Desert and Desertification

Third level - Environmental Sciences Students
(Credit Hours)

Dr. Doaa Adel Elemam

Assistant Professor

Lecturer of Environmental Sciences

Environmental sciences department

Faculty of science - Damietta University.

Email: doaa_elemam17@yahoo.com
doaa_alemam@du.edu.eg

Mobile: +201148748730

Content

Desert

Deserts are areas that receive very little precipitation. People often use the adjectives “hot,” “dry,” and “empty” to describe deserts, but these words do not tell the whole story. Although some deserts are very hot, with daytime temperatures as high as 54°C, other deserts have cold winters or are cold year-round. And most deserts, far from being empty and lifeless, are home to a variety of plants, animals, and other organisms. People have adapted to life in the desert for thousands of years.

One thing all deserts have in common is that they are arid, or dry. Most experts agree that a desert is an area of land that receives no more than 25 centimeters of precipitation a year. The amount of evaporation in a desert often greatly exceeds the annual rainfall. In all deserts, there is little water available for plants and other organisms.

Desert

Deserts are found on every continent and cover about one-fifth of Earth’s land area. They are home to around 1 billion people—one-sixth of the Earth’s population. Although the word “desert” may bring to mind a sea of shifting sand, dunes cover only about 10 percent of the world’s deserts. Some deserts are mountainous. Others are dry expanses of rock, sand, or salt flats.

Desert Characteristics

Humidity—water vapor in the air—is near zero in most deserts. Light rains often evaporate in the dry air, never reaching the ground. Rainstorms sometimes come as violent cloudbursts. A cloudburst may bring as much as 25 centimeters (10 inches) of rain in a single hour—the only rain the desert gets all year.

Desert humidity is usually so low that not enough water vapor exists to form clouds. The sun’s rays beat down through cloudless skies and bake the land. The ground heats the air so much that air rises in waves you can actually see. These shimmering waves confuse the eye, causing travelers to see distorted images called mirages.

Desert Characteristics

Temperature extremes are a characteristic of most deserts. In some deserts, temperatures rise so high that people are at risk of dehydration and even death. At night, these areas cool quickly because they lack the insulation provided by humidity and clouds. Temperatures can drop to 4°C or lower.

In the Chihuahuan Desert, in the United States and Mexico, temperatures can vary by dozens of degrees in one day. Daytime temperatures in the Chihuahua can climb beyond 37°C , while nighttime temperatures can dip below freezing 0°C.

Desert Characteristics

Winds at speeds of about 100 kilometers per hour (60 miles per hour) sweep through some deserts. With little vegetation to block it, the wind can carry sand and dust across entire continents and even oceans. Windstorms in the Sahara hurl so much material into the air that African dust sometimes crosses the Atlantic Ocean. Sunsets on the Atlantic coast of the U.S. state of Florida, for example, can be tinted yellow.

Deserts have unusual landscapes, which may include dunes, towering bare peaks, flat-topped rock formations, and smoothly polished canyons. These features differ from those of wetter regions, which are often gently rounded by regular rainfall and softened by lush vegetation.

Water in the Desert

Rain is usually the main source of water in a desert, but it falls very rarely. Many desert dwellers rely on groundwater, stored in aquifers below the surface. Groundwater comes from rain or other precipitation, like snow or hail. It seeps into the ground, where it can remain for thousands of years.

Life in the Desert

Plants and animals adapt to desert habitats in many ways Desert plants grow far apart, allowing them to obtain as much water around them as possible. This spacing gives some desert regions a desolate appearance.

In some deserts, plants have unique leaves to capture sunlight for photosynthesis, the process plants use to make food. Small pores in the leaves, called stomata, take in carbon dioxide. When they open, they also release water vapor. In the desert, all these stomata would quickly dry out a plant. So desert plants typically have tiny, waxy leaves. Cactuses have no leaves at all. They produce food in their green stems.

Life in the Desert

Other desert plants have very deep roots. The roots of a mesquite tree, for example, can reach water more than 30 meters (100 feet) underground.

Mesquites, saguaros, and many other desert plants also have thorns to protect them from grazing animals.

Many desert plants are annuals, which means they only live for one season. Their seeds may lie dormant for years during long dry spells. When rain finally comes, the seeds sprout rapidly.

A soaking rain can change a desert into a wonderland of flowers almost overnight.

Life in the Desert

Animals that have adapted to a desert environment are called xerocoles. Xerocoles include species of insects, reptiles, birds, and mammals.

Most xerocoles are nocturnal. They sleep through the hot days and do their hunting and foraging at night. Deserts that seem desolate during the day are very active in the cool nighttime air.

Foxes, coyotes, rats, and rabbits are all nocturnal desert mammals.

Life in the Desert

Snakes and lizards are familiar desert reptiles. Insects such as moths and flies are abundant in the desert. Most desert birds are restricted to areas near water, such as river banks. However, some birds, such as the roadrunner, have adapted to life in the desert. The roadrunner, native to the deserts of North America, obtains water from its food

Kinds of Deserts

The world’s deserts can be divided into five types

01 Subtropical

02 Coastal

03 Rain shadow

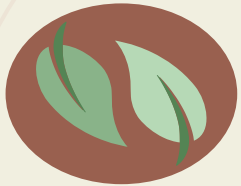
04 Interior

05 Polar

Subtropical Deserts

- caused by the circulation patterns of air masses.
- They are found along the Tropic of Cancer, between 15 and 30 degrees north of the Equator, or along the Tropic of Capricorn, between 15 and 30 degrees south of the Equator.

Subtropical Deserts



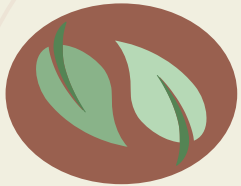
- caused by the circulation patterns of air masses.
- They are found along the Tropic of Cancer, between 15 and 30 degrees north of the Equator, or along the Tropic of Capricorn, between 15 and 30 degrees south of the Equator.

Hot, moist air rises into the atmosphere near the Equator. As the air rises, it cools and drops its moisture as heavy tropical rains. The resulting cooler, drier air mass moves away from the Equator. As it approaches the tropics, the air descends and warms up again. The descending air hinders the formation of clouds, so very little rain falls on the land below.

Subtropical Deserts

- The world’s largest hot desert, the Sahara, is a subtropical desert in northern Africa.
- The Sahara Desert is almost the size of the entire continental United States.
- Other subtropical deserts include the Kalahari Desert in southern Africa and the Tanami Desert in northern Australia.

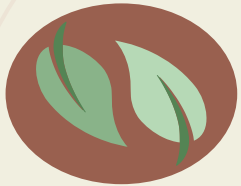
Coastal Deserts



- Cold ocean currents contribute to the formation of coastal deserts. Air blowing toward shore, chilled by contact with cold water, produces a layer of fog. This heavy fog drifts onto land. Although humidity is high, the atmospheric changes that normally cause rainfall are not present. A coastal desert may be almost totally rainless, yet damp with fog.

- The Atacama Desert, on the Pacific shores of Chile, is a coastal desert. Some areas of the Atacama are often covered by fog. But the region can go decades without rainfall. In fact, the Atacama Desert is the driest place on Earth. Some weather stations in the Atacama have never recorded a drop of rain..

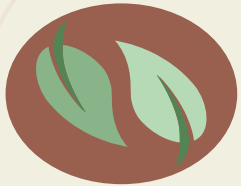
Rain Shadow Deserts



- Exist near the leeward slopes of some mountain ranges. Leeward slopes face away from prevailing winds.
- When moisture-laden air hits a mountain range, it is forced to rise. The air then cools and forms clouds that drop moisture on the windward (wind-facing) slopes. When the air moves over the mountaintop and begins to descend the leeward slopes, there is little moisture left. The descending air warms up, making it difficult for clouds to form.

Death Valley, in the U.S. states of California and Nevada, is a rain shadow desert. Death Valley, the lowest and driest place in North America, is in the rain shadow of the Sierra Nevada mountains.

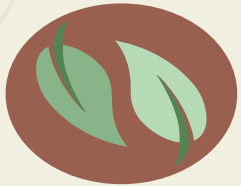
Interior Deserts



- Are found in the heart of continents, exist because no moisture-laden winds reach them.
- By the time air masses from coastal areas reach the interior, they have lost all their moisture. Interior deserts are sometimes called inland deserts.

- The Gobi Desert, in China and Mongolia, lies hundreds of kilometers from the ocean.
- Winds that reach the Gobi have long since lost their moisture.
- The Gobi is also in the rain shadow of the Himalaya mountains to the south.

Polar Deserts



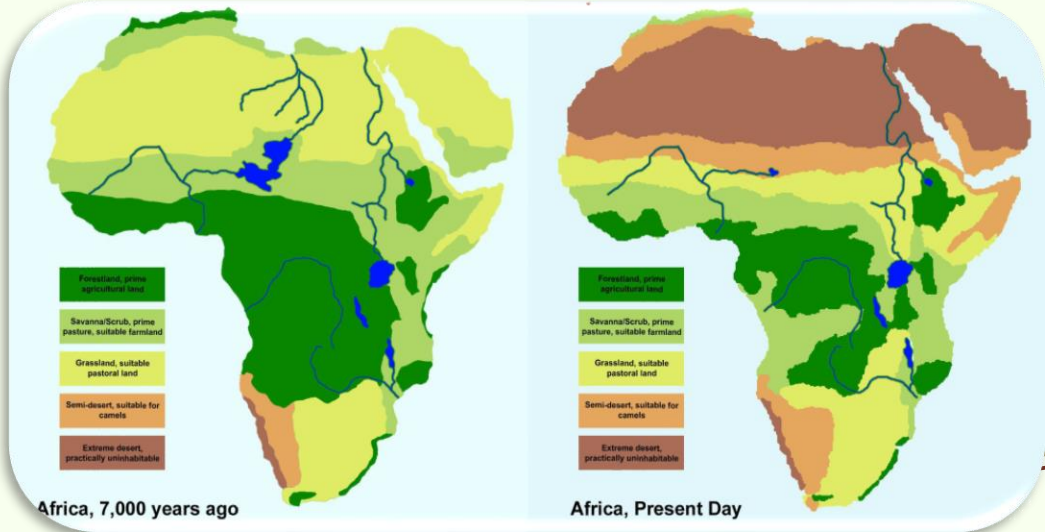
- Parts of the Arctic and the Antarctic are classified as deserts.

  These polar deserts contain great quantities of water, but most of it is locked in glaciers and ice sheets year-round. So, despite the presence of millions of liters of water, there is actually little available for plants and animals.

- The largest desert in the world is also the coldest.
- Almost the entire continent of Antarctica is a polar desert, experiencing little precipitation.
- Few organisms can withstand the freezing, dry climate of Antarctica.

Changing Deserts

The regions that are deserts today were not always so dry. Between 8000 and 3000 BCE, for example, the Sahara had a much milder, moister climate. Climatologists identify this period as the “Green Sahara.”



Desertification

Desertification

- Desertification is the process of productive cropland turning into non-productive, desert-like environments. Desertification usually happens in semi-arid areas that border deserts.
- The UNCED defined desertification as land degradation in the arid, semi-arid, and sub-humid areas resulting from various factors, including climatic variations and human activities.
- A process of turning the productive land into desert

The United Nations Conference on Environment and Development (UNCED)

Desertification

- Is also a situation on the desert expansion. That means desert is continuously expanding to the surrounding area
- The expansion of dry lands due to poor agricultural practices (e.g. overgrazing, degradation of soil fertility and structure), improper soil moisture management, salinization and erosion, forest removal, and climate change

Desertification Causes

Human activities are a primary cause of desertification. These activities include overgrazing of livestock, deforestation, over cultivation of farmland, and poor irrigation practices. Overgrazing and deforestation remove plants that anchor the soil. As a result, wind and water erode the nutrient-rich topsoil. Hooves from grazing livestock compact the soil, preventing it from absorbing water and fertilizers. Agricultural production is devastated, and the economy of a region suffers.

People often overuse natural resources to survive and profit in the short term, while neglecting long-term sustainability.

Rapid population growth also can lead to overuse of resources, killing plant life and depleting nutrients from the soil.

Desertification Causes

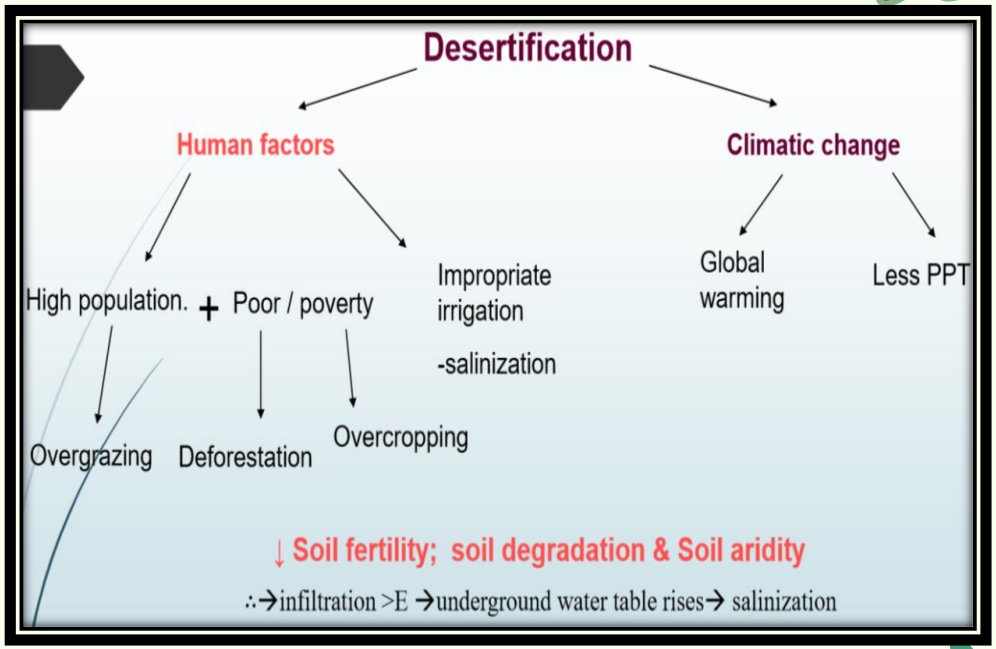
Desertification is an increasing problem. Every year, about 6 million square kilometers (2.3 million square miles) of land become useless for cultivation due to desertification. The Sahara Desert crept 100 kilometers (39 miles) south between 1950 and 1975. South Africa is losing 300-400 million metric tons (330-441 short tons) of topsoil each year.

Many countries are working to reduce the rates of desertification.

New technologies are also being developed to combat desertification. “Nanoclay” is a substance sprayed on desert sands that acts as a binding agent. Nanoclay keeps the sand moist, clumping it together and preventing it from blowing away.

Desertification Causes

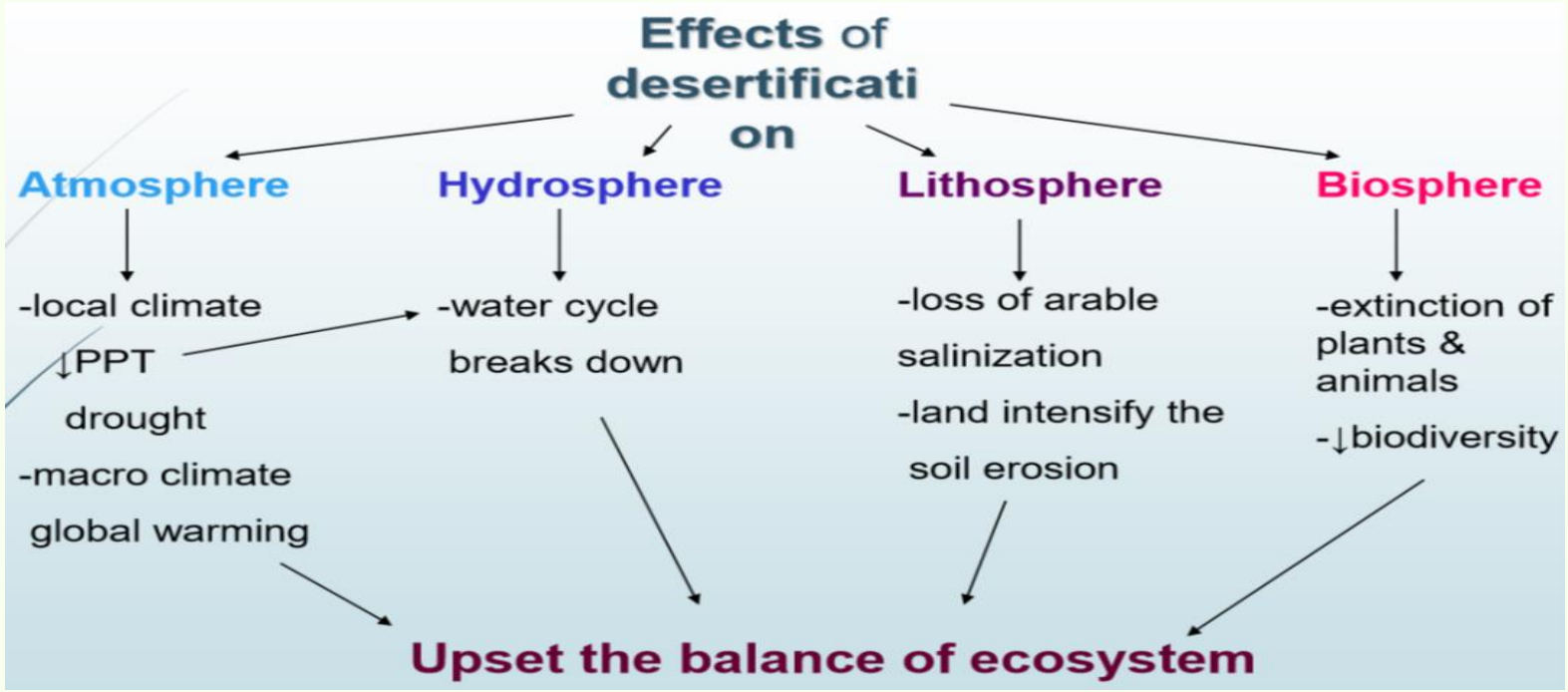
Overcropping : deplete (soil) by growing crops continuously on it. Overgrazing and overcropping have resulted in nutrient depletion and widespread soil erosion



Causes

- Deforestation
- Farming
- Excessive use of fertilizers and pesticides
- Animal grazing
- Global warming
- Overpopulation
- Changes in land use
- Mining
- Excessive consumption
- Waste production and disposal
- Soil pollution
- Acid rain
- Natural causes

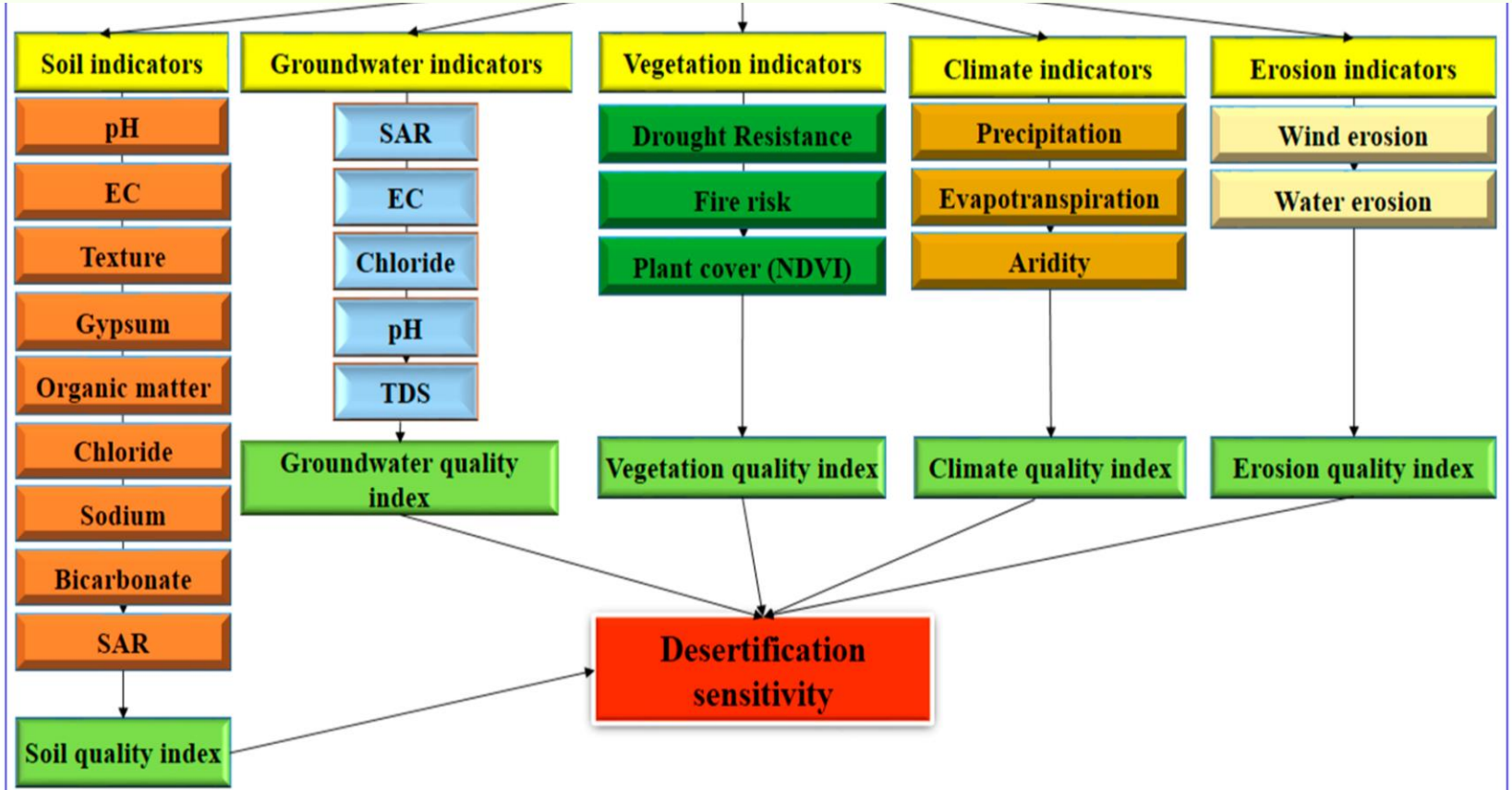
Desertification effect



Effects

- Decrease in crop yields
- Poverty
- Hunger
- Starvation
- Weak immune system
- Destruction of habitats
- Biodiversity loss
- Endangerment and extinction of species
- Floods
- Water pollution
- Global warming
- Migration

Indicators of desertification



Indicators of desertification

Physical indicators

- Decrease in soil depth
- Decrease in soil organic matter
- Decrease in soil fertility
- Soil crust formation/compaction
- Appearance/increase in frequency/severity of dust sandstorms/dune formation and movement
- Salinization/alkalinization
- Decline in quality and quantity of ground and surface water
- Increased seasonality of springs and small streams
- Alteration in relative reflectance of land (albedo change)

Indicators of desertification

Biological indicators

Vegetation

- Decrease in cover
- Decrease in above-ground biomass
- Decrease in yield
- Alteration of key species distribution and frequency
- Failure of species successfully to reproduce

Animal

- Alteration in key species distribution and frequency
- Change in population of domestic animals
- Change in herd composition
- Decline in livestock production
- Decline in livestock yield

Indicators of desertification

Social/economic indicators

- Change in land use/water use
- Change in settlement pattern e.g. abandonment of villages
- Change in population (biological) parameters (demographic evidence, migration statistics, public health information)
- Change in social process indicators - increased conflict between groups/tribes, marginalization, migration, decrease in incomes and assets, change in relative dependence on cash crops/subsistence crops

Solutions for Desertification

1. Stricter regulations regarding farming practices
2. Reduction in fertilizer and pesticides
3. Reforestation
4. Population control
5. Technological advancements
6. Confinement of mining practices
7. Avoidance of pollution
8. Adjustments in consumption
9. Avoid waste production
10. Education
11. Convince others

Egypt and desertification

Egypt has a total area of about one million km_2, under arid and hyperarid climatic conditions, of which only a small portion (3% of total area) is agriculturally productive.

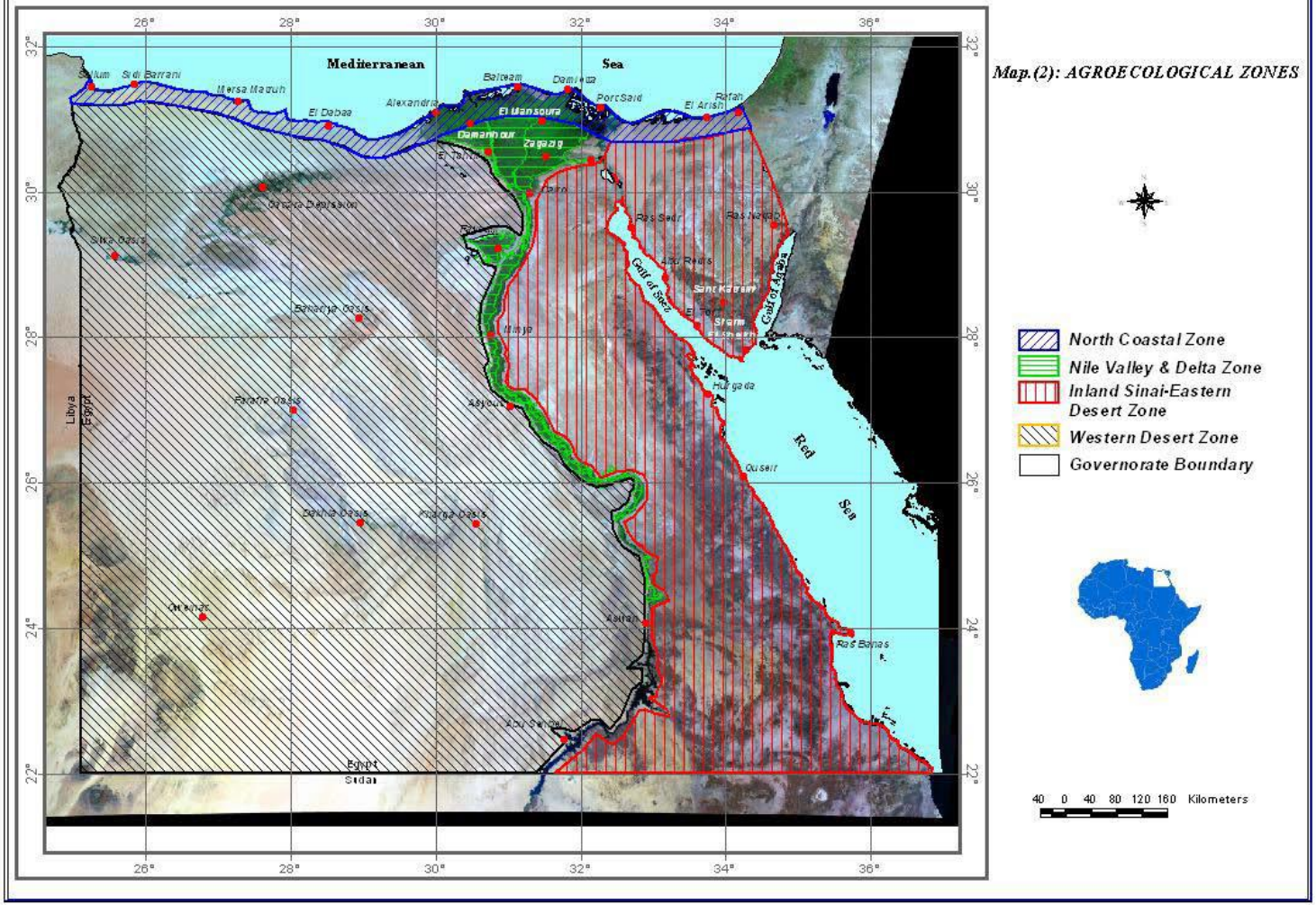
It is endowed with four main agro-ecological zones:

1. The Nile Valley: encompassing the fertile alluvial land of Middle and Upper Egypt, the Nile Delta region and the reclaimed desert areas in the fringes of the Nile Valley.

2. North Coastal zone: including the coastal area stretching east ward from North-Western coast to North coastal area of Sinai.

3. The Inland Sinai and the Eastern Desert with their elevated southern areas.

4. The Western Desert: encompassing oases and southern remote areas, including East Uweinat, Tushka and Darb El-Arbian areas.


Mediterranean Sea
Sollum
Sidi Barrani
Mersa Matruh
El Dabaa
Alexandria
Balteam
Damietta
Port Said
El Arish
Rafah
El Mansoura
Damanhour
Zagazig
El Tanta
Cairo
Ras Sedr
Ras Nasrani
Abu Redis
Gulf of Suez
Sant Katrin
Gulf of Aqaba
Siwa Oasis
Bahariya Oasis
Faiafra Oasis
Minya
Asyout
Libya
Egypt
Hurgada
Red Sea
Quseir
Dakhla Oasis
Kharga Oasis
Aswan
Abu Simbel
Ras Banas
Egypt
Sudan
26°
28°
30°
32°
34°
36°
22°
24°
26°
28°
30°
32°
Map.(2): AGROECOLOGICAL ZONES
North Coastal Zone
Nile Valley & Delta Zone
Inland Sinai-Eastern Desert Zone
Western Desert Zone
Governorate Boundary
40 0 40 80 120 160 Kilometers

Egypt and desertification

Egypt ratified the United Nation Convention to Combat Desertification (UNCCD), in 1995 and ratified in 1995, with the active participation of Egypt, gave emphasis for combating the major threats to sustainability of dry lands.

This convention defined desertification and also combating desertification as activities that aimed at:
a) Prevention and / or reduction of land degradation.
b) Rehabilitation of partly-degraded lands.
c) Reclamation of desertified land .

The first commitment of the countries that ratified the UNCCD is

The preparation of National Action Programmes (NAP) to combat desertification,

which identify the factors contributing to desertification and prescribes environmentally practical and sound measures to combat desertification

Egypt and desertification

A Scientific Committee (SC) was also established to be affiliated to the National Coordinating Committee for Combating Desertification (NCCCD).

The Scientific Committee is entrusted with the following :

(a) Survey, compile and analyze previous and ongoing activities to combat desertification.

(b) Assessment and monitoring of desertification processes.

(c) Coordination of activities with the various stakeholders.

(d) Follow up the implementation of commitments of Egypt towards the UNCCD agreement.

(e) Follow up the implementation of the NAP and assessment of the impacts of its activities.

The major causes of desertification in Egypt

- Spreading of urban and peri-urban areas into the fertile land especially within the Nile Valley and Delta, where most of big urban agglomerations are located.

- Poor water management due to;

- Inefficiency of the traditional gravity irrigation system employed in most of the agricultural land .
- Inadequate maintenance of irrigation and drainage networks.
- Over abstraction of ground water particularly in the reclaimed areas, e.g., West of the Nile Delta and Oases.
- Seawater intrusion in the coastal areas.

- Unsustainable agricultural practices, particularly under the conditions of frequent and intensive cropping in the Nile Valley and Delta, which resulted in: salinity, water logging, depletion of soil fertility, and excessive use of pesticides, fertilizers as well as inappropriate time and machines of tillage which led to problems of physical and chemical desertificaion, e.g., compaction, pollution

The major causes of desertification in Egypt

- **Depletion of plant cover and conversion of range areas to other uses including**

- Shifting and/or expanding cultivation of field crops, especially winter crops followed by fallow summer, causing considerable degradation of the natural ecosystem.
- Overgrazing and fuel wood collection.
- Encroachment of tourist villages and other random urbanization.
- Remarkable high density of livestock population with consequent overgrazing, loss of vegetation and hence biodiversity (e.g., in NCZ).
- Increased development of stock watering points for grazing herds allowing for the extended use of rangelands in which grazing was only possible during the rainy season. This increased the proportion of degraded areas around water points.
- Increasing use of trucks and water tanker for transporting grazing herds and water to far range areas.

The major causes of desertification in Egypt

- Reduction of the traditional grazing system as a result of the appropriation of rangelands by the desert Governorates, individuals and families, for tourism activities, housing, roads, manufactures … etc.

- Salinity build-up has reduced fisheries production, the productivity of the land base, and the palatability of water supplies for domestic use. It has also caused significant reduction of the agricultural production.

- Due to harsh natural environment, specially the arid climate and dominant shallow soils, the ecosystems of the rangelands for the most parts is fragile and is, therefore, highly vulnerable to mismanagement or overuse.

Activities to Combat Desertification

Major activities carried out each of the agroecological zones to facilitate setting of priorities and is enhance the efficiency of the future NAP activities.

North Coastal Areas

- ***The World Food Programme (WFP)***
  - Cleaning of old cisterns and establishment of new ones.
  - Construction of dikes.
  - Building of houses and animal sheds.
  - Planting fruit trees.
- ***The Food and Agricultural Organization (FAO)***
  - Trials on soil and water conservation works in Wadi Shaiab and Wadi Taweila
- ***The Australian Dryland Farming System***
  - Planted crops and established pasture on some 3.800 fed at seven trial sites

Activities to Combat Desertification

- ***The German Agency for Technical Cooperation (GTZ)***
  - Established agro-climatic stations and land use planning and environmental monitoring stations. The project focused on rural development.
- ***The World Bank and the Government of Egypt (Ministry of Agriculture and Land Reclamation***
- ***Programme for Rehabilitation of Rangelands***

Activities to Combat Desertification

The Nile Valley and Reclaimed Desert Fringes

- **Soil improvement activities**
- **Conservation of land Resources from pollution**
- **Afforestation in the desert fringes**
- **Drainage improvement and conservation of water resources**

a) Combating soil salinization and soil alkalinity.

b) Minimize soil logging , improve aeration and ameliorate the oxidation / reduction potential.

c) Enhance soil productivity by 17-25%.

d) Lowering of water table.

e) Improving physical and chemical soil properties.

f) Adding, additional areas to be cultivated upon conversion from open drainage to tile drainage.

Activities to Combat Desertification

- **legislations**

Egypt has also been achieved pronounced legislation and regulations for environmental protection including the conserving the agricultural land, prohibiting the air water pollution ….etc. Some of the most relevant laws are;

1- penalty law 58(1937).
This law had several articles penalizing acts leading to desertification, polluting water streams as well as the main river (Nile River)

2- The Agriculture law No.53 (1966).
Concerned with the protection of the environment and the control of desertification phenomenon through preserving the agriculture environment from deterioration and conserving its cultivable lands.

3- **The law No. 124(1983).**
Concerning fishing marine animals and organizing fish farms which concerned with protecting the environment from the desertification problems through protecting water resources

4- **Law Number 4 (1994)**
Promulgating the environmental law and its executive regulation.

Activities to Combat Desertification

- **legislations**

However, these laws are ineffective and need further modifications due to;

- All legislations do not address the desertification phenomenon directly.
- Numerousness the competent administrative agencies concerned with executive thus legislation and absence the coordination among them that due to decrease reliability thus legislation.
- Delaying the judicial procedures are considered one of the most reason of beggary thus legislations.
- Absence of the mechanism for executing the courts decisions.
- Absence the data-base relevant to these legislation in facilitating execution of legislations by the responsible bodies.
- Lack of coordination among the concerned authorities responsible for executing the legislation.

Thanks!