaminant in irrigated areas. About 200,500 dunums which are used as irrigated land in the West Bank (3.6% of the land area) are intensively exposed to these chemicals. It is estimated that the total quantity of pesticides used in Palestine in 95/96 growing season is 454 tons. Unfortunately some of the used pesticides are internationally forbidden.

The excessive and uncontrolled use of fertilizers is another source of contamination for both soil and groundwater. It is estimated that the total quantity of fertilizers used in 95/96 growing season is 49,420 tons.

Chaotic disposal of industrial and municipal wastes is another source of soil contamination in the West Bank. Sewage streams can be easily noticed around major cities and big towns leading to severe soil contamination. There are about 450 dumping sites in the West Bank. Unfortunately, most of the dumping sites are located in wrong places either adjacent to agricultural arable land or urbanized areas. There are several hot spots in terms of the negative effects of the industries waste disposal. For example, many industries are located inside Hebron City and their wastes disposed to the surrounding agricultural land. These industries are leather tanning, shoes making, ceramics and glass, electroplating and metal industries. They represent a serious source for the accumulation of heavy metals in soil.

Limestone waste sludge resulted from cutting stone factories concentrated in Hebron District is another source of soil contamination. Approximately 7500 tons of building stone slag is produced annually in the West Bank, representing thus a waste disposal problem.

The accumulated settled heavy particles of limestone slurry and dust would probably change the soil chemical and physical structure of the agricultural land adjacent to the quarry. The dust would increase the calcium carbonate percentage that leads to more alkaline soils that are already alkaline in this region. Also, these particles would change the texture of the topsoil depending on the particle size of the settled dust. Also, the wastewater resulted from the quarries, which is probably drained into the soil with the help of rain, would pollute the surrounding soils. As a matter of fact, studies should be conducted in the area to figure out the impact of the quarries pollutants on soil and the consequent impact on its fertility.

IV. Soil sealing:

The rate of soil loss due to surface sealing is relatively high in Palestine. Urbanization and transport infrastructure is rapid either by Palestinians or the expansion and establishment of Israeli colonies and confiscation of land.

In the eastern parts of the West Bank, there has been an increase in the animal population resulting in critical ratios of biomass to animals and consequently to overgrazing. During periods of drought, livestock have to be herded for long distances in search of water and suitable pasture, resulting in serious trampling due to the increased traffic by animals. As a result, there is seasonal migration of nomadic communities. These migrations are associated with soil deterioration, particularly around water holes.

V. Decline of soil fertility.

The above four mentioned pressures in addition to other factors as the uncontrolled fertilizers application clearly lead to the decline in organic matter, loss of nutrient elements and an increase in toxicity scale. There are no systematic recording of soil fertility parameters that would help in

evaluating the fertility status with time of soils in the West Bank and Gaza Strip. However, agricultural productivity in many areas indicates the degradation in soil fertility.

VI. Reduction of vegetation cover.

Although forest area in the West Bank is very small (about 4900 ha - <1%), it is estimated that 23% of the forest area has been destroyed from 1971 to 1999. The majority of this destruction has been caused by the construction of Israeli colonies and military camps.

Rangeland and natural grassland are also negatively affected in the last three decades due to the political situation. The limitation of the access to Palestinian herds resulted in intensive grazing to the remaining small area that is estimated to be about 15% of the former area.

VII. Loss of Biodiversity.

The uniqueness of Palestine is also represented in its high degree of biodiversity due to the diversity in soil and climate. At the crossroads of Asia, Africa, and Europe, Palestine region is composed of rich and diverse eco-systems that act as homes to many of rare species. Almost all the distinguished ecosystems in Palestine are under one type or another type of driving forces for biodiversity loss. For example, the Jordan Valley ecosystem comprising the Dead Sea is clearly a threatened ecosystem in terms of biodiversity loss due to land degradation.

Brief Description of the Status in Gaza Strip:

Gaza Strip is described separately in terms of the status of soil degradation because it has completely different characteristics from the West Bank and averaging in this case (describing them as one unit) would be misleading.

Gaza Strip has an area of 365 km^2 and populated with about 1.26 million Palestinians and about 5,000 Israeli settlers. It is located at the southwestern part of Palestine at the Mediterranean cost on the edge of Sinai Peninsula (map 1). It has one of the highest population densities in the world (3450 people/ km^2).

The climate of Gaza Strip is transitional one between arid desert climate of Sinai Peninsula and the temperate semi humid Mediterranean climate along the coast. Average rainfall ranges from 230 mm in the southern part to 400 mm in the north. Average temperature ranges from 13 °C in Winter to 25 °C in Summer.

In Gaza Strip, groundwater exists in the shallow coastal aquifer. The total amount of recharge from this aquifer is estimated at about 50 MCM. It has a yearly deficit due to over pumping which result in its replenishment from brackish or seawater leading to water quality deterioration. Most of the pumped water is used in irrigation that resulted in soil contamination and an increase in soil salinity. Settlers in the area consume about 6 MCM for all purposes while 1.26 million Palestinians consume 127 MCM.

The land use figures of Gaza Strip, indicates the degree of pressure on the land in this area. The agricultural areas comprise about 69% of the area; the artificial surfaces occupy about 21%, the forests and semi natural area is about 9% and the water courses represented in Wadi Gaza is less than 1%. Investigating these figures indicates how much pressure is on the agricultural land due to urbanization expansion. If we add to this pressure the fact that the Israeli colonies utilize large agricultural area (more than 7,500 dunums).

There are three types of soil associations in Gaza Strip: sand dunes (106 km^2) which is occupying the coastal western area, loessial arid brown soil (190 km^2), which is composing the main agricultural land, at the eastern area and sandy regosols (69 km^2) at the southeastern part.
In the loessial arid brown soil, substratum consists of sandstone cemented by $CaCO_3$ (*kurkar)* and alluvial brown clay represents an impeding layer to the root penetration.

Impacts and Responses:

Having a clear picture about driving forces and pressures of land degradation does not mean that the impacts on the ground are also seen clearly; therefore, the responses as a consequent are not promptitude or ad hoc. As a matter of fact, there are no time referenced quantitative parameters for the state of land degradation several aspects in Palestine to help in assessing the impacts.
The main impacts of these pressures are low agricultural and forage productivity and more abandonment to agricultural practices that collectively lead to more poverty and more fragile ecosystems. The negative impact on human and animal health is indirectly deduced by the comparatively high percentage of cancers in Palestine.
The general characteristics of ecosystems in Palestine at various scales are getting worse when investigated over short period of time. In most agro-climatic zones, soil productivity has already been lowered by erosion or degradation. Direct quantitative parameters are not available but indirect parameters like agricultural productivity, dependency on working in agriculture, forestry and livestock production are all indicating negative impacts.
Responses to the impacts of various pressures on land would be categorized at the national or governmental level and the technical or farm level. Some of these responses are actually taking place, some of them are recommended by the author.

National Level:

Although PNA is a newborn authority, the following responses took place at the national level:

- Setting the necessary and convenient legislation to protect land resources represented in issuing the Palestinian Environmental Law No. 7 of 1999 and publishing the Palestinian environmental strategy. Ministry of Agriculture (MoA) Strategic and Policies framework also adopted the protection of land resources as a high priority.
- MoA and Ministry of Environment (MoE) formulated in cooperation with specialized Palestinian NGOs the Palestinian National Committee for Combating Desertification (PNCCD).
- The majority of land reclamation projects implemented in Palestine were supervised in cooperation with MoA.
- Organization of tree planting campaigns and annual tree-planting dates. Large number of seedlings distributed free of charge by MoA.

Recommended responses that should be conducted by PNA:
The following are suggested responses that should be conducted by PNA to reduce land degradation:

- Adopting a strategic plan for land use at the country level;
- Activate the PNCCD to take its responsibility of developing strategic framework and policy for combating desertification in Palestine;
- Improve administration, policy and plans of national institutions, human resources, research and scientific capabilities;
- Continue and intensify adopting and supervising the activities of land reclamation and soil conservation on new solid bases;

- Prepare and implement national action plans for the establishment, management and conservation of forests and rangeland;
- Setting the convenient plans for the proper management and utilization of water resources;
- Encourage, facilitate and provide capabilities for applied research related to land degradation.

Technical and Farm Level:

The responses to land degradation should vary from one ecological zone to another. There is a lot work done by specialized Palestinian NGOs at the farm and technical level to mitigate land degradation. This is represented in land reclamation and water harvesting projects supervised by MoA and funding agencies and conducted in various spots of the country. Unfortunately, there is no available statistical data of the land area reclaimed or the number of wells constructed or rehabilitated.

Recommended Actions and responses that should be undertaken by NGOs and farmers:

In the small humid and sub humid zones traditional agricultural practices ensure that soil degradation is kept to a minimum. The mixed crop canopy protects the soil from physical destruction and keeps organic matter up. However, zones of extremely arid to semi arid climates can be maintained by:

- Soil erosion could be stopped or mitigated in sparsely vegetated areas which represent high percentage of the West Bank area (21%) by the conversion of traditional planting systems from planting field crops to pastures with different and beneficial types of shrubs and grazing plants (introducing agro-forestry approach);
- Maintaining ground cover most of the year by introducing crops with trailing systems;
- Utilization of household organic wastes as fertilizer (composting) for selected crops in the farm or garden.
- In mountainous environments in the West Bank, soil degradation would be traditionally tackled by a combination of crop rotation involving legumes, the application of animal manure and allowing animals to graze harvested fields, as well as fallowing usually for one or two years.
- Palestinian NGOs and research institutions should develop technical solutions to practical problems facing farmers as fluctuating soil salinity, proper soil tillage practices, etc. This should be combined with public awareness campaigns and extension programs for farmers. This means also promoting the involvement of local people in data collection and identifying the technical problems facing them in the field.
- It is desperately needed to survey and collect the available data on land degradation and build specialized database utilizing GIS and remote sensing techniques.

Conclusions:

Almost all types of soil degradation processes are taking place in Palestine and unless conservation measures are urgently introduced, soil degradation will have catastrophic impacts on the environment and on the national agriculture capability. It is evident from this paper that there are a lot pressures and negative impacts but very few responses due to the fact that PNA is a new born (1994), and the difficult access to land by Palestinians.

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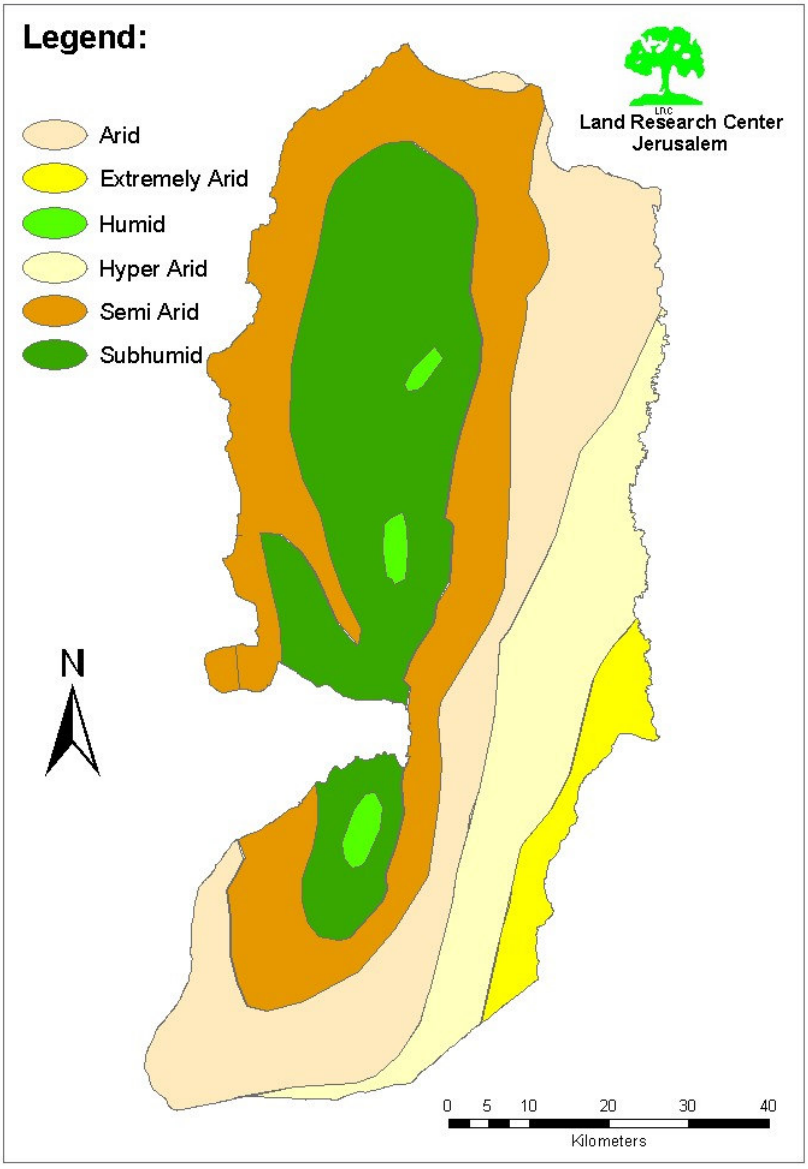
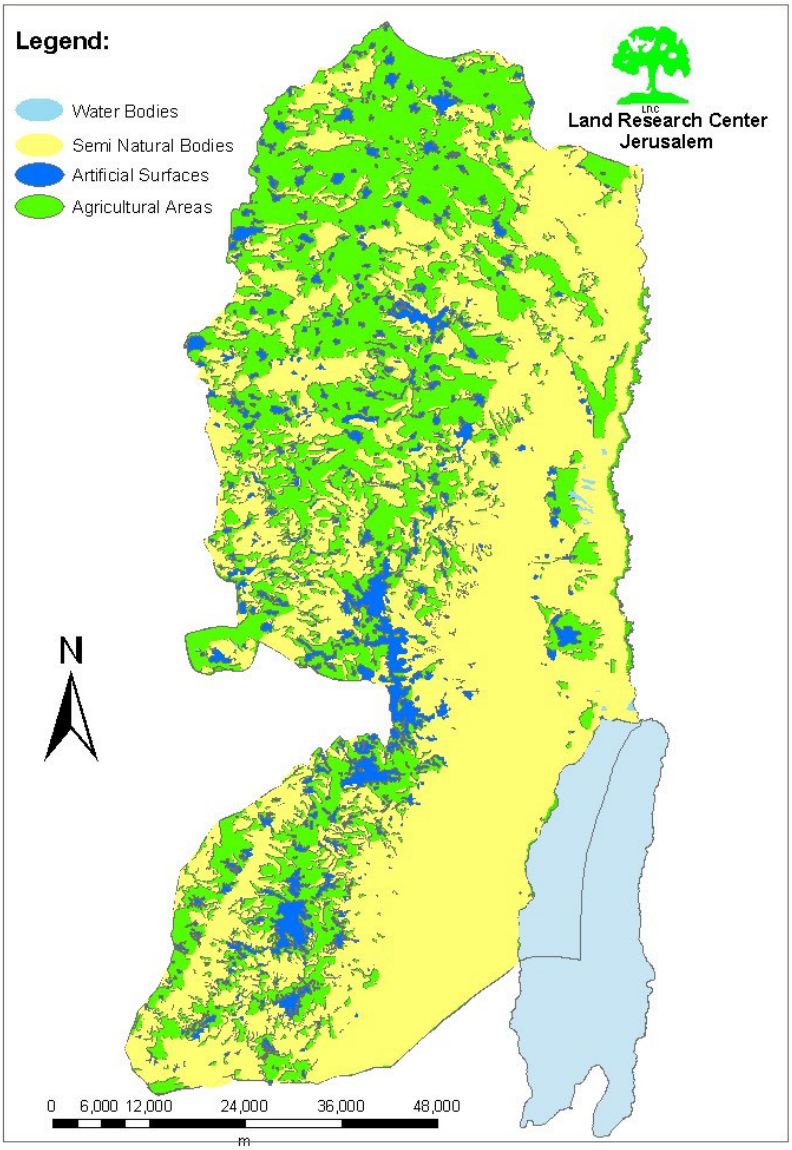
Climate Classification of the West Bank



General Land Use of the West Bank
CORINE 2nd Level



Soil Map of the West Bank