# Changes of the Palestinian agricultural Land use under Drought

## Introduction

Climate change refers to long-term fluctuations in temperature, precipitation, wind, and other elements of the Earth's climate system (Beaulant et al., 2008). It is recognized as a major issue of global concern with serious and long-term challenges that have the potential to affect every part of the globe; including the occupied Palestinian territory (oPt). Climate varies naturally on all timescales; as a result of changes climate elements; which is ranging from decades to millions of years. However, human influences, including industrial zones and activities and urbanization, along with Israeli destructive practices are thought to be bringing about a rapid change in the climate, due to massive emissions of greenhouse gases. This has both direct and indirect long-term climatic impacts on every region of the globe, causing alteration of oceanic and atmospheric currents that lead to shifts in precipitation patterns and changes in air temperature which will augment evapo-transpiration reducing infiltration and aquifers recharge (IPCC, 2007); The decrease of the annual average rate of precipitation in the Middle East and North Africa (MENA) region is expected to reach between 10 - 20% (IPCC, 2007).

Drought is a condition resulting from changes in the climate which entails limited amounts of precipitation generally for an extended period of time. When a region is experiencing a drought, its ecosystems, agriculture and economy are all vulnerable to damages. Many studies and projections showed that the Middle East is among the most susceptible regions to persistent droughts, desertification, and water scarcity. Global climate change is increasingly affecting the status of water security especially in regions were water is already scarce: "with the Middle East being the world's most water-stressed region, climate change will contribute to even greater water stress in the region" (Freimuth et al., 2007). Since the results of a drought are still largely unpredictable, as its impacts are related to the length of time of its occurrence and its intensity, developing a monitoring system as well as implementing preventative and mitigation measures presents a difficult task.

## International environmental law

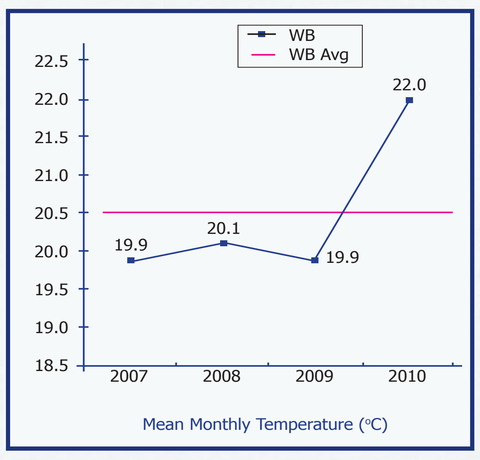
The Palestinian status under international law is a specific one, given that there is so far no recognition of Palestine as state. . The oPt has been given observer status and some additional rights at the UN, but is neither a full member of the UN nor a party to multilateral environmental agreements thus far. As funding is frequently linked to party status under environmental agreements, this also makes it difficult for the PNA to receive funding for certain environmental projects. At the same time, the oPt and population are negatively affected by several environmental problems such as water scarcity and lack of sanitation. Moreover, global environmental phenomena such as climate change and the loss of biodiversity are environmental issues of relevance for Palestinians.

According to Article 2 of UNFCCC, states have a duty of prevention with regards to dangerous climate change, and they should act to achieve this in a way that allows ecosystems to adapt naturally to climate change, to ensure food production is not threatened and to enable sustainable economic development. Through its global scope, this duty of prevention, in principle, benefits oPt. Of course, the oPt is not a Party of the UNFCCC, though it has legal status within the UN governance system. Insofar as the oPt receives climate change damage, there is also the application of the customary rule of international environmental law that states do not cause harm to the environment of other states or areas beyond national control. States could be construed as fulfilling this harm prevention obligation to the Palestinian population, in regards to climate change, by their climate mitigation efforts (indirect damage prevention) and/or by directly assisting adaptation efforts within the oPt (direct damage prevention). There are conceptual uncertainties and practical difficulties over apportioning specific responsibilities of harm prevention to particular polluting states. However, the notion of 'common but differentiated responsibility', as employed in UNFCCC Article 3, directs attention instead to the special needs of those developing countries particularly vulnerable to the adverse effects of climate change. This Article could support the Palestinian National Authority (PNA), representing a territory with high climate vulnerability, in seeking access to climate change adaptation financing available under UNFCCC even though it is not a Party to the treaty

## Temperature:

The increase in temperature during the 20th Century was obvious according to the Palestinian Central Bureau of Statistics. That increase was by no means uniform during the last decade, with the year 2010 being the warmest in the 125 years (PMD database, 2011) (Figure, 8.1). Generally speaking, heat waves have become longer and more intense

**Figure : Annual Mean Monthly Temperature in the West Bank**



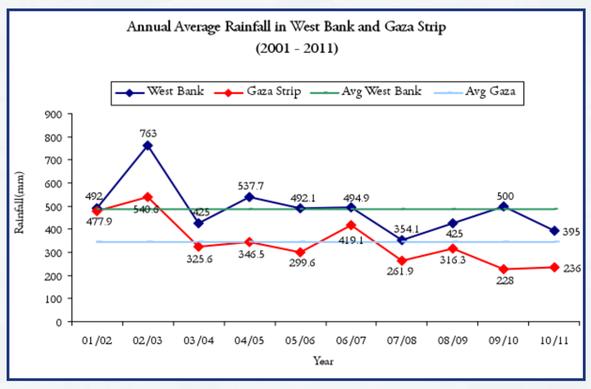

There has been a high increase in the annual mean monthly temperature in the West Bank across the previous four years; noted to be 19.9 °C in the year 2007 and 22.0 °C in the year 2010, which means a 2.1 °C difference increase. (PMD database, 2011). Besides the increase in temperature, cooling trends should be mentioned, since Kutiel and Maheras, (1998) noticed that the cooling trend in the autumn of about -0.5oC/100yr was detected in most regions of the Mediterranean. In addition Nasrallah and Balling, (1996) found a slight but non-significant cooling trend in the Arabian Peninsula over the last 40 years. A cooling trend is also evident from measurements of sea surface temperature. In its Fourth Assessment Report, the IPCC predicts that, for the southern and eastern Mediterranean, warming over the 21st century will be larger than global annual mean warming – between 2.2-5.1ºC.

## Decreased Precipitation:

The oPt which is one of the natural areas in the western Mediterranean basin was vulnerable during recent years to low rainfall. The amount of rainfall in the West Bank for the rainy seasons during 2007-2011 was between 354 mm and 500 mm (MoA database, 2011) compared to a yearly historical average rainfall of 532 mm (MoA, 2011). The impact of such climate change on Palestinian Agriculture is especially high owing to already existing water scarcity in the region and dependency of Palestinian agricultural on rainfall. The same climatic conditions are affecting the Gaza Strip governorates, where the amount of rainfall for the rainy seasons during 2007 – 2011 was between 228 mm and 316 mm (MoA, 2011). This amount is less than the historical average rainfall which is 358.5 mm (MoA, 2011).

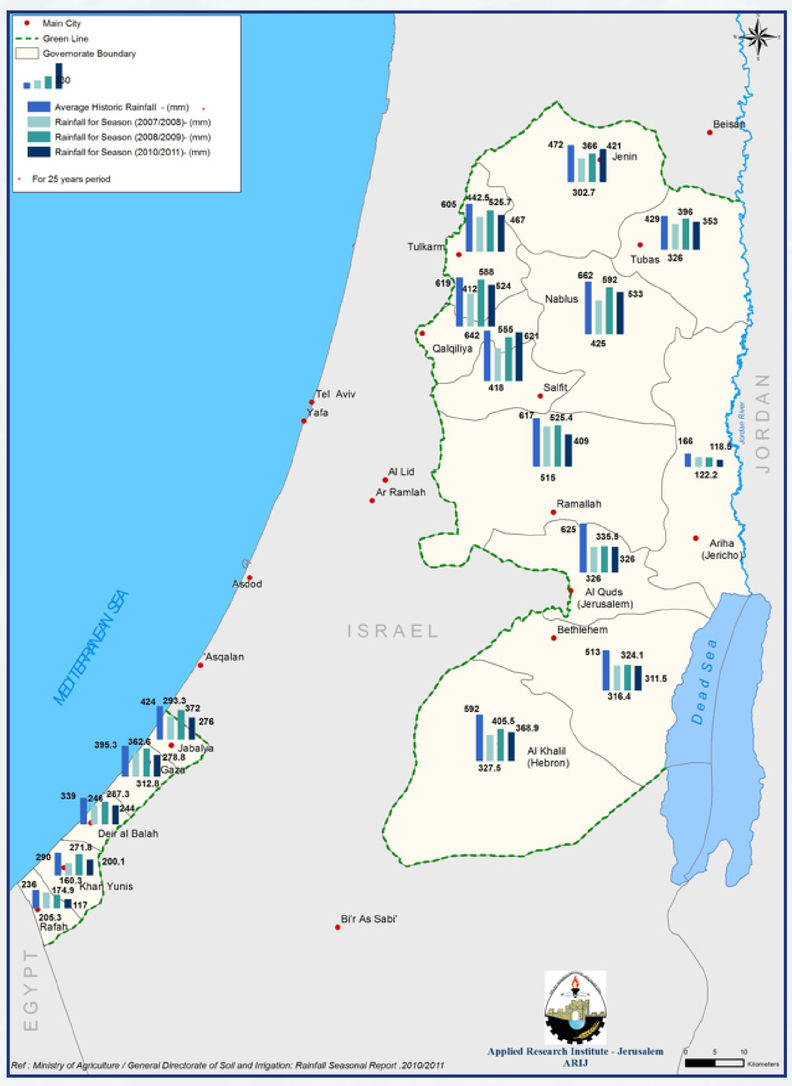
It is still believed that the phenomena of climate change and global warming are two of the most important reasons that affect change on the region's rainfall. Variations in the amount of rainfall from one year to another in both the West Bank and Gaza Strip during the past years are noted from the Figure below showing that rainfall is increasing in one year and decreasing in another. During the period from 2007 to 2011, a significant decrease in the amount of rainfall in the West Bank and Gaza Strip has been noted in the rainy season 2007/2008. In the rainy season 2008/2010 the average amount of rainfall has increased in the West Bank and Gaza Strip, but still it was below the average. The rainy season 2009/2010 had registered the highest rainfall in the West Bank (500 mm), while in Gaza Strip it registered the lowest rainfall (228 mm). In the season 2010/2011 rainfall has decreased significantly in the West Bank, where the average was 395 mm which constitutes only about 74% of the average annual rainfall in the West Bank. In the Gaza Strip, the rainfall for the same season maintained almost the same level compared with the previous rainy season and was 236 mm, which constitutes about 66% of the average annual rainfall (MoA, 2011).

**Figure: The average annual rainfall in West Bank and Gaza Strip (2001-2011)**




The Palestinian Water Scarcity Task Force (WSTF) has reported that, at the end of the rainy seasons (2009-2010 and 2010-2011), the rainfall registered 72 % of the historical average expected so far in the season in the West Bank; with regional variance in precipitation highlighting the concern with the continued shortfall in rainfall as the winter season comes to an end.

**Map: Average annual rainfall in West Bank and Gaza Strip (2007-2011)**




Changes in the yearly distribution of rain in the historic Palestine from 1976 to 2000, found that the winter rainy season shortened over this period, particularly in the last decade (Kutiel, 2000). The delay in the rainfall resulted in nearly 60 percent drop in the volume of rain-fed crops planted during the September- November season compared to the 2010 season (Water Scarcity Task Force, 2011).

## Israeli destructive factors affecting climate change in the oPt

Natural Palestinian ecosystems are a casualty of the Israeli Occupation, due to the systematic uprooting of both natural and planted trees, to the demolition of fertile agricultural land, and to the destruction of groundwater aquifers.

There are almost 93 major forests in the West Bank and 13 in the Gaza Strip, approximately covering 230 km² and 2 km², respectively. Forests cover approximately 4% of the total area of the West Bank and 0.5% of the Gaza Strip (ARIJ, 2007). It is well-known that forests alter the environment by moderating climate, improving air quality, conserving water, and harboring wildlife. Climate control is obtained by moderating the effects of sun, wind, and rain. Radiant energy from the sun is absorbed or deflected by leaves on deciduous trees in the summer and is filtered by their branches in winter.

The construction of the Segregation Wall, upon completion, will intensify these problems. Tens of thousands of trees were uprooted in the West Bank. In addition, the Wall itself will act as a physical barrier to the terrestrial ecosystem disrupting wildlife corridors and, hence, wildlife mobility. Around 1.5 million trees have been uprooted by the Israeli Occupation Forces between 2000 and 2011 in the West Bank and Gaza Strip (ARIJ UMD database, 2011. This will have a destructive effect on the oPt's climate, by disrupting the natural carbon sequestration process, in which carbon dioxide ($CO^2$) from the atmosphere is absorbed by trees, plants and crops through photosynthesis, and is stored as carbon in biomass (tree trunks, branches, foliage and roots) and soils. Trees that sequester carbon, when subjected to anthropogenic disturbances, can suddenly or gradually release the carbon back to the atmosphere. Practices that increase carbon losses and decrease sequestration generally devastate the quality of soil, water, air, wildlife habitat, and the ecosystem in general.

**Table: Uprooted trees by Israeli occupation in the West Bank**

| Year | Uprooted Trees |
|---|---|
| 2000 | 19,003 |
| 2001 | 55,698 |
| 2002 | 16,058 |
| 2003 | 150,594 |
| 2004 | 42,384 |
| 2005 | 90,104 |
| 2006 | 20,900 |
| 2007 | 31,785 |
| 2008 | 8,638 |
| 2009 | 8,745 |
| 2010 | 10,364 |
| August 2011 | 10,410 |
| **Total** | **464,683** |

## Effect Of drought on Plant growth

Because of the potential seriousness of a drought whenever and wherever it occurs, landowners and managers need to be aware of the effects of drought on forage growth. Obviously, lack of soil moisture restricts plant growth, both in terms of the total quantity of tissue produced and the time that the plant tissue is produced. The extent to which forages production is decreased by drought varies with the soil type, temperature, vegetation type, and current and past grazing management. Every situation is different and it is impossible to present management guidelines that will be universally applicable.

Productivity of annual plants generally will be reduced by drought more than that of perennial plants. In a drought, annuals produce little or no forage. Annuals are not as deeply rooted as perennial grasses and woody forbs or shrubs and trees and therefore cannot tolerate the same degree of moisture deficit. In a drought, annuals will be very short with fewer leaves present and will use available water to produce flowers and a viable seed crop earlier than is normally the case.

Annuals are well adapted to dry years where they can escape periods of drought by remaining in the seed stage. Warm season annuals typically germinate in the spring as warmer conditions arrive and persist.

Typically warm season, perennial sod grasses and bunchgrasses support above ground growth for six to nine months out of the year, depending on where in the state they are located. When initiating growth following the winter dormant season, the plant must draw on food reserves (carbohydrates) that were produced during the previous growing season and stored in the roots or crown of the plant. About 20 percent or more of the current year's growth will occur using these stored reserves before the plant stops using reserves, begins to fully photosynthesize, and maintain itself with mature leaves produced during the current season.

In a drought, the plant has to rely on the stored reserves for a longer period of time, thus reducing stored nutrients for future use and increasing the plant's susceptibility to damage in extended periods of drought and grazing uses. A healthy root system is of paramount importance to the growth of a forage plant when we realize that 50% to 80% of the plant exists below the soil surface. An old range science rule of thumb is "if you take the shoot, you kill the root." Whether due to excessive grazing pressure or drought, lack of aboveground photosynthetic material (green leaves) will decrease root production, thus, decreasing the plant's ability to fully exploit the soil profile for badly need moisture.

The lack of available moisture usually reduces the length of the growing season. Warm season perennial grasses will initiate growth in the spring, but produce less forage and go dormant sooner under drought conditions. During drought plant growth begins to slow before carbohydrate reserves (sugars and starches) are replaced. Because of this, grasses may enter a longer than normal dormant period with less reserves. Once rainfall does come, the plant is slower to respond. If heavy grazing has occurred, this may hinder the accumulation of new root reserves. A perennial grass that is heavily grazed during the growth period could stop growth altogether. If soil moisture were declining rapidly at the same time, the grazed plant would not have an adequate opportunity to recover from the combined effects of heavy grazing and drought. In drought years, grazing should be light to enhance the plant's ability to make maximum use of soil moisture available. Plant loss or death occurs in periods with several growing seasons with below normal precipitation.

The effect of drought on forage plants is a function of both the intensity and duration of drought and the general health and vigor of the vegetation before the drought. Plants with healthy root systems and adequate carbohydrate reserves will fare much better during and after drought than plants that have been struggling to maintain themselves continuously. This illustrates the need for a soil test and fertilizer application based on soil test recommendation so that the plant has all of the opportunity to tolerate drought that it is genetically capable of.

## Weaknesses and Limitations

There are a few serious weaknesses and limitations in dealing with climate change issues and factors affecting our area which can be summarized as follows:

1. Limited legal frameworks for disaster risk reduction, which are response-led rather than preventative.
2. Underdevelopment of policies for disaster preparedness, mitigation, and emergency response.
3. Weak capacity in disaster management and rescue operations.
4. Lack of capacity and training in disaster risk management and policy implementation at government level (national and local).
5. Lack of coordination between central and the local level authorities in disaster management activities.
6. Limitations in using high technologies and devices used to monitor climate change issues.
7. Scattered data (if exists) in different institutes and government and not easy to get it.
8. Media coverage of climate change – both mitigation and adaptation.
9. Low level of awareness of aspects of the environment, especially those related to climate change.
10. Weakness or lack of studies on climate change.
11. Limited local expertise.
12. The belief that the problem of climate change is of global character and is not processed locally.

## Results and Discussion

Accordingly, it is expected that climate change will lead to less precipitation in winter and higher temperatures in summer. Temperatures are expected to rise by 2-4 degrees Celsius by the year 2100 (Dayan, 2011). The risk of rainfall reduction is higher in the southeastern part of the West Bank, mainly in areas where the annual rainfall is less than 250 mm. There is a fear from the expansion of these areas to towards the north to reach Jerusalem and maybe further to central mountainous areas. In the last few years, there has been a marked increase in signs of droughts, particularly in the southern and eastern slopes of the West Bank. 87% of the West Bank cultivated land is cultivated by rain fed agriculture and 33% of the entire West Bank landmass is used as pastureland for grazing. The total area of hyper-arid, arid climates comprises about 35% of the land area of the West Bank (ARIJ & WFP, 2010; FAO, 2008).

Drought is expected to become more frequent, more intense and less predictable as a consequence of climate change. The amount of rainfall in the West Bank for the rainy seasons during 2007 - 2011 was between 354 mm and 500 mm compared to the average annual rainfall of 532 mm (MoA, 2011), which constitutes only about 74% of the average annual rainfall in the West Bank. The impact of such climate change on Palestinian Agriculture is especially high due to already existing water scarcity in the region and dependency of Palestinian agricultural on rainfall. Farmers who cannot irrigate their crops and herders who cannot rely on parched grazing lands are some of the most vulnerable to the immediate effects of climate change. During the last 5 years, 63 km² of the heterogeneous agricultural areas decreased and 108.4 km² of open space areas increased from the year 2006 to 2010 due to the drought impact. Additionally, an increase in the plastic houses agriculture was noticed and reached 3.7 km² in the year 2010 as a result of decreasing the annual rainfall which imposed the Palestinian farmers to use intensify the usage of available water resources except for irrigated agriculture to avoid the risk of the rain fed agriculture.

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