



**Arab Republic of Egypt
Ministry of Agriculture & Land
Reclamation**



UNCCD



Desert Research Center

**Egyptian National Action Program
To
Combat Desertification**

June, 2005

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**ARAB REPUBLIC OF EGYPT
Ministry of Agriculture and
Land Reclamation
Desert Research Center
(DRC)**

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June, 2005

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INTRODUCTION

Egypt has a total area of about one million km², under arid and hyperarid climatic conditions, of which only a small portion (3% of total area) is agriculturally productive. The country is endowed with four main agro-ecological zones having specific attributes of resource base, climatic features, terrain and geomorphic characteristics, land use patterns and socio-economic implications. Therefore, it is found appropriate to formulate a programmes comprised of subcomponents geared to address the specific attributes in each of the agro-ecological zones distinguished as follow:

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.

Since significant variations in the environmental characteristics are apparent in each agro-ecological zone, the active factors and processes of desertification and their impacts are necessarily variable. Accordingly, it is not appropriate to formulate a unified programme to combat desertification in such zone. To address and focus on the varied natural attributes, priorities of actions and specific processes of desertification, sub-components of the action programme are figured out to facilitate investigation and identification of appropriate techniques, suitable -indicators, monitoring, capacity building, awareness needs, participating stakeholders, required legislations, economic tools, incentives, finance, institutional setup, responsible parties, ongoing and future projects for combating desertification as well as social implication, geared and tailored for the needs of each agro-ecological zone to ensure the achievement of the Convention objectives .

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 .

In this regard, 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.

To ensure the success and achievement of the NAP of Egypt, a National Coordination Committee, (NCC) was formulated according to the Ministerial Decree No.2356 for the year 2001 to substitute the former steering committee previously formed. This committee is headed by the Deputy prime Minister and Minister of Agriculture and Land Reclamation as high level decision maker, with active representatives of concerned ministries including: Agriculture and Land Reclamation, Water Resources and Irrigation, Foreign Affairs, Local Development, Higher Education and Scientific Research, Environmental Affairs, Planning and International Cooperation , in addition to representatives of parliament, NGO`s as well as a group of professional experts in the concerned fields. This newly formulated committee

was entrusted with ; **(a)** formulation of general policies in accordance with commitments of Egypt towards the implementation of the UNCCD, **(b)** endorsement of local, regional and international agreements and projects and, **(c)** coordination among ministries, authorities, NGO's and stakeholders concerned with combating desertification .

A Scientific Committee (SC) was also established to be affiliated to the National Coordinating Committee for Combating Desertification (NCCCD). The Scientific Committee is headed by the president of the Desert Research Center who is the National Focal Point for UNCCD. The other members of the Scientific Committee are high level experts from various institutions and recognized expertise in the fields of combating desertification. The Scientific Committee is entrusted with the following :

- (a)** Survey, compile and analyse 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.

Egypt is endowed with a multitude of academic and research institutions, as well as central and local governmental institutions and authorities . It would be very wise to benefit from the previous studies, plans, data, research outcomes and reports. Each of the agro-ecological zones has had its share of previous studies and investigations. Processing and compiling these previous activities would be very useful as a database. The required basic and thematic maps, aerial photographs, satellite imageries, GIS facilities and interpretation expertise in various institutions, ministries and research centers are available.

Basic tools for planning could be acquired or jointly used from the various sources and institutions provided proper collaboration plans and suitable incentives are assigned . Ample consideration will be given to the documentation and compilation of indigenous knowledge and experience which are a wealth in itself and of great value for appropriate planning of NAP's activities.

Three national reports were submitted to UNCCD during the period 2000 - 2004 . These reports were mainly concerned with the general information overviews on desertification factors and processes together with the previous and ongoing activities, institutional aspects, basic features of the identified agro-ecological zones with particular emphasis on climate, physiography, natural and human resources and specific desertification aspects of each agro-ecological zone. Moreover, the basic features of the NAP were preformed .

To proceed further towards the preparation and completion of Egypt's NAP, several efforts were made to integrate and strengthen the cooperation between the concerned ministries, authorities, institutions, organizations, NGO's, and stakeholders. These efforts can be summed up as follow ;

- Setting up a dedicated group for preparing, compiling and finalizing the NAP.
- Since the inception of NCC (The National Coordination Committee) and its affiliated, Scientific Committee in July 2001 concerned activities were conducted to expedite the formulation and endorsement of NAP of Egypt.
- Development of effective public awareness about the desertification (its socio-economic feedback and environmental and social benefits) through demonstrating systems, printed materials (leaflets, brochures,... etc.), training courses, seminars, presentations and workshops for targeted stakeholders as well as educational programmes in schools and universities .
- Vulnerability mapping of risk/sensitiveness to desertification and drought is initiated for some hot spots, in the four agro-ecolgal zones.

- An inventory of relevant data for desertification assessment and monitoring is carried out and preparation of standard database for the most relevant agro-ecological zones is in progress.
- Initiate and facilitate some projects in the four agro-ecological zones, these will be further extended in the form of sub-projects dealing mainly with the urgent hot spots.
- These projects were presented and discussed with the official authorities, targeted stakeholders, NGO's, institutions, organizations and social communities in five workshops held in the concerned agro-ecological zones and the response of attendants, modifications of the projects and recommendations are figured out .

The current NAP of Egypt is, therefore, formulated to comprise four parts, each of which geared to address and focus on the specific attributes of the four agro-ecological zones distinguished in Egypt, priorities of action and striking desertification processes. Each part constitutes relevant chapters concerned with natural resources (their physiographic setting), agriculture, desertification (factors and causes, impacts, monitoring and assessment, previous and ongoing activities), topics and aspects of national action programme (policy, strategy, legislations, capacity building, early warning network, alleviation or eradication of poverty, population and demographic problems including migration and immigration, desertification maps and data base, response of communities), general and anticipated constraints as well as conclusions and recommendations updating to suite the NAP implementation. Beside, nineteen projects concerned with the four agroecological zones had been prepared.

This work programme describes activities undertaken in the dedicated set of measures, within the framework of the specific programme for combating desertification. They all will take into account fundamental cross-cutting issues such as environmental, economic sustainability and social equity.

Appropriate institutions and processes are actively encouraged with a view to ensure the highest positive impact possible in developing social dimensions such as gender roles, ethics and social equity that must be adequately addressed as a matter of ensuring such impact.

It is hoped that such NAP would facilitate the investigation and identification of appropriate techniques, capacity building needs, participating stakeholders, required legislations, economics tools, incentives, finance, as well as social implications. This approach would also help to define institutional setups and responsible parties and facilitate the identification of suitable indicators for desertification processes, as well as, appropriate techniques for monitoring ongoing and future desertification processes in each of these agro-ecological zones. Moreover, it may also ensure the identification of the most profitable projects, research needs and public awareness campaigns geared and tailored for the needs of each agro-ecological zone.

1. PHYSIOGRAPHIC SETTING

1.1. Location

Egypt can be considered an African / Asian / Mediterranean country. It occupies an area of about one million Km², between Lat. 22° and 32°N and Long 25° and 35° E. It is bordered on the North by the Mediterranean Sea, on the South by the Republic of Sudan, on the West by Libya, and on the East by Palestine, Gulf of Aqaba and the Red Sea.

Geographically, Egypt can be distinguished into four main geographic regions; Nile Valley & Delta, Sinai Peninsula, Eastern Desert and Western Desert. An account for these regions are given below.

I- Nile Valley and Delta

The Nile Valley and Delta cover an area of 35,000 Km², mostly in the Delta and have fertile soils, formed of deposits carried down by the River Nile. The Nile Delta is associated with the northern lakes (Maryut, Idku, Burullus, and Manzala) .In the Nile Valley, the cultivated area mostly consists of a narrow strip of land surrounded by desert on both sides.

II-Sinai Peninsula

Sinia Peninsula is located in the northeastern portion of Egypt, and occupies a very small portion of the extremely SW part of Asian continent.

The total area of Sinai is 61,000 km², the southern part of it is formed of a complex of igneous and metamorphic rocks.

III-Eastern Desert

The Eastern Desert covers an area of about 223,000 km².It is bordered by the Nile Valley on the West and by the Suez Canal, the Gulf of Suez and the Red Sea on the East. The backbone of this desert is a series of mountain chains (Red Sea mountains), running parallel to the Red Sea and separated from it by a narrow coastal plain.

IV- Western Desert

The Western Desert extends over a vast area occupying about 681,000 km². It is composed of large, rocky surface with the highest portion in the southwestern corner where Gebel (mountain) Uweinat is found. North of Uweinat, the Gilf el-kebir plateau (100 m a. s.l) formed of Nubian Sandstone occurred. This plateau is characterized by scarps which slope sharply towards large depressions in the East and North; Kharga and Dakhla depressions. To the North of this plateau , another plateau with arms extend in several directions. This plateau is composed of limestone and is lower in elevation than the Gilf el-kebir plateau, and constitutes the main landform feature West of the Nile Valley. Hollowed out in the plateau surface are two great depressions, those of Farafra and Bahariya . The area of the former is more than 3000 km², and the latter has an area of about 1800 km². The Qattara – Siwa depression is considered to be part of a huge depression in the northern sector of the Western Desert.

1.2. Climate

1.2.1. Climatic regions

Egypt is located in the hyper-arid regions of North Africa and West Asia astride the Sahara and Arabian Desert with annual rainfall in most parts of less than 50mm.

According to the aridity index P/ETP (P = precipitation and ETP = potential evapotranspiration, calculated by Penman's formula), the arid regions are classified to hyperarid ($P/ETP < 0.03$) and arid ($P/ETP = 0.03 - 0.20$). These classes are, in turn, subdivided according to the mean temperature of the coldest month and that of the hottest month of the year. Consideration is also given to the time of rainy period relative to the temperature regime. On these bases, four climatic provinces in Egypt are distinguished.

(i) Hyperarid provinces include all the area between $Lat.22^\circ$ and 30° N, except the coastal mountains along the Gulf of Suez. These are distinguished to:

- Hyperarid with a mild winter and a hot summer (mean temperature of the hottest month is $20-30^\circ C$), this includes the Eastern Desert and the northeastern part of the Western Desert of Egypt, and Gebel Uweinat .

-Hyperarid with a cool winter (mean temperature of the coldest month is $0-10^\circ C$), and a hot summer, represented around the highlands of southern Sinai .

The rain in hyperarid provinces is less than 30mm/yr and is occasional and unpredictable.

(ii) The arid provinces include the northern section with winter rainfall, it extends along the Mediterranean coast and the Gulf of Suez. This section is distinguished into two provinces namely;

- The coastal belt province under the maritime influence of the Mediterranean, with a shorter dry period (attenuated),
- The more inland province with a longer dry period (accentuated) and an annual rainfall from 20 to 100 mm.Both provinces are characterized by a mild winter and a hot summer.
- The salient features of the main climatic variables in such provinces can be summarized in the following:

1.2.2. Basic climatic elements

a) Temperature

Generally, summer is hot (mean of the very hottest month ranges between 20 and $30^\circ C$), or very hot (mean of the hottest month is more than $30^\circ C$). Winter is either warm (mean of the coldest month is $20-30^\circ C$) or mild (mean minimum of the coldest month is $10-20^\circ C$) except on the highlands where the winter is cool with a mean minimum of the coldest month (between 0 and $10^\circ C$).The temperature along the Red Sea coast varies between a mean minimum of the coldest month of about $10^\circ C$ towards the North and about $20^\circ C$ towards the South , and a mean maximum of the hottest month of about $33^\circ C$ towards the North and $40^\circ C$ towards the South. The range of variation becomes greater further inland (from about 4 to $38^\circ C$ in the oases of the Western Desert). In continental locations, temperature extremes of less than $4^\circ C$ in the coldest month (e.g. oases of the Western Desert) have been recorded. The coldest month is between December and February and the hottest month is between June and August in hyperarid and arid provinces, respectively.

b) *Relative Humidity*

The relative humidity is affected mainly by the relative proximity to the Mediterranean and the Red Sea. The lowest records are those of inland locations of the arid and hyperarid provinces and the highest ones are those of locations closer to the Mediterranean coast and in the Nile Delta within the arid province (e.g. mean minimum 60% and mean maximum of 72 % in Damanhur). The lowest records of relative humidity are generally those of late spring, whereas the highest records are those of late autumn and early winter.

c) *Rainfall*

In general, three rainfall belts may be distinguished in the deserts of Egypt:

(1) The Mediterranean coastal belt, (2) middle Egypt with latitude 30° N as its southern boundary, and (3) upper Egypt. The first and second belts have a winter rainfall (Mediterranean regime), the rainy season extends from November to April, though mainly concentrated in December and January. These belts correspond roughly to the attenuated and accentuated arid provinces of northern Egypt, where the average annual rainfall ranges from 100 to 150 mm in the attenuated arid province, and from 20 to 100 mm in the accentuated arid province. It extends rather south along the Gulf of Suez to Lat.26° N due to the orographic influence of the Red Sea coastal mountains. The third belt is almost rainless; it corresponds roughly to the hyperarid provinces. Rain at this belt is not an annually recurring incident; 10mm may occur once every ten years. The rainfall increases gradually to the North until reaches about 20mm at the borders with the arid province (at Giza).

One of the major features of rainfall in arid and semi arid regions other than being scanty, is its great temporal variability, average deviation of annual precipitation from the mean, expressed as percentage of the mean, is greatest in the hyperarid provinces (e.g. Siwa 83 %). In the arid province the percentage variability is 65 % at Giza which is close to the hyperarid provinces.

d) *Wind*

In winter, the Sahara high-pressure system dominates the circulation and the northerlies bring cool dry air from the North Africa continental source region though occasionally the Arabian high brings warmer air to the eastern parts of the Sudan. Both of these types are occasionally interrupted by E-W depressions along the Mediterranean, and replaced by cold dry air from the Eurasian landmass. In spring and autumn, the Arabian high is more dominant in the East, and the effect of Mediterranean depression is rarely felt, as air from both the North Africa and the Arabian sources is considerably warmer than in winter. In Summer, the Saharan high is again dominant bringing hot dry air.

Occasionally, very hot dust-laden winds blow (Khamaseen) which have numerous environmental consequences including possible effect on climate, soil formation, ground-water quality and crop growth. They may create problems including substantial degrees of deflation and erosion.

e) Moisture Regime

The evaporative power of the air in the hyperarid provinces of Egypt as measured by the Piche evaporimeter, varies in January from 3.6 mm/day in Aswan to 7.9 mm/day in Dakhla Oasis, and in June from 14.0 mm/day in the Bahariya Oasis to 24.3 mm/day in the Dakhla Oasis. In the arid province, the mean minimum evaporation rate during winter is, in general, within the same range as in the hyperarid provinces .

The annual potential evapotranspiration is, in general, lower in the arid than in hyperarid provinces .The lowest is that of Giza (592 mm according to Penman's equation, and 1582 mm according to Turc's equation) .

1.2.3. Agro-ecological Zones

Egypt has been distinguished into four Agro-ecological zones on basis of climate in combination with the physiography, natural resources, agriculture and other factors affecting the socio-economic activities. This approach would facilitate the investigation and identification of the active factors of desertification, their impacts, capacity building needs, participating stakeholders, required legislations, economic tools and social implications. It would also facilitate the selection of indicators and measures for monitoring ongoing and future desertification processes. These zones are given below (Map.1).

(i) The Nile Valley and Delta

This zone is distinguished into two sectors : **i)** The Nile Delta and its vicinities, with latitude 29° N as southern boundary. Except for the north coastal belt, the area corresponds roughly to the accentuated arid province with 20 to 100 mm annual rainfall. The Nile Valley and the surrounding reclaimed areas which are almost rainless; roughly belongs to the hyperarid province.

ii) North Coastal Zone

This zone is composed of two major subzones; northwestern coast and northeastern coast of Sinai. Such zone represents the arid province under the maritime influence of the Mediterranean with shorter dry period (attenuated) .

The northwestern coast (NWC) is characterized by dry Mediterranean climate with an average high and low temperature of 18.1 and 8.1°C in the winter and 29.2°C and 20°C in summer seasons, respectively. Rainfall in the northwestern coast ranges between 105.0 mm/yr at Salloum and 199.6 mm / yr at Alexandria. Data from eight stations situated near the coastline show that most of the rainfall (70 % or more) occurs within the winter months (November to February) ,mostly during December and January. The NWC area has the highest average wind speed in Egypt in the winter which can reach 18.5 Km/h and drops gradually inland.

The north coastal areas of Sinai are also characterized by the Mediterranean climate with relatively rainy, cool winter and dry hot rainless summer. Air temperature are similar to those of the NWC. The greatest amount of rainfall in Egypt (300 mm/yr) occurs on the far northeast of North Sinai (at Rafah). Generally about 70 % of rain along the North Coastal Zone, occurs in winter and 30 % falls during the transitional months.

iii) The Inland Sinai and Eastern Desert

This zone is characterized by the hyperarid conditions; with a mild winter and a hot summer. Exceptional being the coastal belt along the Gulf of Suez and highlands of South Sinai which represent the hyperarid province with a cool winter and hot summer .

iv) The Western Desert

This zone is characterized by hyperarid climatic conditions with rare rainfall and extremely high temperature. The northwestern and the northern winds extend from the Mediterranean over the Western Desert with fallen speed south wards. These winds are the major factors of erosion and deposition.

1.3. Water Resources

Nile River is the main fresh water resource (Egypt water quota is 55.5 billion m³/year), serving mainly the Nile valley and Delta. About 80 % of the total annual discharge is flowing during the three months of the flood season (August to October). The average annual flow of the Nile estimated at Aswan is about 84 billions m³. Its annual discharge is highly variable and may reach 15 billions m³ as in 1978. Several engineering efforts to control the Nile were undertaken, ended by the construction of the High Aswan Dam which was completed in 1968. The reduction of soil fertility in the Nile Valley argues that even though the High Dam contributed to some environmental problems, it has been clearly beneficial to Egypt's overall development. As irrigation drainage water is returned to the Nile River, its salinity gradually increases toward lower Egypt (Nile Valley), however, the water quality or the Nile is good overall for any type of water use with a total salt content generally not exceeding 350 mg/l TDS.

In addition, Egypt has two groundwater aquifers the first comprises groundwater in the Nile Valley and Delta system. The total storage capacity of the Nile Valley aquifer system is about 200 billion m³, with an average salinity of 800 ppm. Another 300 billion m³ is the storage capacity of the Delta aquifer. The current annual rate of groundwater withdrawal from the Valley and Delta aquifers is 6.13 billion m³/yr. The second aquifer is the non-renewable type, which is located in the Western Desert of the Nubian Sandstone, where the groundwater exists and deep seated. Recent studies have indicated that this is not a renewable resource. Use of this fossil water depends on the cost of pumping and potential economic return over a fixed time period. With respect to the rainfall (1.5 BCM / yr) it occurs only in winter in the form of scattered showers along the coastal area and can not be considered a reliable source due to its locality and temporal variability.

Groundwater which is located in many areas outside Nile Valley & Delta is the only water resource characterized by high potential for development and combat desertification. Factors that threaten groundwater are depletion, salinity, salt-water intrusion, and pollution. Inefficient groundwater management can severely damage fragile ecosystems and act as a constraint for the national development plan. In such areas developing new approaches toward solving the problems are essential. These include the conjunctive use of groundwater and surface water, rainwater harvesting and groundwater recharge, and the use of modern irrigation systems for more efficient water use. This calls for adopting efficient management styles of groundwater based on defined criteria for Egypt's sub regions. That managing style

should be flexible to cope with the physical, social, cultural and economical conditions of each region. It should be clear that the real challenge is not in developing the resource, but in its sustainable management to combat desertification and lands degradation. Gearing up for ground water resource management entails the strengthening of the knowledge base in order to come up with reliable short and long term plans. Such plans will be based on logical analysis of the demands, supply, and full understanding of how to optimize the use of all groundwater management tools.

Water resources management

The present situation of water use in the different geographical zones of Egypt can be summarized in the following.

i- Nile Valley and Delta: A distinction is made in this specific zone between old, old/new, and new lands facing shortage in irrigation water. In the old land, the main source of irrigation water is the Nile River, however, at the tail ends of irrigation canals, conjunctive use of groundwater with Nile water is applied. At the fringes ground water is the only source of irrigation which depends on the saturated thickness of the aquifer, storativity, transmissivity and infiltration rate.

ii- The North – Western Coast: For the North – Western coast, no reliable figures are available neither on ground water potential nor on current use. Though this coastal zone of the country has witnessed developmental activities on rain and groundwater settlements threatened for a long time, overpumping of fresh groundwater in coastal areas creates unsustainable situations to the environment. In such areas some tourism resorts are depending on the use of desalination technology. Brine water could be recycled for other purposes instead of discharging into the sea, to avoid unfavorable conditions of environmental hazards.

iii- Sinai: In estimating the groundwater potential in Sinai, distinction is made between shallow groundwater in the Quaternary aquifer and deep groundwater in the fissured carbonate and Nubian sandstone aquifer. The total present usage is about 90 million m³/yr. A large portion of the water is pumped from the Quaternary aquifer in the northern part of Sinai (El Arish, Rafah, Bir el Abd). Most of the groundwater is slightly brackish and poses limitations on its use for potable supplies without further treatment. Fresh groundwater is mainly confined to the sand dunes, which are recharged from direct rainfall. Groundwater salinity shows wide values often exceeding 1,000 ppm (TDS). At El Arish and Rafah, the use has already exceeded the potential resulting in a continuous increase in salinity. In Bir el Abd and Sahl el Qaa, on the other hand, small reserves are still available provided the wells are properly sited. Both the carbonate and sandstone aquifers can be developed, based on the amount of water in storage and recharge from rainfall. The major portion of available groundwater is found in middle Sinai.

iv-Eastern Desert: The present developmental schemes are confined to shallow wells dug in Wadi aquifer system and desalination of groundwater. The total groundwater usage was estimated at about 5 million m³/year and is likely to reach about 8 m³/yr at present. There is a potential for further development, especially on the Nubian sandstone aquifer through deep wells (200-500 m) and in the large Wadis, which drain in the Nile Valley and Lake Nasser. In addition to the fresh groundwater, large amounts of brackish groundwater are expected to be available in the region. This requires proper assessment and prediction of possible change in salinity as a result of development. One of the areas of special interest is the Red Sea coastal

area where a variety of aquifers are present. Signs of water availability are the flowing springs.

v-Western Desert:

In the Western desert, groundwater is mainly abstracted from the Nubian Sandstone and carbonate aquifers. The origin of groundwater in the carbonate aquifer is, however, mainly from the sandstone. Groundwater is considered, in general, nonrenewable both due to the limited recharge across the country boundaries and the lag time. Restrictions are followed in the assessment to ensure economic returns (based on pumping heads and return from agriculture).

In Egypt, there are serious environmental concerns in the irrigated lands as well as in the desert lands. Salinity, water logging and soil fertility may now take much old land out of irrigation (desertification) than these added through new development. Poor irrigation practices cause the water table to rise, leading to secondary salinization and sodication through capillary rise and evaporation of the groundwater. Water salinization due to over-pumping in the coastal areas or due to aquifer leakage is very common in Egypt leading to serious water quality deterioration. The mis-use of groundwater is another serious problem, which minimizes the aquifer capacity or the fresh water potentials. The current trends in the growth of population (2.6%), urbanization and industrialization will substantially increase pressure on the quantity and quality of water. However, the country's limited water resources will come under further pressure as demand increases with rapidly growing population. According to the UN survey of sub-saharan African countries, eight countries out of 29 were suffering from water stress (less than 1667 m³ per capita per yr) in 1990 and will suffer from water scarcity (1000 m³ / capita/yr) in 2025; Egypt is suffering from water scarcity since 1990.

1.4. Soil Resources

According to climatic features, terrain and landforms characteristics, land use patterns and anthropogenic implications, soil resources could be identified as follow:

i-The Nile Valley and Delta Zone

Agriculture production of Egypt is mainly concentrated in this zone where it consists of about 6.6 million acres.

Briefly, most of the soils of Nile Valley and Delta are recent Nile alluvium, these soils comprise levees of the two Nile branches, fluvio-marine and lagoonal deposits located adjacent the northern lakes and the coastal plain in the extremely North of Delta.

The following are the main Soil Taxonomic units which are associated with the different types of landforms and their soils.

- The soils of the fluvio-marine, Nile branches levees, river flood plain and lacustrine deposits: (Typic Torrifluvents, Vertic Torrifluvents, Typic Ustifluvents, Vertic Ustifluvents).
- The soils of the extensive flood plain in the Delta: (Typic Torrerts).
- The soils of the Nile terraces: (Typic Torripsamments and Typic Toriorthents).
- The soils located in the northern-west of Delta: (Typic Calcids and Calcic Gypsids).
- The soils which act as transitional zones between rocky land and elevated terraces in the Upper Egypt: (Typic Torripsamments and Typic Gypsids).
- The soils of the sandy coastal plain and beaches : (Aquic Salids and Typic Salids).

Generally, the soils of the Nile Valley and Delta are affected by the following desertification measures which lead to bring a fragile ecosystem into imbalance and the progressive degradation of the cultivated lands :

- Sea water intrusion into the cultivated lands.
- The irrational utilization of agricultural lands.
- The mismanagement of the agricultural lands which leads to the problems of water logging, salinization and alkalization .
- Soil pollution.

ii-North Coastal Zone

The North Coastal Zone includes two broad subzones; northwestern coastal areas (NWC) and North Coastal areas of Sinai. The NWC areas form a belt to about 20 km deep, and extend to about 500 km between Alex. and Salloum near Libya borders, covering an area of about 10.000 km², (2.5 million acres). These areas are dominated by different landforms covered with soils that are in equilibrium with the environment. From the pedological point of view most of these soils are young. Based on the landforms, the soils of NWC areas could be distinguished into:

- 1- Soils of the old coastal plain, including foreshore strip and lagoonal depressions (Typic Aquic-Psamments, Typic Haplosalids).
- 2- Soils of the old coastal plains, including calcic and quartzitic dunes as well as the interdunal depressions (Typic Haplosalids, Typic Gypsis, Calcic Haplogypsis and Typic Torripsamments).
- 3- Soils of the alluvial fans (Typic Torriorthents).
- 4- Soils of the plateaux (Lithic Torriorthents).

The North Coastal areas of Sinai have the following specific units pertaining to locality i.e.,

- Wadi El Arish constitutes of loamy sediments (Typic Torriorthents).
 - El Tina plain is dominated by fine textured soils and the areas in between are dominated by coarse - textured soils that are classified into seventeen soil groups according to the effective soil depth and soil texture (Typic Aquisalids, Typic Haplosalids and Typic Petrogypsis).

The main land use of the NCZ is marginal rangelands associated with pastoral system. However, vast discontinuous areas are under rainfed cultivation, where cereal crops (barley and wheat), following a long fallow period (May - Oct) are grown during rainy season. Fruit trees (olive, fig, peach, palm and almond) are also planted together with vegetables .

The cultivated areas in this zone reached about 0.3 million acres with cropping area of about 0.5 million acre.

iii- Inland Sinai and Eastern Desert zone

a) Inland Sinai

This sub-zone includes the central and southern parts of Sinai peninsula, which are mostly bounded from the East by Gulf of Aqaba and from the West by Gulf of Suez. This sub-zone is characterized by a hot- dry desertic climate, i.e., torric and hyperthermic moisture and temperature regimes. It covers a rather wide spectrum of altitudes encompassing four major landforms with their associated soils as follows :

- Soils of the southern portion of Sinai are mainly moderately deep and deep gravelly coarse textured.
- Soils of the central part of Sinai are dominated with the following soil types.
- Deep highly calcareous, gravelly coarse-textured soils
- Deep highly calcareous, moderately fine-textured soils
- Deep calcareous, gravelly coarse over fine-textured soils
- Soils of the alluvial coastal plains, located parallel to both Gulf of Suez and Gulf of Aqaba, comprise the following types :
- Deep, gravelly coarse-textured soils
- Deep, calcareous, coarse to moderately fine-textured soils
- Deep, highly calcareous, coarse-textured soils
- Deep, gypsic calcareous coarse to moderately coarse-textured soils.
- Soils of the marshy land and sabkhas occupy narrow and discontinuous patches along the Gulf of Suez. Depth to water table varies widely from very shallow to deep
- Soils moderately fine-textured, sometimes over sandy deposits with salts and gypsum contents in wide ranges.

According to Soil Taxonomy, the soils of inland Sinai could be placed under several subgroups; Lithic and Typic Torriorthents, Torrifluents, Torripsamments, Haplosalids, Gypsic Haplosalids and Aquisalids.

Land use in this sub-zone is mainly mining activities and oil exploitation, however about 8.5 thousand acres are planted with vegetables, fruit trees and some cereal crops where alluvial deposits and low altitudes prevail using ground water as a source of irrigation.

b) Eastern Desert

This sub-zone overlooks the Nile with high scarps, cut by Wadis flowing towards the River Nile and the Red Sea mountains. The Wadis of the Eastern Desert are numerous, mostly deep, very steep and their soils display young stages of development. The most important Wadis are W. Qena, W. El Laqita; W. El Assuity and W. Al-Allaqui. The main landforms of these Wadis are plateau, rubble terraces, Wadi bottoms, outwash plains, alluvial fans and sand sheets and dunes. Soils of these Wadis are mainly shallow to deep coarse or moderately fine-textured with variable content of gravels, (Typic Torripsamments, Typic Torriorthents and Typic Torrifluents) with six subgroups between Lithic and Typic.

Eastern Desert's Wadis have severe to very severe soil limitations, that may contribute to the desertification processes and maximize the input of the agricultural development and minimize the outputs or the benefits gained. These limitations include:

- Topography in most cases is rough with moderate to steep slopes.
- Soil limitations differ widely from one Wadi to another and are mostly concerned with parent materials that are either calcareous or siliceous, some cases are mixed with high content of gravels and boulders. Consequently, these soils have low water holding capacity, high infiltration rate and low fertility status.

iv- The Western Desert Zone

Climatically, this zone falls under hyperarid conditions and its soils could be considered as hyperthermic temperature and torric moisture regimes. In the western desert, several natural depressions of variable areas are scattered and include the famous Oases; Siwa in the north, Bahariya and Farafra in the central position and El Kharga and Dakhla in the South. These Oases, that are distinguished with artesian wells are mainly closed and fragile ecosystems. The Western desert includes also promising remote areas which are put under reclamation and utilization, i.e., Toshka, Darb El Arbain, East El- Uwienat and some Wadis of High Dam Lake.

Soils of the natural depressions (Oases) are mainly ascribed to the erosional patterns, source of parent materials, sedimentational environment and soluviation-deposition of salts, carbonate and gypsum. So, these soils may show differences with regard to their texture, mineralogy content, depth to water table or bedrock and numerous types of morpho-pedological features such as accumulation of salts, carbonate and gypsum, shales and iron oxides. According to Soil Taxonomy, a plenty of soil subgroups could be identified, some of them are : Lithic or Typic Torripsamments and Torriorthents, Typic Haplosalids, Aquic Torriorthents, Aquic Calciorthents, Salorthic Calciorthents, Gypsic Haplosalids, Vertic Torriorthent, Typic Calcigypsic and Leptic Haplogypsid

In general, the soils of the North Coastal Zone (and of other desert areas) have some limitations that reduce their agricultural potentialities and could induce desertification processes. These limitations could be aggregated herein:

- Rough topography that cause severe soils susceptibility to water and wind erosion.
- Shallow soil depth to bedrock or to permanent water table
- Hardpans and fragipans in soils
- The hazardous effect of salts and alkalies accumulations.
- Coarse - textured soils that have low water holding capacity and low fertility levels.
- Sand dunes encroachment on the roads and farmlands.
- Soil erosion induced by wind and /or water
- Inappropriate land use(urbanization / infrastructure,... etc).

1.5. Flora, Natural Vegetation and Rangeland Resources

1.5.1. Flora

Egypt flora comprises about 2121 species and 153 infraspecific epithets belonging to 121 families, unevenly distributed over the different agroecological zones of the country. The highest species density is in the Mediterranean coastal zone, the Nile Valley, Gebel Elba and the mountains of Sinai, Map (5).

The number of species in proportion to the total surface area of the country (one million km²) is considered very small. This is evidently due to the arid climatic conditions, where the annual rainfall nowhere exceeds 200 mm but is below 50 mm in the greater part of Egypt. Egypt and Libya (except El-Gebel Al-Aghder) are the only two countries in North Africa where Saharan climate extends up to the Mediterranean coast, thus preventing the development of any Mediterranean arboreal vegetation.

Due to the very scanty rainfall, most vegetation of Egypt is concentrated primarily in Wadis and depressions (i.e. contracted distribution pattern). Although most of the greater part

of Egypt is Saharan in vegetation, the proportion of Saharan plants is relatively small as compared to other phytogeographical regions.

The plant families comprise 742 Genera. The pteridophytes are represented by 16 species, gymnosperms 6, dicots 1637 and monocots 435 .

The families with the largest number of species are the Gramineae (277) Leguminosae (233) Compositae (230) Cruciferae (102) Caryophyllaceae (85) Chenopoiaceae (77) Scrophulariaceae (62), Euphorbiaceae (57), Boraginaceae and Labiatae (55) each and Umbelliferae (51) species.

The largest genera are : Euphorbia (42 species), Artragalus (32), Silene (24 species), Convolvulus (23), Allium (22), Trifolium (19) , Medicago (18), Centaurea (16), Vicia (15), Anthemis, Indigofera, Salsola and Stipagrostis (14) each; Eragrostis, Erodium and Veronica (13) each, Bellevalia, Helianthemum and Solanum (12), each Amaranthus, Kickxia, Launaea, Reseda and Trigonella (11) each, Juncus, Ranunculus, Muscari, Zygophyllum, Tribulus and Acacia (10 species) each .

The tropical neighbourhood, the high temperatures and the abundance of hydrosegetal habitats are responsible for the high grasses in Egypt. However, notable numbers of the genera of Gramineae are represented by tropical wilds and weeds such as *Desmostachya*, *Eragrostis*, *Tetrapogon*, *Pennisetum*, *Lasiurus*, *Cymbopogon*, *Hyperrhenia*, *Dicanthium* and *Elusine*.

Many of the Leguminosae genera are purely tropical (e.g., Acacia) and others are purely Mediterranean. A considerable portion of the genera of the Compositae is paleotropical, while a large portion of the Cruciferae's genera are truly Saharan (e.g. *Anastatica*, *Moricandia*, *Savignya*, *Schouwia*, *Zilla*, *Farsetia*, *Notoceras*, *Morettia*, *Eremobium*, *Schimpera*, *Maresia*, *Carrichtera*, and *Koeniga*).

Although *Caryophyllaceae* is mainly Mediterranean-Irano-Turanean, it also has a few interesting genera in the Saharan region (i.e., *Gymnocarpus*, *Petranthus*), and in the Sudanian region (e.g., *Robbairea*, *Polycarpea*, *Sphaerocoma*, and *Cometes*).

The *Umbelliferae* has Irano-Turanean species in Egypt (e.g., *Pycnocycla*, *Ducrosia*, *Zosima* and *Malabiala*), and almost no tropical representatives. The tropical influence on Egypt's flora is marked not only in the scores of genera and species of Paleo-tropic origin, but in the occurrence of some tropical families known in the Middle East only from Tropical Arabia (e.g., *Pedaliaceae*, *Ebenaceae*, *Podostemaceae*, and *Salvadoraceae*).

Other Predominantly tropical families include *Capparidaceae*, *Asclepiadaceae*, *Moringaceae*, *Menispermaceae*, *Nyctaginaceae*, *Amaranthaceae*, *Loranthaceae*, *Commelinaceae*, *Hydrocharitaceae* and *Cyperaceae*

A striking feature in Egypt's flora is the large number of genera in proportion to that of the species amounting to about 3 species per genus. This is a very low figure compared to the average global proportion which amounts to about 14. The generic index, i.e., the number of genera per 100 species is relatively high which points to the marginal conditions of Egypt in respect to many genera, and also indicates the lack of accumulation and differentiation centers in Egypt.

1.5.2. Natural Vegetation

i- The Nile Valley and Delta

This agro-ecological zone includes a variety of habitat types, each of which is characterized by some characteristic plant species as follow:

- Hydric habitats: characterized by emergent species (including *Phragmites australis* and *Typha domingensis*), floating species (including *Eichhornia crassipes* and *Jussiaea repens*) and submerged species (including *Potamogeton pectinatus*, *Najas armata* and *Ruppia maritime*).
- Wet salt marshes: characterized by *Juncus acutus*, *J. rigidus* and *Arthrocnemum macrostachyum*.
- Dry salt marshes: characterized by: *Halocnemum strobilaceum*, *Zygophyllum album* and *Atriplex protulacoides*.
- Sandy formations, characterized by *Elymus farctus*, *Alhagi graecorum*, *Heliotropeum curassavicum*, *Stipagrostis lanata*, *Thymelaea hirsuta*, *Moltkeopsis ciliata*, *Asparagus stipularis*, *Pancreatium maritimum* and *Cressa cretica*.
- Canal bank habitat types: support *Panicum repens*, *Imperata cylindrical*, *Desmostachya bipinnata*, *Rumex dentatus*, *Phragmites australis*, *Saccharum spontaneum*, *Polygonum salicifolium* and *Echinochloa stagninum*.
- The most common species in lake Nasser are: *Najas armata*, *N. horrida*, *Vallisneria spiralis*, *Zannichellia palustris*, and *Potamogeton* sp.
- Desert Wadis subject to inundation with Lake Nasser: support species of *Glinus lotoides*, *Tamarix nilotica*, *Pulicaria crispa*, and *Psoralea plicata*.
- The original plant cover of the Nile Valley (Tugai vegetation types) survives on a few number of islands near Aswan. These islands have different vegetation types of *Acacia* forest, represented by *Acacia seyal*, *A. nilotica*, *A. albida*, *Acacia arabica*, *Ziziphus spinachristi*, *Capparis decidua*, *Balanites aegyptiaca*, and *Cocculus pendulus*.

ii- North Coastal Zone

* North Western Coast

The North Western Mediterranean Coastal Belt extends from Alexandria westward to El Sallum for about 500 km, and from the seashore inland for about 40-50 km, is the richest part of Egypt in flowering plants, (50 % of the total number of species of the Egyptian flora). Out of which 154 species are confined in their distribution to this belt. Most of these species are annual weeds that flourish during the rainy season, giving the area a temporary gray grassland aspect. During the longer dry periods the characteristic woody shrubs and perennial herbs, constitute the scrub vegetation of the area, scattered sparsely in parts and grouped in denser distinct patches in favoured habitats.

An account on the plant communities in the different landforms is given hereafter:

- Coastal Sand Dunes

The following are the most common plant communities inhabiting sand dunes:

- a- *Ammophila arenaria* – *Euphorbia paralias* community: which inhabits the mobile sand dunes bordering the sea.
- b- *Ononis vaginalis*- *Crucianella maritima* community which occupies the older, advanced and higher dunes, where the sand may be consolidated impart.

- Swamp and Saline Habitats

The most common leading species in these habitat are: *Phragmites austoralis*, *Typha* sp., *Scripus litoralis*, *Salicornia herbacea*, *Juncus maritimus*, *Halocnemum strobilaceum*, *Limoniastrum monopetalum*, *Salsola tetrandra*, *Suaeda pruinosa*, *Suaeda fruticosa*,

Frankenia laevis, *Limonium pruinatum*, *Haplophyllum tuberculatum*, *Sporobolus pungens*, *Traganum nudatum*, *Reaumuria hirtilla*, *Orlaya maritima* and, *Atriplex halimus*.

- Uncultivated Desert Areas

The following three communities could be distinguished: *Thymelaea hirsuta* - *Gymnocarpos decanderum*, *Plantago albicans* - *Asphodelus microcarpos* and *Anabasis articulata* – *Haloxylon salicornicum*

*** North Eastern Coast of Sinai**

-The dominant plant species of the mobile sand dunes is *Stipagrostis scoparia*. In the coarse sand fields where there is constant removal of the fine sand, *Convolvulus lanatus*, *Artemisia monosperma* and *Cornulaca monacantha* are the dominant plant species. Stable sand dunes support *Artemisia monosperma* - *Retama reatam* community accompanied by some stands of *Iris mariae*.

- Halophytic vegetation dominates near the coast and salt marshes to about 10 km South. The most dominant species are: *Halocnemum strobilaceum*, *Arthrocnemum macrostachyum*, *Suaeda aegyptiaca* and *Limoniastrum monopetalum*. *Pharagimtes australis* and *Juncus arabicus* dominate the brackish parts of the salt marches .

-Anticlinal ridges of North Sinai support *Anabasis setifera* community at the upper parts of the Wadis, while *Retama reatam* – *Achillea fragrantissima* community is found along the lower larger section of the Wadi system.

iii- Inland Sinai and Eastern Desert

Sand and Gravel Habitats of Central Sinai are inhabited with the *Haloxylon salicornicum*, *Noaea mucronata*, *Cornulaca monacantha*, and *Thymelaea hirsuta* communities.

Mountainous Drainage Lines of Sinai support plant communities of *Acacia tortilis*, *Artemisia judaica*, *Lygos raetam* and *Panicum turgidum* .

The Red Sea Coastal land (including Suez and Aqaba Gulfs) support *Avicennia marina* community in Nabq area on the western bank of the Gulf and at Ras Mohammed . Mangrove vegetation is usually presented by *Avicennia marina*, sometimes associated with *Rhizophora mucronata*.

The salt marsh vegetation of the red sea coastal land comprises a number of community types characterized by: halophytic species.

The most common community types of the Red Sea coastal plains include *Salsola baryosma*, *Acacia tortilis* and *Panicum turgidum* which are confined to the drainage system; while those of the coastal mountains include *Acacia tortilis*, *Tamarix aphylla*, *Lygos raetam*, *Leptadenia pyrotechnica*, *Launaea spinosa*, *Haloxylon salicornicum*, *Anabasis articulata*, *Panicum turgidum*, *Artemisia judaica*, *Zilla spinosa*, *Zygophyllum coccineum*. *Capparis spinosa*, *C. sinaica*, *Ficus palmata* and *Cocculus pendulus*.

On the northern and eastern slopes of Gebel Elba, four main altitudinal zones are recognized ; these are:

- A base zone dominated by *Euphorbia cuneata* Scrub.

- A zone dominated by *Euphorbia schimperi* Scrub.
- A zone dominated by *Acacia etbaica* Scrub.
- A top zone with patches of *Dracaena ombet*, *Euclea schimperi*, *Dodonea viscosa*, *Jasminium* spp., *Rhus* spp. and several ferns and mosses.
- On the southern slopes, plant growth is mostly confined to runnels and comprises open scrub of *Commiphora opobalsamum* and *Acacia tortilis*.

- **The Inland Desert**

- Cairo – Suez desert the northern limestone plateau of Maaza, Beni-Suef, Assiut, Qena and the sandstone desert of Idfo-comombo support several species including *Launaea spinosa*, *Blepharis edulis*, *Convolvulus hystrix*, *Barleria acanthoides*, *Iphiona scabra*, *Stachys aegyptiaca*, *Zygophyllum* spp., *Zilla spinosa*, *Pennisetum dichotomum*, *Lycium arabicum*, *Tamarix* sp., *Acacia* sp., *Zilla spinosa*, *Fagonia Arabica*, *Farsetia aegyptia*, *Salsola kali*, *Francoeuria crista*, *Salsola volkensii*, *Echinops spinosissimus*, *Hammada elegans*, *Echium rawolfii*, *Pulicaria undulate*, *Aerva javanica*, *Calligonum comosum*, *Crotalaria aegyptiaca*, *Acacia ehrenbergiana*, *Leptadenia pyrotechnica*, *Crotalaria aegyptiaca*, *Cassia senna*, *Citrullus colocynthis*, *Salsola baryosma* and *Leptadenia pyrotechnica*.

Plant life in the Nubian extremely arid desert is confined to drainage lines and Wadis. These Wadis can be grouped (according to the rock formation they drain and direction of their flow) into four groups as follows :

- **Wadis of the Nubian sandstone that flow into the Nile** include the following communities: *Acacia tortilis*, *Salsola imbricata* - *Acacia ehrenbergiana*, *Fagonia indica*, *Tamarix nilotica* – *Salsola imbricata* and *Psoralea plicata* community type.
- **Wadis which Drain the Basement Rocks into the Nile** include, *Panicum turgidum*, *Acacia ehrenbergiana* – *Fagonia ondica*, *Maerua crassifolia* – *Panicum turgidum*, *Acacia*, *tortilis* – *Zilla spinosa* and *Balanites aegyptiaca* – *Zilla spinosa* community types
- **Wadis Draining the Basement Country to the Red Sea** support *Acacia tortilis* – *Zilla spinosa*, *Balanites aegyptiaca* – *Leptadenia pyrotechnica* and *Tamarix aphylla* – *Salvador persica* community types.
- **Wadis that Drain the Nubian Sandstone Country (Abraq area) to the Red Sea** support *Acacia tortilis* – *Aerva javanica*, *Acacia tortilis* – *Zilla spinosa* and *Acacia tortilis* – *Dipterygium glaucum* community types.

iv- The Western Desert zone

-The Southern Tableland (The Inland Part of the Miocene Plateau)

This part includes Siwa Oasis, El-Qattara Depression and Wadi El Natrun. These depressions have a variety of different habitat types, and are characterized by some leading species as follows:

- *Phragmites australis* and *Typha domingensis* dominate the swampy habitats.

- *Imperata cylindrical*, *Alhagi graecorum*, *Tamarix mannifera*, and *Juncus arabicus* dominate the sandy formations.
- *Zygophyllum coccineum*, *Fagonia arabica*, *Salsola tetrandra*, *Atriplex halimus* and *Zygophyllum simplex* are well presented in closed-in depressions .
- *Fagonia arabica*, *Zygophyllum coccineum*, *Acacia tortilis* and *Pergularia tomentosa* are found in water runnels.
- *Phragmites australis*, *Phoenix dactylefera*, *Nitraria retusa*, *Tamarix mannifera*, *Zygophyllum album*, *Inula crithmoides*, *Cressa cretica*, *Arthrocnemum macrostachyum*, *Halocnemum strobilaceum* and *Salsola tetrandra* are the dominant species in the salt marshes habitats.
- *Zygophyllum album*, *Traganum nudatum*, *Sporobolus spicatus*, *Phoenix dactylefera*, *Tamarix mannifera*, *Monsonia nivea*, and *Calligonum comosum* grow on deep sandy formations with low to medium salinity levels.

-The Middle Limestone Plateau

This is an extremely arid part of the Western Desert where water may flow to the surface under artesian pressure. The principal groups of habitat types in this plateau are:

- Fresh water ponds are rich with reed swamp of *Phragmites australis*, and *Typha domingensis*.
- Salt-affected lands and deserted farmlands, support *Imperata cylindrica*, *Alhagi mannifera*, and *Tamarix* sp.
- Sand bodies (sheets, small hillocks, large dunes .. etc). support *Stipagrostis vulnerans*, *Calligonum comosum*, *Imperata cylindrica*, *Prosopis farcta*, and *Calotropis procera*.

- The Southern Sandstone Plateau

Under the extremely arid conditions of this extension of the Western Desert, plant life is confined to special favoured habitats including oasis-like sites around the wells or those with some artesian flow of water. Plant life is also restricted in time depending on the accidental occurrence of rainfall.

Gebel Uweinat and its associated territories form specially favoured habitat, where runnels and lower sites collect runoff water. Seventy nine plant species were recorded and the following vegetation type were described:

- Ephemeral vegetation comprises annuals and potential annuals (perennials that may acquire short-lived growth form). This is the type that appears in years with some rain (accidental vegetation).
- Ephemeral and perennial vegetation in water collecting Wadis, which is also dependent on rainfall. Among the common species of these two vegetation types are *Zilla spinosa*, *Panicum turgidum*, *Stipagrostis plumosa*, *Anastatica hierochuntica*, *Trichodesma africanum* v. *abyssinicum*, *Fagonia arabica*, and *Farsetia ramosissima*.
- Perennial vegetation near wells, (oasis-like vegetation) including *Hyphaene thebaica*, *Phoenix dactylifera*, *Tamarix nilotica* and *Acacia ehrenbergiana*.

- Perennial vegetation in mountain gorges in the higher altitudes includes *Ochradenus baccatus* (900-1400m a.s.l.) and species of *Lavandula*, *Salvia*, *Heliotropium* and *Monsonia nivea*(1250-1580m a.s.l.).

1.5.3. Rangeland Resources

a) *Area and Location*

The total rangelands area of Egypt is about 4 mil. ha distributed in three sub-ecological zones as follows:

- 2,300,000 ha in NWC sub-zone.
- 1,100,000 ha in Sinai Peninsula comprising parts of the northern plains, Wadi beds in the northern and middle, and sandy plains in the southwest of the peninsula.
- 600,000 ha in Shalateen-Halayeb region. Other small rangeland areas are scattered in various locations (saline and wetlands, steep topographical areas, rainfed crop areas particularly after harvesting, steep high mountains and banks of irrigated canals and drainage systems).

b) *The Main Range Types of the NWC Sub-zone*

The following is the major distinguished range types of the NWC sub- zone:

-The Sand Dune Range Type Complex

This range type is characterized by a mixture of concrete plant communities including transitional zones; It includes some highly specialized psammophytic species which has the ability to grow vertically on burial with sand.

Although this range type is a fragile ecosystem, its vegetation cover includes some valuable forage species (annuals and perennials).

-The Salt Marches Range Type

This range type is characterized by some plant communities consisting of halophytic species which grow in saline habitats. Less saline areas support some salt tolerant species which could grow well in light and medium salt affected soil. Similarly some glycophytes are frequently found on non saline elevated areas.

The plant species with some forage value for camels , sheep and goats are *Suaeda terandra*, *Suaeda pruinosa* which grow on the dry parts on the coast where soil salinity is relatively low. *Atriplex species* , *Traganum nodatum*, *Reaumuria hertilla*, *Chenolea arabica*, and *Medicago marina*, have also good forage value during the dry season when more palatable species are severely grazed. Most of saline and sand dune habitats along the seashore had been destroyed due to various activities. In general, this range type provides limited grazing in all seasons.

- Gymnocarpos decander Range Type

This range type includes a bigger number of good grazeable species such as *Dactylis glomerata*, *Lygium spartum* , *Suaeda pruinosa*, *Artemisia haraba alba*, *Haloxylon scoparium*, *Salvia aegyptica*, *Salsola tetrandra* and *Lycium europaeum*.

Artemisia herba alba is present in sites with alluvial deposits along with other perennial sp. This range type is mainly grazed during late autumn, winter and spring.

- Artemisia herba-alba Range Type

This range type occurs mainly in area 10-20 Km inland south of the coast, occupying medium deep calcareous loamy to sand loam soils around Sidi Barrani , Ras El-Hekma, Fuka and Dabaa. *Artemisia herba-alba* communities are frequently found in mixture with *Haloxylon* and *Anabasis sp.* *Asphodelus microcarpos* is often a dominant associate in degraded phases of this range type due to its low palatability and low grazing value. This range type is mainly grazed during late summer, autumn and early winter.

- Haloxylon scoparium Range Type

This range type is mainly found on the Negaila plateau and east of Sidi Barrani growing on relatively shallow loam soil. It always occurs within sagebrush range type particularly when over grazed and / or ploughed. *Haloxylon scoparium* is of low to medium palatability depending on the type and intensity of the companion species. So the main grazing resources for animals are the annuals and accompanied perennials. Thus, most grazing is provided in winter and early spring. Barley aftermath and dried up annuals provide grazing in late spring and early summer. In autumn and winter seasons, *Haloxylon* are grazed when other grazeable companion species are reduced or overgrazed . The palatability of pure or semi-pure stand of *Haloxylon* is very low. Under such condition, the presence of dried annuals(letters) increase its consumption rate.

- Plantago albicans Range Type

This is one of the most important and valuable range type in Sidi Barrani district, and on the plateau south El-Omayed on medium and semi stabilized aeolian deposits. The main palatable associate species are *Echiochylon fruticosum*, *Helianthemum lippii*, *Gymnocarpos decander*, *Salvia aegyptiaca*, and *Pituranthos sp.* In good rainy years, it provides the bulk of grazeable forage for sheep and goats. In the *Plantago* ranges, grazing in the late winter and spring is provided by *Plantago albicans* and annuals, while the other perennial shrubs, subshrubs and dried annuals are the main grazing resources in late spring and early summer.

- Anabasis articulata Range Type

This range type occurs mainly in the south parts of NWC sub zone extending to the inland desert to depths of 30-40 Km south of the Mediterranean Sea. It is considered the most xerophytic range type extending south of the rainfed areas as well as south of the other range types regularly used for sheep and goats grazing. Under such condition, *Zygophyllum album* is the most dominant associate with *Anabasis articulata*, particularly, in areas further south. Favorable sites within this range type (i.e. depressions) support relatively dense stands of other companion species such as *Haloxylon sp.*, *Salsola tetrandra*, *Gymnocarpos decander* , *Salvia aegyptiaca.*, *Stipa parviflora* , *Atriplex halimus*, *Suaeda pruinosa*, *Stipa capensis*, *Salsola vermiculata*, *Noaea mucronata*, *Scorzonera sp.*, *Plantago albicans* (on sandy accumulations), and *Artemisia herba- alba*. Outside the favorable sites, many of these associate species are reduced to a minimum number of individuals of the most drought tolerant species. Annuals are often restricted to depressions receiving run-off water from adjacent higher areas. Their types, density and duration are controlled by winter rainfall. In normal and good rainy seasons, camels graze the *Anabasis* range throughout the year, while sheep and goats graze it in winter and spring, and can continue grazing to early summer if watering points are available.

- Suaeda pruinosa Range Type

This range type occurs in some scattered areas in east Fuka to Ras El-Hekma, between Matrouh and Boqqush, Matrouh – El- Garawla, south Om Ashtan dam, around Wadi Halazine, between Matrouh and Negeila and between Sidi Barrani and Alam El – Hammam. It mainly occurs as tussocks of different size on relatively, heavy loamy slight saline soils. In this area *Suaeda pruinosa* is almost the dominant, and the annuals are very abundant. The most important range species presented in this range type are : *Suaeda pruinosa*, *Lycium europaeum*, *Haloxylon sp.*, *Plantago albicans*(on sandy spots), *Gymnocarpos decander*, *Salsola vermiculata*, , *Schorzenara sp.*, *Noaea mucronata* , *Atriplex halimus* , *Salsola tetrandra*, *Artemisia herba-alba*, *Reaumuria hertilla*, , *Lygeum spartum*,. and, *Centaurea sp.*

C) The Important Range Types of NEC Sub - Zone (North Sinia)

- The Mediterranean Sandy and Salt Marches Range Type

The dominant plant of the mobile sand dunes and sometimes the only species presented is the perennial grass *Stipagrostis scoparia*. In the coarse sand fields, the dominant plants are *Convolvulus lanatus*, *Artemisia monosperma*, and *Cornulaca monacantha*. Stable sand dunes with some stable deposition of fine grained materials support *Artemisia monosperma-Retama reatam* community. Halophytic vegetation dominates near the Mediterranean coast and at salt marches to about 10 Km south of the coast. Seasonal fluctuation in the depth of water table and in salinity had greater influence on the distribution of vegetation .

- Anticlines Range Type of North Sinai

Anabasis setifera community dominates at the upper small parts of the Wadis; *Retama reatam* – *Achillea fragrantissima* community is found along the lower larger section of the Wadi system. Most of the semi-shrubs on the slopes are xerophytes such as: *Anabasis setifera*, *Reaumuria hertilla*, *Halogaton alopecuroides*, *Atriplex leuoclada*, *Suaeda palastina*, *Salsola tetrandra* and , *Atriplex glauca*. Alluvium in the Wadis support *Acacia gerrardii* trees.

d) The Range Types of Central and Western Sinai

- Table Mountains Range Type

Hammada scoparia is the dominant species on marl outcrops having salt regime. The steep escarpments of Tih plateau support a community dominated by *Halogeton alopecuroides* and /or *Anabasis setifera*. The small Wadis are dominated by *Artemisia herba-alba*, *Hammada scoparia*, *Zygophyllum dumosum*, *Gymnocarpos decander*, *Anabasis articulata* and *Salsola tetrandra*. The larger Wadis are dominated by *Retama reatam-Achillea fragrantissima* community.

- Gravelly Plains Range Type

This range type compare the major parts of central Sinai characterized by some different substrates. Each substrate has a characteristic Wadi pattern and usually supports a distinctive vegetation type. In Wadis with deep channels, vegetation is generally found on the banks and is often dominated by *Tamarix nilotica*, *Tamarix aphylla* and *Acacia sp.* The dominant semishrubs and shrubs are :*Anabsis articulate*, *Artemisia hirba-alba*, *Zygophyllum*

sp. Hammada scoparia and, Gymnocarpos decander. Sand covered hills support communities of *Retama reatam and Anabasis atriculata*; The deep sandy layers of sandy fields near *Gebel libni* support a community of *Panicum turgidum*, an important range perennial grass species of southern Sinai. Large Wadis with sandy silt soil support the *Anabasis articulata – Artemisia herba-alba* community.

e) Range Types of Southern Sinia

- Coastal plains of Suez Gulf

Vegetation is mostly in contracted pattern in the whole area except in sandy area and salt marches where it is presented in diffused pattern. The vegetation in small Wadies is dominated by *Hammada salicornica, Zygochloa coccineum, Anabasis articulata, Panicum turgidum, Fagonia mollis, Schouwia sp., Ephedra alata, and Artemisia judaica*. Larger Wadis support tree species of *Acacia tortilis, Tamarix aphylla and Tamarix nilotica*. Salt marches along shores are dominated by the *Hydrohalophytes species*.

Diffused vegetation pattern occupies the sandy areas and salt marches ; the dominant species in sandy areas is *Hammada salicornica*, while the hydro halophytes dominating the salt marches along the shore. *Salvadora persica* dominates areas of deep sandy soil where the water table is non saline and are several meters deep.

- Coastal plains and foothills of Aqaba Gulf

As a result of the great diversity in rock types, there are many different plant communities in the Wadis of this district. Each of the following species is a dominant in different associations of mall Wadis: *Hammad salicornica, Artemisia judaica, Abutilon sp., Seidlitzia rosmarinus, Lavandula coronopifolia, Salsola cyclophylla, Panicum turgidum, Lasiurus hirsutus, Corotalaria aegyptiaca, Cleome chrysantha, Zilla spinosa, Gymnocarpos decander, Taverniera aegyptica, and Cyperus jeminacus*.

The trees found in large Wadis are: *Acacia Sp., Moringa peregrina, Calotropis procera, Copparis decidua, Leptadenia pyrotechnica, Tamarix nilotica, Tamarix aphylla and Salvadora persica*. The most interesting phenomena of Aqaba Gulf is the presence of mangrove on its southern shores represented by the most northerly stands of *Avicennia marina* at 28° 10' N.

- Lower and Upper Massif Range Type

At the lower elevations, vegetation is restricted to Wadis. Dominant species in small Wadis are *Retama reatam, Zilla spinosa, Aerva persica, Artemisia judaica, Capparis cartilaginea, Fagonia mollis, Launaea spinosa, Moricandia siniaca, Ochradinus baccatus and Tephrosia sp.* Large Wadis support some tree species of *Acacia tortilis, Tamarix aphylla and Calotropis procera*. Other tree species such as *Moringa peregrina, Ficus sp. and Phoenix dactylifera* grow near springs. Higher elevations are dominated by *Artemisia herba-alba, Fagonia mollis, Gymnocarpos decander, Anabasis articulata, and Varthemia montana*.

The flora of the upper massif is dominated by *Artemisia herba-alba* accompanied by *Gymnocarpos decander, Zilla spinosa and Fagonia mollis* in stony alluvium. Rock vegetation is very rich in shrubs and trees. Characteristic trees and shrubs include: *Pistacia khinjuk, Ficus pseudosycomorus, Sageretia brandcethiana, Rhus tripartita and Rhamnus desperma*.

f) Main Range Types of Shalateen-Halayeb District

- Swampy and Salt Marches Range Type

Longitudinal narrow and shallow lagoons and bays dominated by *Avicennia marina*, few individual trees of *Rhizophora mucronata* could be found in this swampy habitat. Wet salt marches are dominated by halophytic vegetation.

Non saline elevated areas within or close to these salt marches support scattered vegetation of *Euphorbia granulata*, *Citrullus colocynthis*, and *Caylusea hixagyna*. Some scattered trees of *Acacia ehrenbergiana* are also presented.

-Desert Sandy Plains Range Type

This range type extends between the coastal salt marches in the east and the coastal hills and mountains westwards. The area is non saline leveled and/or undulating plains confined to the drainage system, but far of the tidal sea water. The dominant plant species are *Anabasis setifera*; companion species are *Cassia senna*, *Crotolaria egyptiaca*, *Panicum turgidum*, *Salsola tetrandra* and *Acacia tortilis*.

-Wadis Range Type

The dominant plant communities which constitute the permanent backbone of vegetation within Wadis ecosystem are: *Acacia tortilis* – *Zilla spinosa*, *Acacia ehrenbergiana* – *Indigofera argentea*, *Acacia tortilis* – *Depterygium glaucum*, *Acacia tortilis* – *Aerva javanica*, *Balanites aegyptiaca* - *Leptadenia pyrotechina*, *Maerua crassifolia* – *Panicum turgidum*, *Tamarix nilotica* – *Salsola imbricata*.

The limited few number of trees mentioned above are the species which play the role of edificators in the structure of plant communities. However, the richest growth of trees and companion shrubs are found in narrow tributaries upstreams of Wadis. The driest portions of the Wadis, where ground water is below the root zone, are often devoided of permanent vegetation. In such habitats, ephemerals of short lived plant appear during spells of rain and last as long as water is available. The most important annuals in the rainy seasons are : *Astragalus sp*, *Reseda sp.*, *Trigonella stellata*. and *Cyperus rotundous*. Wadi sites which have little or no access of available ground water support plant communities dominated by medium and short life perennials. The most widely distributed of such plant communities are those dominated by *Zilla species*, *Aerva javanica*, *Panicum turgidum*, *Stipagrostis plumosa*, *Crotolaria aegyptiaca*, *Policaria crispa*, *Senna italica*, *Stipagrostis plumosa*, *Asphodelus sp.*, *Zygophyllum simplex*, *Chorsophora plicata*, and *Frasetia egyptiaca*.

g) Rangeland Production and Carrying Capacity of Rangelands

No real data are available from actual stocking rate trials to estimate the carrying capacity of the range types. The available are only some estimates carried by some experts based on their field observation and their long experience in the region. However, the carrying capacity varied from 3-5 Acres for the *Plantago albicans* – *Echiochilon fruticosum* association growing in deep sand soil to 15 Acres/sheep unit/year for the *Haloxylon* – *Anabasis articulata* range type. A field survey was carried out to estimate the carrying capacity of the different range types extending from Burg El-Arab to Sulloum. The carrying capacities estimates varied greatly for the different range types, ranging from 4-15 Acres for *Plantago albicans*, 5-20 for *Artimisia herba alba*, 5-25 for *Gymnocarpos decander*; 8-30 for *Anabasisi articulata*; 8-28 for *Suaeda pruinosa* and 15-35 Acres/sheep unit/year for

Haloxylon ranges. Estimated carrying capacity differed from 4 Acres/sheep unit/year (SU) for Fuka grazing district to 22 Acres / sheep unit /year for El-Salloum district.

The annual / feed production of the rangelands varies between nil in poor rainfall years to 30-40 feed unit (FU) with an average of 20 FU/Acre/year. On the basis of the barley acreage in 1990 and an estimated production of 230 FU/Acre of barley, the carrying capacity of the area extending from Ras El-Hekma to Salloum was estimated as about 93000 sheep unit – (SU) year while the actual number of small ruminants raised at the time was about 214000 SU, indicating that the actual production of rangelands can only support about 44% of the actual number of the small ruminants raised. This also indicates that about at least 60% of feed staff requirements came from outside resources. Any shortage in the supply of feeds of outside the region would have to be offset from rangelands because the grazing animal will be maintained on the rangelands causing more deterioration of rangelands and lower production of grazing herds.

A recent report estimated the consumable productivity of some plant communities in Bakbak project (south west of Sidi Barrany) between 20-30Kg/dry matter /Acre/year. The average productivity of the whole area was estimated as 25 Kg/Acre/year. This area is a part of natural poor degraded range type.

Due to the proximity to the mountains, the Wadis in Halayeb basin have more floristically variable vegetation with higher frequency of palatable species than Wadis in Shalateen basin. However, Shalateen rangelands are more suffering from heavy over grazing due to excessive animal numbers, cutting and uprooting of trees and shrubs. Furthermore, herbaceous plant communities in Wadis of Shalateen basin is dominated by the unpalatable species of *Sasola baryosma* and *Francoeria crispa*. While in Wadis of Halayeb basin, there are more palatable species dominated by *Panicum turgidum* which is good forage grass.

Similarly, Wadi Hederba in Halayeb basin has the richest grazing resources and the highest potential for conservation and improvement than of other Wadis. The most important forage species in Wadi Hederba are *Panicum turgidum*, *Aristida mutabilis*, *Artemisa judaica* and *Lycium shawii* which could provide good useful grazing resources for small ruminants and camels during winter and summer.

h) Rangeland degradation (desertification) phases

Desertification in rangeland starts when vegetation cover starts to deteriorate. The following four phases of desertification are commonly observed in rangelands of Egypt .

- Slight desertification phase

This phase is marked more by decrease in the quality rather than the quantity of forage due to the decrease of high palatable species of good forage value. Normally forage production under this phase declines by 10-20% of its potential. Water and wind erosions remain within their normal averages or accelerate in a few locations only.

Such retrogression phase is common in most interior or far rangelands areas that lack permanent watering points, have steep topography, partially protected by tribal rules or where grazing purposes is controlled by governmental agencies; and local communities or for military purposes.

-Moderate desertification phase

The early stages of this phase start with the appearance of invader plants of those alien to communities. The plants are mainly mobile annuals and are followed by weedy perennials of which some are of low palatability and other are valueless or even poisonous or harmful to livestock. During this phase, forage production declines by about 25-40 percent of its potential,

wind and water erosion begin to exceed their normal rates as marks of sheet and gully erosion start to appear and sand may accumulate in the form of hummocks or dunes. This is a common phase in the majority of Egyptian rangelands.

-Severe desertification phase

In this phase the changes is more drastic as the palatable species assume complete disappearance and the total forage production decline by nearly 50-70 percent or more. The ratio of the bare soil increases, dunes and gravel plains become more conspicuous, and loss of top soil and erosion pavements become the dominant scene. These conditions are common in areas subjected to continuous and early overgrazing (i.e range areas between or closed to rainfed cultivated areas, touristic constructions, roads, watering points and near settlements) .

- Very severe desertification phase

This is the worst stage of plant and soil retrogression, it is characterized by the striking appearance of a barren state produced by the inability of the remaining subsoil to support vegetation. The already advanced process of sheet and gully erosion may be seen to have cut steep gully banks, exposed pedstalled plants, increased dunes and extended gravel plains. The ranges are eventually transformed into sterile land, where forge production drops by 75-100 percent. This stage of desertification is very common in areas around permanent watering points, near permanent or occasional settlements (towns, villages, nomads tents) and around the markets of animals and livestock production. In such places, brisk winds and dust storms are very common.

i) Causes of Desertification of Rangelands

Low erratic rainfall and long drought periods are by far the most dominant limiting factors in the rangelands of Egypt. However, drought diminishes rangeland productivity but also adversely affects feed species diversity and the composition and size of grazing herds. Furthermore, drought and poor soil developed in arid lands impose a highly fragile ecosystem in which vegetation and soil resources are vulnerable to deterioration from slight misuse. Range lands deterioration had been accelerated during the last decades of the twentieth century by over use and improper management practices such as:

- Expansion of rainfed cultivation (particularly barley and wheat and horticultural crops) in the favorable rangeland areas (specially in the coastal areas, Wadis and depressions) .
- Increasing uprooting of trees and woody shrubs for fuel.
- Continous overgrazing due to the rapid increase in the population of small ruminants which was encouraged by availability of subsidized feed.
- 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 sacrificed areas around water points.
- Increasing use of trucks and water tanker for transporting grazing herds and water to far range areas .
- Discretion of the traditional grazing system as a result of the reduction of common grazing areas due to appropriation of rangelands by the desert Governorates, individuals and families for touristic purposes activities, housing, roads, manufactures ... etc.
- In our opinion the present policy of rangeland management and utilization is the main root cause of deterioration of rangelands of the country. However, utilization of rangelands as common open free access ranges (without any restrictions on livestock

population, animal movement, grazing seasons and duration does not permit for any sustainable conservation and development of rangeland resources .

j) The current rangelands status (condition) and trend

Rangelands of Egypt are in variable conditions of desirable plant cover and productivity. However, about 45% of the total rangelands areas are severely degraded and could be described as very poor, ranges, 35% as fair, 15% as good and 5% as excellent ranges. The last two categories are restricted to far rough topographic areas, areas lacking water point and/or areas protected by tribes, governmental agencies or for military purposes.

The general trend is shrinkage of areas and decline in quantity and quality of forage production. Adverse changes in range plant composition, i.e. more annuals, less palatable and more unpalatable and noxious species are reported for most range areas. The combined effects of overgrazing, uprooting of woody plants and extension of rainfed cultivation have accentuated the decline in native forage production and the deterioration of good native forage species gene pool , thus threatening biodiversity. A recent report indicated that in most areas of western coastal zone and, north Sinai, forage production had declined by 50-60% in less than 30 years and about 40-50% of the plant cover has been lost. This changes are mainly attributed to ploughing of the most productive range areas to cultivate barley (and sometimes wheat), uprooting of shrubs for fuel and to increasing grazing pressure.

k) Signs of Desertification of Rangelands

The general signs of rangeland degradation can be summarized in the followings:

-Signs of vegetation cover degradation

- Decreasing total vegetation cover percentage .
- Increasing the ratios of invaders, noxious and harmful species, and plants of low forage value such as *Astragalus spinosus*, *Zilla spinosa*, , *Alhgi maurorum*, *Fagoni species*, *Citrullus colocynthis*, *Peganum harmala*, *Daemia sp.*, *Solanum sp.*, *Anabis setifera*, *Thymea hirsuta*, *Cleome sp.*, *Marobium sp.*, *Hyoscyamous sp.*, and *Calatropis procera*). Such species are currently dominating the perennial component of vegetation cover.
- Decline of most high and medium palatable species percentage and total disappearance of others. However, good perennial palatable species are either extinct or at the brink of extinction in their native habitats, with some remaining shrubs having hedged shape.
- Pedstalled plants and the cushion growth of shrubs and sub shrubs are more frequent.
- Decrease and / or disappearance of many good annuals of high forage value.
- Marked decrease in the quantity and quality of forage production coupled by marked decline of livestock production.
- Increasing proportion of bare areas.

- Signs of Soil Degradation

- Increasing soil hummocking.
- Increasing wind and water erosion such as sheet and gulley erosion.
- Loss of top soil.
- Increasing thickness of wind – borne deposits.

- Salt encrustation.
- Decreasing organic matter.
- Increasing dust storms.
- Increasing areas covered by gravells and stones.

1.6. Wildlife

The presence of various terrestrial and aquatic ecosystems in Egypt, e.g. the arid and semi-arid areas, the Mediterranean Sea, the Red Sea, the River Nile, lakes, ponds and oases create a suitable media for more than 175,000 species of living animals : from invertebrates to vertebrates and from aquatic to terrestrial animals. For example, the herpetofauna includes 98 species of reptiles and 7 species of amphibian, out of which 51 species of lizards, 37 species of snakes, 8 species of turtles and one species of crocodilian. Amphibians includes 4 species of toads and 2 species of frogs and one species of tree frog. Mammals detected until now are about 105 species and birds are about 515 species; out of which 200 species are resident types and the others are migratory and about 200 species are considered as extinct. Fresh water fish about 85 species; of which 22 species are the common but 49 species are rare and 14 species are considered as extinct.

It is undoubtedly that the Egyptian wild fauna is considered a part of the global wealth due to the singularity in its characters and habitats. Some names of these animals retain the word Egypt either in its Latin, English or common names which may indicates that they were firstly discovered in Egypt or are endemic to it. Among of these wild animals are:

Psammophis schokari aegyptius, *Uromastix aegyptius*, *Walterinnesia aegyptia*, *Aegyptius monachus*, *Alopochen aegyptiacus*, *Caprimulgus aegyptius saharae*, *Caprimulgus aegyptius aegyptius*, *Centropus senegalensis aegyptius*, *Rousettus aegyptiacus*, Greater Egyptian gerbil, Lesser Egyptian gerbil, Egyptian plover, Egyptian Kite, Egyptian Vulture, Egyptian Wagtail, Egyptian Night jar, Egyptian goose.

In fact, all these kinds and types of living animals are considerably affected and consequently threatened by several environmental factors. The absence of laws and proper legislations, in addition to the type of activities of local people, overgrazing modernization and socio-economic impacts are also important limiting factors for the development of fauna in Egypt. No much information about characteristics, problems and prospects of fauna and other wild life in Egypt are available.

a) *Distribution of fauna*

According to the geographical distribution of the fauna habitats in Egypt, it can be classified as follows :

Nile Valley and Delta

The wet land within this area together with lakes are green habitats which allow several thousands of vertebrates and invertebrates species to exist.

Sinai peninsula

-North Sinai Governorate

Bardaweel and Malahat lakes are considered a very good media for animal, particularly birds and are actually conservation areas. They are considered very important as transit stations for birds that migrate from Europe to Africa in autumn and from Africa to Europe in spring.

-South Sinai

It is characterized by some unique groups of wild life. It is rich of protectorates; it has also important role in marine life and in the migration of some birds such as herons, storks and falcons.

- Eastern Desert

It is characterized by great numbers of wildlife conservation areas, extending from Suez in the North to Gabal Elba in the South where more than 40 % of the Egyptian fauna are existed.

- Western desert

The hyper-arid nature of this area leads to low the density of fauna. The presence of several oases, in the region, with saline lakes increases the humidity and allow the growth of several types of grasses and cultivated crops which increase the presence of reptiles ,birds and mammals .

b) Current situation of the wild life resources

- Egyptian endangered fauna

The continuous damage of the Egyptian fauna habitats had negative impact on the national wild life. About 700 species out of 17000 species of the Egyptian fauna became endangered in the few last years, for examples: Sinai Leopard, Nobain Ass, Barrbary sheep, Addax antelope, Pharaonic Ipex, etc. Some other species have been facing and suffering dramatic decline in numbers such as most of the Egyptian reptiles and mammals. In this respect, most members of family Elapidae, which inhabit the wet lands and south Sinai are going to be extinct since they are collected for medical purposes. *Testudo Gracea, T. kleinmanni* ,soft shell turtle, Red neck ostriches, Nubian ibex and Addax antelope could be considered as endangered species.

- The protected areas in Egypt

There are at least 24 common protectorate and conservation areas in Egypt distributed all over the country. These are concentrated mainly in the Eastern desert and Sinai. The most important ones are: Ras Mohamed national park, Zaranik protectorate, Ahrish protectorate, El Omayed protectorate, Elba national park, Red sea islands (22 islands), Al Abraq protectorate, Al Daniep protectorate, Elba protectorate, Saluga , Ghazal protectorate, St. Katherine protectorate, Ashtum El Gamil protectorate. Lake Qarun protectorate, Wadi El Rayan protectorate, Wadi Alalaqi protectorate, Wadi El Asuity protectorate, Hassana Dome protectorate, Petrified forest protectorate, Sannur Cave protectorate, Nabaq protectorate Abu Galum protectorate, Taba protectorate, Lake Burullus protectorate, Nile Islands protectorate (144 Islands), Wadi Digla protectorate, Siwa protectorate, White desert protectorate, Wadi El Gemal protectorate, and Hamata protectorate.

1.7. Aquatic Wealth

Egypt is characterized by its long shorelines, 3500 km on both the Mediterranean and Red Sea. The coasts of these two seas are considered as special areas that need protection from misuse by man.

On the Mediterranean, the area from Salloum to Alamein (Matrouh Governorate) of Matrouh is considered as virgin areas with no industrial activity that dumps directly to the shores of the Mediterranean. The Red Sea is characterized by its coral reefs and its colored fishes. Its beaches are considered as some of the loveliest area for fishing and diving as well as for the different sea sports.

Because of lack of environmental awareness, many mistakes resulted in disappearance of many assets. This necessitates immediate action to adopt specific plans for conservation and management. The resources in the coastal zone of Egypt. The Mediterranean and Red Sea are enriched with several variable resources including oil and mineral deposits, fisheries, tourism and other living resources e.g. Sea plants ...etc.

1.8. Renewable Energy

-The total primary energy consumption in Egypt reached 42.188 MTOE in the year 1999 and is expected to be 45 MTOE (Million Ton Oil Equivalent) by the year 2017.

Fossil fuels can be considered as the main energy resource in Egypt, in addition to hydropower and non-commercial fuels such as firewood, agricultural wastes and dried dung. At present and for many of the coming years, petroleum fuels, oil and natural gas "NG", are the most important source of energy in Egypt. The total production of oil and natural gas has been increased by about 60% in the last 18 years, where in 80/81 the total production was 33 MTOE meanwhile it became 55.482 MTOE in 2000/2001. Great efforts have been exerted in the field of oil exploration since 1968. At the end of 2000/2001 the reserves from crude oil were 3.81 BBOE (Billion Barrels Oil Equivalent). Recently, crude oil annual production is about 50.318 MTOE.

Natural gas is used as fuel, electricity generation and in petrochemical and fertilizer industries. Its reserves are estimated to be about 7.3 BBOE. The current level of the annual gas production is in the order of 13.190 MTOE, accounting for 22.39% of the total production of primary energy resources.

Hydropower resources also supply a recognized amount of the current electric energy consumption. The energy generated from the high dam, Aswan dam, Esna and Naga Hammady barrage power stations reaches 15.3 TWh (Terra Watt hour), representing 22.5% of the total electricity generated. Hydropower resources are already used to supply some of the electric energy needs.

- With regard to renewable energy, Egypt can be considered as one of the earliest users of such resources, particularly, in the fields of passive solar buildings, solar drying, use of wind mills for water pumping and use of animal and agricultural wastes. However, the present and future situation of energy challenges necessitates the extending of implementation and development of the use of renewable energy resources. Intensive efforts have been made to achieve this goal.

Egypt enjoys also a tremendous wind resource in the Gulf of Suez where the annual average wind speed reaches 10 m/sec. The southeastern desert of the Uweinat area can be

considered as another promising area, where the average wind speed is 7 m/sec. A brief account on the most important resources of renewable energy can be presented as follows:

a) Solar Energy

Several solar (technology/applications) options were studied by field demonstration and evaluated with a promising market penetration. These include both low and high temperature technologies.

In 1995 the Ministry of Electricity and Energy carried out an assessment and identification study for the Solar Thermal Electricity Generation (STEG) potentials in Egypt to the year 2017 and concluded that:

- Egypt has one of the highest potentials in the Mediterranean region for the "STEG" technologies. It reaches almost 30% of the total potential in the region.
- The total accessible potential for centralized connected STEG systems in Egypt is tremendous and far exceeds all practical expectations for implementation.
- The Integrated Solar Combined Cycle Systems (ISCCS) using parabolic trough solar technology with a conventional gas turbine combined cycle is the most appropriate system for Egypt's first plants. The choice of technology for the next plants will be decided in accordance with the state of art at the time of implementation.

Currently, NREA (National Renewable Energy Authority) has already finalized the pre-feasibility studies for the plant of the first ISCCS at Kuraymat with a capacity of about 150 MW and is taking actions for its implementation. The planned installed capacity of ISCCS is 150 MW in the year 2002 and rises up to 400 MW in the year 2005.

b) Wind Energy

Egypt has surpassed the phase of demonstration and pilot projects and already has large scale wind farms in operation. Currently, a 5 MW wind farm in Hurgada is operating successfully with different designs and sizes of wind turbines ranging from 100 to 300 kW capacities. The wind farm is connected to the local distribution network of the city. A lot of experience has been gained in erection, operation and maintenance. The project is under expansion to increase the share of environmentally sound energy sources in the overall energy supply of this tourist city.

A wind energy technology centre was established in Hurgada to provide a research environment for wind energy manufacturers and developers. The centre incorporates full scale testing and certification facilities that can serve to reach local objectives and to realize regional co-operation programmes.

The first large scale wind farm connected to the national grid at Zafarana at the Gulf of Suez is under construction. The wind farm has a 60 MW stage supported by the Danish government as well as a 20 MW face supported by the German government. The installed capacity of the Zafarana wind farm is planned to reach 600 MW by the year 2005, out of which 300 MW are to be privately financed under the formula of the BOOT system. The expansion plan is associated with a parallel plan to foster the local manufacturing of wind energy equipments through technology transfer arrangements.

c) Biomass Utilisation

Several studies, research and development activities have been carried out mainly in the areas of biogas production, stoves improvement and small scale grassfires. NREA is presently utilizing its facilities for studies and testing activities, mainly related to the field of anaerobic digestion and gasification.

1.9. Human Resources:

Egypt population is estimated at 71.0 million (2005) with about 1.9% annual growth rate. About 20% of the population is concentrated in the Greater Cairo, 6% in the coastal governorates, 40% in the Delta governorates, 33% in Upper Egypt governorates and 1 % distributed among the remaining areas of the country. The population density varies from 15000 to 0.4 person /Km², in Cairo and the New Valley Governorate, respectively.

Desertification is usually a result of human activities and drought. It is mainly considered a problem caused by human misuse of natural resources, and thus affects sustainable development and standard of living, especially, such as malnutrition, food scarcity and the problems due to immigration and migration.

The social profile of women encompasses a number of activities such as education and health where gender gaps may be still observed with regard to a number of key positions:

-With regard to girls education, statistics reveal that although enrolment and retention of girls at all levels of education has generally improved in recent years, the ratio of girls to boys enrolled is considerably low for primary education. Girls' access to education appears to be hindered by socio-economic factors including customary attitudes, early marriage and pregnancy, the lack of adequate and physically accessible schooling facilities, the high indirect costs of education as well as family dependence on child labor for supplementary income.

-In 1996, the high rate of female illiteracy reached 36% for urban women and a staggering 63% for rural women. Male illiteracy rate was much lower at 29% (20% urban and 36% rural). Illiteracy among women is correlated with early marriage, high fertility rates and ill health. It also limits women's accessibility to formal market, remunerated economic activity and political participation. This marginalization usually extends to children.

-The pattern of women's employment in Egypt is reminiscent of patterns of employment prevalent in other developing countries in participation rates for women in labor which tend to be low, while unemployment rates are higher among women. It is currently estimated that one fifth to one fourth of women ages 15-24 are unemployed.

-Privatization measures appear to have had a disproportionately bigger role on women. They constrained jobs opportunities resulting from the mismatch between disciplines offered by the current education system and the actual market requirements. The opportunities for vocational training are inadequate, too costly or inexistent.

-Poverty of women is likely increased despite the sound economic growth witnessed by Egypt in recent years. However, women in rural and remote areas deserve special attention due to economic under development and social marginalization.

-Female households are among the poorest and more vulnerable because of wages discrimination and occupational segregation patterns in the formal labor market and

irregularities of income often characterizes work in the informal sector. Statistics reveal that over one fifth of households are headed by females. Divorce, death of the spouse, family instability as well as international migration are factors contributing to the rise in female headed households which are illiterate and have little access to credit and gainful employment. Credit restrictions are also a result of lack of collateral, legal illiteracy, the inability to deal with bureaucratic systems and lack of ownership of personal identification cards.

-The rural population as percentage of total population has been stable for the last three decades. It formed 56% of total population in 1976 and 1986 and increased slightly to 57% in the year 1996.

From the above situational analysis of rural women, the most important issues, social or economic, are as follows :

- Women's lack of ownership of agriculture resources.
- The weak contribution of women to the decision making processes.
- The lack of technology available to women, in the performance of their agricultural tasks.
- Women provide 100% of most household tasks (cleaning, cooking , care for children, carrying water, gathering wood for fuel and cleaning latrines) in addition to their tasks in agriculture production which leads to the well known phenomenon of double burden work;
- Women in agriculture suffer from high illiteracy.
- Women have minimum income and thereby they suffer from high poverty levels; especially women who are heading households; and
- Lack of knowledge of legal rights.

2. AGRICULTURE

2.1. Land Use Pattern

Egypt covers an area of about one million km² \simeq 100 million hectares, out of which an about of 76.5 thousands km² \simeq 7.6% of the total area are inhabited, and the remaining (92.4%) area is desert.

Generally, the land use pattern of the inhabited area could be aggregated as follows:

-About 8.4 million acres, \simeq 3.5 million hectares, \simeq 3.5% of the country area under cultivation, from which about 2.9 million hectares are cultivated with field and vegetable crops. Meanwhile, the remainings areas (0.6 million hectares are cultivated with horticulture).

The total areas of cultivation are mainly concentrated in the Nile Valley and Delta and, to lesser extent, in the very limited patches distributed allover Egypt.

-About 3.6 million acres \simeq 1.5 million hectares (1.5 % of the total country area) is the marginal rangelands and associated pastoral system. This area is distinguished in NWC, the NEC and Shalteen and Halayeb regions.

-The remaining area of the inhabited area (about 2.6 million hectares) is devoted for urban and rural settlements as well as industry sectors and other utilities.

Table (1) and map (6) include the land use pattern of the agroecological zones in Egypt.

Table 1. Land use pattern in the different Agroecological Zones (Million ha).

Zone	Northern Coast		Nile Valley & Delta		Western Desert	Total Area	%
	NWC	NEC	Nile Valley	Delta	New Valley		
Non agricultural land							
- desert						228.0	95
- inland waters						0.6	0.25
-urban and industrial areas and public utilities						1.1	0.46
Agriculture land							
- rainfed	0.3	0.1				0.4	0.17
- irrigated (old lands)	-	-	1.9	3.8		5.7	2.38
-reclaimed (<1980)	-	-					
cropped	-	-	0.1	0.5		0.6	0.4
uncropped	-	-	0.1	0.1	0.1	0.3	
- reclaimed (>1980– until now	-	0.3	0.2	1.8	0.2	2.5	1.04

2.2. Agricultural Production

Agriculture is a key sector in the national economy of Egypt. It accounts for about 20% of both GDP (Gross Domestic Production) and total exports and about 33% of total labour force. During the seventies, the increase in the agricultural GDP approached an average annual rate of 3.5%, but since the eighties, it fell around 2.5% which was lower than the growth rate of the national economy.

This decline is related to the faster growth in other sectors, e.g., oil and tourism and many of growth obstacles, e.g., limited water resources, adapting and application of modern technologies as well as distortions of policies including land tenure, subsidies , marketing, trade, ... etc.

- Agricultural land

Although Egypt has an area of about one million km², about 100 million hectares, a small portion is agriculturally production land. Based on some estimates, the cultivated area approaches, about 3.5 million hectares, i.e., about 3.5% of the total country area.

Nevertheless, these estimates are imprecise, because the statistics refer to the gross areas while the net irrigable areas need to be estimated. Also, no estimates are made of the unproductive, not fully reclaimed areas and / or areas transformed to non-agricultural use. Moreover, there is no reliable records on land losses due to urbanization, which average according to many reports between, 15,000 and 30,000 acres annually.

Based on water quantities released annually for agriculture, the Ministry of Water Resources and Irrigation has estimated the total cultivated areas at 8 million acres, including 5.5 million acre of old land, 2 million acres of new land and 0.5 million acres in the oases (New Valley) and rainfed areas.

Evidently, these are rough estimates because water release especially for new land are not based on accurate quantities of water requirements of such areas. Therefore, the estimates of the agriculturally productive areas in the country are not precise and need to be verified. On basis of these estimates, Egypt is one of the lowest world's per capita levels of agricultural land, i.e., 0.11 acre or 0.046 ha.

Generally, the old lands have good soils, and often have sustainable crop rotations which had evolved as a result of several generations of cropping. However, there remains considerable potential for increasing agricultural productivity from the old land, upon adopting measures for better land and water management, including the issues of land degradation (water-logging, salinity, exhausting soil fertility, pollution,etc.). The newly reclaimed land (2 million acres) are viewed as an opportunity for increasing agricultural production and ensuring food security in the country. Likewise, such areas provide a chance for absorbing the increasing population and improving the demographic situation of the country. Nevertheless, the return from most of the already reclaimed areas is low compared to its full potential most probably due to inefficient use of land and water resources, inferior or absence of agriculture background, weakness or absence of extension service which focuses on the specific needs of the new land, poor agricultural credit and input supply which meet the need of the new settlers in these areas.

Rainfed agriculture occupies about 0.25 million acre, i.e., about 3% of total agricultural land. About 70% of such area lies in the North Western coastal sub-zone NWC of the country, while the rest lies in the eastern one (NEC). Although these areas may not appear significant in relation to the total agricultural land, they are important for local communities and economic. Moreover, it is believed that better and more-efficient use of the natural resources as well as the adoption of appropriate research, training and extension programmes are essential.

- Irrigation water

Agriculture in Egypt is almost entirely dependent on irrigation, except a few rainfed areas in the narrow band along the northern coastal zone. Furthermore, the limited supplies of ground water especially outside the Nile basin (oases and some other scattered areas) which are very low compared to total volume required for irrigation, the agricultural development in Egypt is closely linked to the River Nile and its management. Nevertheless, the water use from the River Nile shows a rapid increase and the agricultural water demand has currently

met via using of drains water, consequently the flow of drains to the sea is sharply reduced. This situation poses serious issues since the drains water is of poor quality due to pollution from industrial, municipal and agricultural sources.

In this respect, the effect of agricultural activities on water pollution is mainly related to salinization, and the use of pesticides and fertilizers which are among the highest rates in the world. Some of these fertilizers infiltrate to the surface and ground water system. This may put the use of ground water for drinking at risk. Therefore, it is clear that the impact of the present activities of mixing drainage water with Nile water (such as El Salam Canal project) have to be carefully monitored to avoid environmental and health hazards or risks.

Though water is the limiting factor in agriculture sector, the use efficiency of irrigation water is generally low and does not improved, especially in old cultivated land, 50%,therby many of the related land degradation issues have been arisen. (This is discussed in details chapter 4).

- Crop production

During the five years (1998-2002), the total cropped area has increased by about 5% at the end of (2002), such area totaled about 13.2 million acre (Table 2). Most of the increase came from the summer crops, primarily oil crops such as peanuts and sesame as well as rice and vegetables. Meanwhile, there was a significant decline in most of Nili crops, and many of summer crops, such as cotton, soybeans and maize (Tables 3&4). A slight increase also occurred in winter crops, especially in berseem and wheat, (Table 5).

The crop productivity levels in Egypt are relatively high compared to yields of the world standards and in countries with similar agroclimatic conditions. Moreover, there is a potential for increasing the yield by about 20% for the self pollinated crops such as wheat and rice and more than 30% for cross – pollinated crops such as maize by using hybrid seed.

It is worthwhile to notice that most of the agricultural land is occupied by wheat, berseem, maize and sugar cane. Rice and sugar cane are financially attractive to farmers because irrigation water is free of charges. Therefore, the current crop rotation which includes cotton and wheat as well as orchards and oil crops need governmental and suitable incentives.

In rainfed areas, crop productivity is relatively low. Some studies estimated the yield of cereals, i.e., barely and wheat ranges between 250 and 350 kg/ acre. It is also estimated that the productivity of figs, olives, and vegetables reached about 1800, 865 and 600 kg/acre, respectively, (MRMP,1993). The same studies showed that such levels of productivity can be increased, at least by about 15 % upon improving the management of the natural resources in the rainfed areas of NWC sub-zone of Egypt .

Table (2). Development of the cropping area (thousand acre) during the last 5 years (1998-2002).

Cropping season	1998	1999	2000	2001	2002
Winter crops (1)	6323	6366	6454	6286	6479
Summer crops (2)	5800	5868	5757	6015	6103
Nili crops (3)	675	598	623	590	606
Total (4)	12798	12832	12834	12897	13188

(1) From November to May.

(2) From March / April to September including sugar cane and cotton.

(3) From May to October.

(4) Excluding orchards.

Source: Ministry of Agriculture, Egypt.

Table (3): Development of areas (thousand acre) of the dominant summer crops during 5 years (1998-2002).

Type of crop	1998	1999	2000	2001	2002
Cotton	789	645	518	731	706
Rice	1225	1559	1569	1340	1547
Sorghum	365	384	376	354	365
Maize	1698	1561	1623	1711	1552
Soybeans	43	17	9	13	14
Sugar cane	291	307	319	312	324
Peanut	104	141	144	151	141
Potatoes	76	72	68	66	66
Sesame	52	67	72	68	72
Vegetables	773	760	726	885	868
Others	368	341	333	385	448
Total	5784	5854	5757	6010	6013

Source : Ministry of Agriculture, Egypt.

Table (4): Development of areas (thousand acre) cultivated with Nili crops during the period 1992 to 2002.

Type of crops	1998	1999	2000	2001	2002
Rice	7	(1)	1	(1)	(1)
Sorghum	11	10	11	12	7
Maize	325	284	305	277	281
Potatoes	74	45	44	47	48
Vegetables (2)	153	161	166	164	179
Others	105	98	96	90	90
Total	676	598	623	590	606

(1): Less than one thousand acre.

(2): Include 6000 acre onion.

Table (5) : Development of areas (thousand acre) cultivated with winter crops during the period 1998-2002.

Type of crops	1998	1999	2000	2001	2002
Wheat	2421	2380	2463	2342	2450
Broad Beans	428	351	307	368	343
Barley	143	224	230	237	229
Lentil	11	5	5	5	5
Flax	16	8	10	18	21
Onion	59	90	73	61	70
Berseem	2439	2461	2389	2499	2564
Garlic	18	25	29	22	21
Sugar Beet	104	128	136	143	154
Vegetables	615	608	693	505	523
Others	85	100	119	86	97
Total	6339	6380	6454	6286	6479

- Rural Population

The rural population of Egypt represent about 53 % of the country's total population. Recent years have show a trend towards increasing urbanization, where some estimates show urban population growth rate approached around 3 % per annum as compared to the national population growth rate of around 2.5 % per annum. The inability of the rural economy to respond to demands for employment is an important determinant of migration which occurred. Generally, the salient features of the rural economy includes ;

a)The land tenure is generally small. It is estimated that about 82 % of the farms are less than 2 acre, and about 95 % are less than 5 acres. It is also evident that about 85 % of farmers hold only 48 % of the total area, indicating that fragmentation is common.

b)While the agriculture dominates the rural economy, a large number of farm households derive a significant part of their annual incomes 35% from non-farming activities. Such activities may offer possibilities for the development of private initiatives and investment in agricultural services in the rural community.

c)Rural women represent an important resource for promoting agricultural development. About 50 % of the total active female population in Egypt is engaged in agriculture work. They participate in all facets of agriculture activities and handicraft activities linked to agricultural byproducts. However, severe constraints limit the role and contribution of rural women in increasing agricultural production and national income. These constraints include illiteracy, high fertility, lack of access to resources (such as agricultural supplies & services), and extension which are mainly geared to serve male farmers . In order to remediate this situation, it is important to made a reliable data-base and information on women activities, constraints as well as preparing and executing training programmes and extension service for rural women, that are relevant to their cultural and rural environment .

- Agricultural Extension and Training

At present and after the compilation of liberalization and privatization programmes the role and responsibility of the Ministry of Agriculture and Land Reclamation (MALR) has been confined to agricultural research , extension and training, regulatory measures and economic policies. However, the extension function of MALR is weak and fragmented partially due the inadequately trained staff, but mainly to an uncoordinated approach towards providing extension services particularly to the smaller farmers. Presently, the extension services are being provided by the Governorates, the Agrarian Reform

organizations to farmers within their areas of responsibility and to limit extent by the staff of the General Authority of Projects And Development (GAPAD) for the newly reclaimed areas. Because of this weak , dispersed and poor linkages with research institutions, extension system needs to be developed particularly from the standpoint of extension methodologies, training, staffing, ensuring linkage between research & extension... etc. It is also important to adopt special programmes for the new land. At the same time, there is a need to encourage the emerging private sector initiatives by providing extension services. A key requirement, is the need to build and develop a well defined monitoring and evaluation system for the agricultural activities in fields of research, extension and training.

2.3. Livestock, Poultry and Fish Production

2.3.1. Livestock Production

The total animal population are 4.1, 3.7, 5.1, 3.6, 0.13 and 1.1 millions of cows, buffaloes, sheep and goat, camel and draught animals, respectively (Census of 2003).

These numbers increased steadily from year 2001 up to year 2003 with various rates of changes as illustrated in Table (7) according to data derived by FAOSTAT (2003).

Table (6). Total numbers and rate of changes of animal resources (1000 heads)

Year	Draught	Camel	Goat	Sheep	Buffaloes	Cow
2001	1349	134	3497	4671	3533	3801
2003	1079	127	3583	5101	3717	4083
Change,%	- 20	- 5.2	3.4	9.3	5.2	7.4

The rates of change are higher for sheep followed by

cows while the numbers of camels and draught animals are declined by 5.2 and 20 %, respectively.

Animal production systems in Egypt vary from one zone to another based on availability of local resources, activities of local communities and available of investments in the region.

Production systems and breeds in the four agro -ecological zones are different. For instance, the production system in the Nile Delta is very intensive unlike the other zones where the extensive production system is mostly practiced. The Nile Valley (Upper Egypt) the production system is less intensive. Sheep are raised either by small-scale farmers or in village flocks managed by shepherds, and goats are kept mainly as household dairy animals.

Buffaloes appear to be the most important source for milk. They produce more milk than that of cows although their numbers are low. The total milk yield in Delta and Nile Valley zone represent about 90% of the total milk production. Under good management, milk production of Buffalo ranges between 1000 and 3000 kg per lactation, two to three times higher than that of native cows. They tend, however, to have lower rates of reproduction than dairy cattle. It is likely that these low rates could be improved through better nutrition, health care and management, rather than genetic manipulation. Milk yield of the native Baladi cows is low, about 800 kg per lactation, and is used mainly for nursing the calves. Because of

increased demand for milk, Friesian cattle were introduced and the cross-bred cows lactate longer and have a shorter dry period.

On the other hand, the Desert zones are dominated by sheep, goats and camels raised under extensive production system. Therefore, such zones are poor in milk production due to the scarcity of cows and buffaloes, in general, where most bedouins depend on goat milk production for local consumption.

2.3.2. Poultry Production

Poultry production is progressively increased during the last fifteen years since the products of poultry (meat and eggs) could sufficiently cover the local consumption.

The poultry and egg sector in Egypt has been developed dramatically since the early 1990's, enhanced by economic reform and government policy. In 2001, poultry meat production, reached 646,600 metric ton, exceeded all other types of meat. In value terms, 26 percent of Egypt's total livestock products came from poultry meat and egg production. In fact, Egypt's livestock sector contributed 27 percent of total domestic agricultural production in 1999.

It is noticed that, more than 90% of poultry production is found in the Nile Valley and Delta zone. On the other hand, poultry production activities are still not intensified and limited in the other agro-ecological zones.

The total number of Egg farms in Egypt is about 14519 and produce around 628144000 eggs per year. Such amounts of egg production are enough to cover the local requirements. Most of egg production is produced in the Nile Valley and Delta zone while the Desert zones are poor in their egg production due to several factors mainly environmental.

However, one of the major constraints that encounter the poultry industry in Egypt is infectious diseases, which is responsible for great economic losses. It consequently have devastating effects particularly on intensive production. Although vaccination programmes have reduced the incidence of diseases; vaccination programme can not alone cope with infectious diseases adequately. Therefore, special attention has been made to the ability of poultry breeds to respond to pathogenic challenges.

-Feed resources

In Egypt, serious shortages of animal and poultry feed hinder animal production. Lack of appropriate statistics about feed production in certain parts of the country may imply the lower rank of it and, therefore, the less important role of this industry in the national economy. In 2002, Egypt's poultry producers imported feedstuffs for their flocks while high tariffs restrained meat imports. By 2010, Egypt will likely rely on imports for nearly all of soybeans and about 48 percent of corn to satisfy its feed requirements. However, the estimates of MALR, for 2003 indicated, that the total amounts of livestock and poultry feed materials had been increased from the year 2001 to 2002 at rates of 2.8 and 12.1% , respectively

Generally, animal resources and their productivity systems in Egypt are generally constrained by main four limiting factors: environment, range resources ,nutritional constraints, beside socio- economic stresses.

Current situation of animal production

From the previous brief notes on animal production resources in Egypt, the general features could be summarized in the following points:

- productivity

Livestock productivity is generally low due to one or more of ; High parental mortality, high barrenness, low conception and fertility rates , low prolificacy, low birth and weaning weights, slow growth rate and reduced animal productivity (meat, milk, etc.).

- health and disease control

Livestock encounters economic losses due to several factors relevant to health and diseases such as: ecto- and endo parasites cause, fertility disorders, reduced body weight gain, and deterioration of animal production. Viral and /or bacterial diseases and toxic plants could have major impact on animal health. Frequency of coccidia infection is high in Sinai region compared with other parts of Egypt. The incidence of parasitic infection among camels is very high, particularly in Halaib- Shalateen region. The toxic plants affect animal production on the rangelands and cause a lots of troubles to livestock holders.

2.3.3. Fish Production

A. Marine Fisheries

In 2001, the Egyptian marine registered fishing fleet operating in the Mediterranean and Red Seas. Fishing fleet consisted of 6388 vessels of which 3954 were motorized and the other under sail.

i) Mediterranean Coast:

The main fishing ground used by Egyptian vessels is the continental shelf of the Nile Delta, and may extended to the eastern side of Port Said and rarely to the Western side of Alexandria. Landings of the Mediterranean Sea represent about 45 % of the total marine catch.

ii) Red Sea adjacent gulfs:

The fisheries of the Red Sea are based on long-standing traditional fishery where coral reefs spread along the Red Sea Coast and Gulf of Aqaba, with relatively shallow fishing grounds with flat sandy bottoms in the Suez Gulf.

B. Inland Fisheries

Egypt has about 8716 km² of inland waters, including Nile river, lakes, reservoirs and brackish water lagoons. Both commercial and sport fishing take place on these waters. Some inland waters are regularly restocked with both marine and fresh water fish fry.

C. Freshwater Fisheries

These include the River Nile, irrigation canals, the Aswan High Dam and lake, and some western desert water bodies.

D. Brakish-water Fisheries

The brackish-water lagoons are in the North Delta (lakes Maryuit, Edku, Burullus, Manzala and the almost dry Wadi Al Rayian).

E. Saline – water fisheries

These comprise Bardaweel Lagoon, Port Fouad Lake, Timsah and Bitter Lakes and Lake Qarun. Bardaweel and Port Fouad Lagoons are hypersaline shallow lake linked to the Mediterranean Sea.

According the Ministry of Agriculture and Land Reclamation records Senses 2003 the total country fish production has increased from 545593 to 799467 ton/yr (about 40%) during the period from 1998 to 2003. In 2003 the recorded fish production of the Mediterranean, Red seas, Northern Lakes (Manzala, Brolos, Edko, Maryut) and inland Lakes (Karon, High Dam, Rayan) reached 435673 ton / yr (i.e. 54.5% of the total production). Meanwhile fish farms production approached 375051 ton / yr (i.e. 45.5% of the country production).

3. CAUSES, PROCESSES AND IMPACTS OF DESERTIFICATION

Egypt as located in the arid and hyperarid zones is severely affected by various types and forms of desertification which are stemming from the climatic variations and human activities and their interactions. Human activities include unsustainable management of the available resources as well as inappropriate policies, plans and legislations.

3.1. Causes of desertification.

The major causes of desertification in Egypt can be outlined in the following:

- i) 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.
- ii) 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.
- iii) 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 desertification, e.g., compaction, pollution... etc.
- iv) 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.
 - 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.

3.2. Desertification Processes

The main processes involved in land degradation include:

3.2.1. Urbanization

Urbanization is one of the most extreme forms of land degradation because it means irreversible loss of soil function, and causes sealing of agriculturally productive land. In Egypt, where merely 3% of its total territory is fertile land, encroachment of cities, towns and random urbanization impose serious stress. On basis of the aerial photograph and remote sensing facilities, the Academy of Scientific Research & Technology (1994) has estimated the annual expansion rates of some selected cities and towns located on highly productive land within the Nile Valley and Delta, and reported that during the period from 1978 to 1984, the annual expansion rates of the dwelling area ranged between 5.3 and 30.8% of studied sites. It was also observed that the magnitude of increase was significant and more pronounced with time especially in the smaller cities, administration centers and urbanized locations in different provinces. Concomitantly, another types of land degradation was developed, starting with the illegal dereliction of agricultural land with the objective of diverting its use to dwelling purposes and other forms of encroachments.

Also, skimming of the fertile soil surface layers of the agricultural land, up to an average of one meter depth, for brick industry causes another dimension of degradation and sealing of productive agricultural land. In fact, the main reason of this type of degradation is the overwhelming increase of population in such zone, where the annual growth rate during eighties approached 2.9%. Needless to mention that the population density in the Nile Valley and Delta reaches about 2000 per km², which is one of the highest densities in the world.

Various reports mentioned that the annual losses average at 15000 to 30000 acres. Recently, the Ministry of Agriculture and land Reclamation has estimated the total loss as 1,200000 acres, i.e., about 16% of the total irrigated agricultural area of the country. Likewise, the issues of population growth and condensation of constructions within the agricultural land are closely linked to pollution and the overall environmental management in these areas.

3.2.2. Salinization

Salinity problems are wide-spreaded in Egypt. Almost 30% of the irrigated farmlands is salt-affected. It is estimated that 60% and 20% of the Northern cultivated land and both Middle and Southern Delta regions, in sequence, are salt-affected soils. Meanwhile, in the Nile Valley, i.e., Upper Egypt, salt affected soils represent about 25% of the cultivated areas. Likewise, many areas of the reclaimed desert land adjacent to the Nile Valley and Delta as well as in Sinai and Oases suffer from water-logging and high salinity. These soils are characterized by excess soluble salts with sodium chloride in substantial quantity. Consequently, soils accumulate sodium on the exchange complex causing poor physical and

chemical properties, which adversely affect water infiltration, soil tilth, plant growth and yield. The process of salinization is due to;

- Excessive application of irrigation water.
- Irrigation with poor-quality water, e.g., using low quality mixed drainage water, and increased use of low quality ground water.
- Inadequate salt leaching practices.
- Inefficient or impaired drainage conditions.
- Evaporation from water-table especially when it is within 2m, significantly contribute to root-zone salinity.
- Poor land leveling with consequent localized redistribution of salts can often cause salinity problems of significant magnitude.

3.2.3. Pollution

Chemical degradation of water and land resources, defined as the combined negative effects of the chemicals and chemical processes on the aquatic system and the properties that regulate soil function, has considerably emerged as an important agent of desertification.

In most cases the root of such problem is the mis-management of water and agricultural land as well as the poor implementation of pollution control regulations. The major sources of land and water pollution in the country can be summed up as follows;

- i)** The discharge of industrial effluents and agricultural drainage water and navigation activities into the Nile, main canals and drains contaminate the surface water resource. The most important industrial areas that directly affect the water quality of the River Nile system include KIMA factories at Aswan; sugar factories at Kom-Ombo, Edfu and Naga-Hammadi; cement and fertilizer plants at Assiut; iron and steel, coke and chemicals at Helwan; Kafr El-Zayat and Alexandria industrial areas,... etc.
- ii)** In the rural areas where 75% of the population (about 45% of total country population) has no access of any sanitary facilities, thereby waste water and latrine fills are directly absorbed underground or discharged by truckloads in drains, therefore the shallow groundwater, i.e., Nile aquifer (less than 50m) show signs of pollution (WRC). Consequently, the use of such contaminated water sources for irrigation progressively undermines not only the quality and quantity of agricultural production but also the soil bio-diversity.
- iii)** The excessive use of fertilizers due to the frequent and intensive cropping pattern, whose rate reaches, on average, 319 kg/ha of basic nutrients N,P and K. Such rate is very high compared to application rates worldwide. This overuse has resulted in nitrate pollution of the water-table and drainage water. Though imports of pesticides and herbicides have considerably reduced following the import limitations, excess amounts of their residues in soil and in both surface and shallow water table are reported to have serious impact on public health and environmental risk for communities in the rural areas.

3.2.4. Soil fertility depletion

Extensive and frequent cropping, under the conditions of unsustainable irrigation water management and improper agricultural practices, in the Nile Valley and Delta have resulted in depletion and deficiency in many nutrient elements. This situation has been exacerbated after the construction of the High Dam, which sharply decreased the annual additions of the fertile sediments to the soils. Consequently, all Egyptian soils are poor in their content of organic matter, total nitrogen and other nutritive elements.

3.2.5. Wind Erosion

Because of the arid climate, wind erosion is one of the major processes of land degradation in Egypt, as it prevails in the Western desert and Eastern desert & inland Sinai agro-ecological zones which are mostly sand- textured. Wind erosion also occurs in the coastal zone where coastal sand dunes dominate. Therefore, wind erosion affects about 90% of the total country area. The major reasons of such desertification process are the fragility, vulnerability and nature of the soil, aridity; scarcity of natural vegetation, and the advancement of the sand dunes. In the rainfed areas of the northern coastal zone, destruction of plant cover, overgrazing, ploughing and extending cultivation to the shallower and less suitable soils accelerate wind erosion.

The average rate of soil loss via wind erosion in the Western desert Oases has been estimated as 5.5 ton/ha/year, indicating that the rate of wind erosion is of moderate class, meanwhile the rate of deposition varied from 4.5 to 66.9 ton/ha/year. Data of the percentages of total hours of the active wind speed per year showed that their values varied between 9.4 and 29.0, indicating that wind erosion hazard in this area ranges between moderate and severe. However, the calculated annual rate of wind erosion in Omayed area (NWC) using WEQ (Wind Erosion Equation) reached 100ton/ha. Meanwhile, the calculated rates in Fuka in the same sub zone have shown to be dependent upon the land use, and ranged between 5.2 to 71.3 ton/ha compared with the measured values of 2.43 and 10.63 ton/ha for the same site. In El-Sheik Zowaied, along the northeastern coast of Sinai, the amount of airborne materials reached 3.16 ton/100m width over 193 days.

3.2.6. Water Erosion

Water erosion is among the major processes of land degradation in the northern coastal zone of the country where abrupt and intense rainstorms cause excessive runoff and considerable soil loss. Such process also prevails in the coastal plains, hilly and mountain slopes of the Red Sea, Al Aqaba Gulf as well as the southern parts of Sinai and many wadis in the Eastern Desert. The annual soil loss via water erosion in rainfed areas along the northwestern coastal sub- zone was found to be related to the number of the effective storms, amount of rainfall in each storm, land use, soil erodibility and slope. The annual water erosion rate has been estimated between 0.8 and 5.3 ton/ha/year. It is also found that the losses of plant nutrients; nitrogen, phosphorus and potassium are linearly proportional to soil loss. In addition, the Universal Soil Loss Equation (USLE) was the best for predicting the rate of soil erosion.

3.2.7. Sand Encroachment

Sand dunes and other sand forms in the coastal and inland deserts are the most vulnerable to wind erosion and deposition, consequently they constitute a serious threat to the agricultural development, rural and urban settlements, road traffic and public health.

Active dunes and sand encroachment cover more than 166000 km², i.e., about 16.6% of the total country area. The erratic rainfall, active winds, soil instability, scarcity of plant cover, increased this detrimental phenomena especially in the coastal area due to overgrazing and cultivation of marginal land which led to severe disturbance of the natural equilibrium of the ecosystem.

The characteristics of sand dunes either active or inactive and their potential threatening of the agricultural land in the Nile Delta and Valley were studied using the multitude land satellite imageries across the area surrounding the cultivated land. The study concluded the following :

- i) There are five discernable areas characterized by serious sand dune encroachment;
- a) West of the Nile Delta in which dunes cover about 255 km² with an orientation towards the western and southwestern sides of the cultivated land in the Nile Delta.
 - b) Fayoum and Wadi El-Rayan depression, which have three types of active dunes, namely; the longitudinal dunes covering about 480 km², sand sheets covering about 240 km² and barachan dunes having an area of about 160 km². Because of hyper-arid conditions, activity of wind and the virtually non-existing desert vegetation, such sand sediments are actively attacking the cultivated land of the western and southern sides of Fayoum and Rayan depression.
 - c) Nile Valley; in which the linear dunes located southwest El-Minya governorate, approximately cover 350km² and characterized by steep slip, are actively encroaching on fertile cultivated land along the western side of the Nile Valley.
 - d) Al Kharga Oasis; which are dominated by longitudinal and linear dunes covering about 400 km². The source of the longitudinal mobile dunes is the Great Sand Sea in the Western Desert. Due to the fact that such area is almost rainless, flat in topography and has an increasing gradient in wind velocity, such dunes are active and migrate from the North and northeast to the South and southeast. These dunes seriously affect infrastructure and even engulf the villages and Palm grooves in the area.
 - e) Northwestern High Dam lake; where longitudinal and barachan dunes located at a distance of about 5 km to the northwest of the lake and extend from northwest to southwest to cover an area of about 800 km². These dunes migrate to the South and southeast directions, and hence attack the northwest edges of the lake.
- ii) There are two major areas characterized by inactive sand accumulations, which can be delineated, briefly in the following;
- a) East of the Nile Delta, in which some longitudinal and barachan dunes are located between East of the Nile Delta and North the Gulf of Suez. These dunes have low elevation (2-5 m) with about 2-5 km length and, 1-2 km in width and are surrounded with sand sheets. They are trending from North to South and not currently possess any threat to the cultivated land in the Nile Delta.
 - b) Sinai Peninsula, in which a zone of inactive sand extends between the East of Bitter Lakes and North of Wadi El Arish. These dunes are far from the fertile land in the Nile Valley and Delta, Nevertheless, at present a new land reclamation project is currently implementing and a greater canal (El Salam) crossed part of such dunes, which may disturb the dunes ecosystem, thereby special attention should be focused on the influence of such dunes on the agricultural development in this area.

3.3. Impacts of desertification

The major impacts of desertification can be summed up in the following:

a) *Vegetation cover and grazing resources*

- Decreasing natural vegetation cover percentage .
- Increasing the ratios of invaders, noxious and harmful species, and plants of low forage value.

- Decline of most high and medium palatable species percentage and total disappearance of others. However, good perennial palatable species are either extinct or at the brink of extinction in their native habitats, with some remaining shrubs having hedged shape.
- Pedstalled plants and the cushion growth of shrubs and sub shrubs are more frequent.
- Decrease and / or disappearance of many good annuals of high forage value.
- Marked decrease in the quantity and quality of forage production coupled with marked decline of livestock production.
- Increasing proportion of bare areas.
- Overuse and mismanagement cause a remarkable degradation of the biotic and non biotic components of the ecosystems (flora, fauna, soil, water...etc.).
- Overgrazing of plant species led to their disappearance or marked decline and the range condition becomes progressively poorer due to the big decline in forage production.
- Due to the increase of invader species, the range productivity declines in terms of animal production probably without real reduction of the total biomass production. Currently, the present plants of most Egyptian rangelands are species which are either non palatable or of very low palatability and low forage value for grazing animal due to the dominance of low grade species particularly when they are green.
- The change of the forage produced (both perennials and annuals) to species of low forage value (invaders, noxious and harmful plants) implies reduced site productivity, livestock performance and production. The perennial vegetation which is essential for reducing raindrop impact and reduce wind speed at ground surface had low average cover (3-7%) which led to reduced organic matter in the soil with loss of structural stability and exposure of soils to agents of erosion.
- Rains falling on uncovered soil of low organic matter and poor structural stability reduced permeability and infiltration and increased run-off and soil erosion.
- Gulleys take lands out of production and their healing requires expensive treatment.
- Increased run-off reduced infiltration, production and ground water recharge.
- Reduced perennial cover also reduced production from annuals at the top 10 cm of soil.
- Loss of surface soil will not be conducive for growth of annuals.
- Increased frequency of sandstorms which have serious economic implication for the country. Deposition of sand on natural vegetation bury plants, thus reducing biological diversity of nations resources.

b) Water and Soil Resources

- Increasing soil hummocking.
- Increasing wind and water erosion such as sheet and gully erosion.
- Loss of top soil.
- Increasing thickness of wind – borne deposits.
- Salt encrustation.
- Decreasing organic matter and nutrient depletion.
- Increasing dust storms.
- Increasing areas covered by gravels and stones.
- Soil salinity and water logging significantly decrease yield of most crops.
- Shifting dunes cause signification hazards not only for the productive land but also for public health.

- Pollution with fertilizers, pesticides, herbicides, disposal of industrial waste and the use of sewage effluent or sludge, has led to contamination of the source of drinking water, adversely impacts fish and aquatic system, also cause many other environmental risks for the community especially in the rural areas.

c) Socio-economic impacts

The greatest impacts of water and land resources on public health are as follows:

- Contamination of sources for drinking water.
- Exposure to pathogenic bacteria and parasites.
- Contamination of fish and food products.
- Sandstorms and air-borne dust as a result of wind erosion are sources of irritation and possibly of respiratory ailments.
- Several villages have been buried under sand deposits during the last three decades (e.g., Ginah and Moushia in the Western Desert Oases and Abu kiraimat in the River Nile Valley).
- Expenses attributable to sandstorms for road blockage are estimated by several million Egyptian pounds per year.

4. Activities to Combat Desertification

This chapter presents a review of some of the previous and ongoing activities to combat the factors and processes of desertification prevailing in each of the agro-ecological zones of Egypt. Such review is of great importance to assess and analyze the impacts of such activities in achieving its technical and socio-economic objectives and be identifying the lessons to be learned. The review is also important for the activities of the NAP to build on previous achievements and preventing duplication of efforts and loss of time and human endeavors. Finally the review of previous and ongoing activities will help in identifying gaps, hotspots and priorities to be addressed and dealt with by the proposed NAP activities. The present review is presented based on major activities carried out each of the agro-ecological zones to facilitate setting of priorities and is enhance the efficiency of the future NAP activities.

4.1. North Coastal Areas

Both the Northwest Coastal areas and that of North Sinai have been the subject of various investigations and activities that could contribute to combating desertification starting in the 1960s. The number of investigations has particularly grown during the last 20 years. These activities were varied in objectives, scale, and applied methodologies. Studies and research projects have been sponsored and carried out by various national institutes and authorities and sometimes in co-operation with regional and international organizations. Foremost among the national institutes are the Desert Research Center (formerly Desert Research Institute), the Agricultural Research Center, the National Research Center, the Academy of Scientific Research and Technology, the General Authority for Reclamation, Projects of Agricultural Development (GARPAD), and the Universities of Alexandria and Suez Canal. The participation of the regional and international organizations are noted in the following activities.

4.1.1. Activities in the Northwest Coast

- *The World Food Programme (WFP)*

This program was carried out in the entire Northwest Coastal areas during (1963-1973). It was revived in 1979 and continues till present. The project focusses on the improvement of soil and water resources, hence contributing to Bedouins welfare sedentarization. The project activities include :

- 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)*

FAO was active in the Northwest Coast in 1965-1970, and again from 1988 till present, the current project aims to develop agricultural production by using modern agricultural methods, irrigation systems, and plastic greenhouses. The project is more active in specific sites such as El Qasr, Om El Rakham, Sidi Barrani, and Abu-Laho. It includes trials on soil and water conservation works in Wadi Shaiab and Wadi Taweila.

- The Australian Dryland Farming System

In 1980-1983, McGowan International Ltd investigated the feasibility of introducing the Australian dryland farming systems in the Northwest Coast. In the course of their work, they planted crops and established pasture on some 3.800 fed (1.357 ha) at seven trial sites.

- The German Agency for Technical Cooperation (GTZ)

In 1988, GTZ began operations in El Qasr on an area of 40 x 70 km. It 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).

A feasibility study entitled "Management Project" was conducted in 1992 in the Western Province from Matrouh westward almost to the Libyan border. The aim of the study was to make the best use of the limited resources available to the local populations through the analysis of natural resource base and the assessment of the sustainable development possibilities. This was followed by a development programme that extended till 2001.

- Programme for Rehabilitation of Rangelands

Since the fifties several projects for rehabilitation and development of rangelands were covered. These projects included:

- a) The project for improvement of rangelands of Ras El Hekma in Matrouh Governorate. This project was carried out by the Desert Research Center (DRC) with the support of US-PL 480 programme in an area of 5000 feddans. The main objectives were to protect has El-Helema rangelands against overgrazing, introduction of new species and varieties appropriate for rangelands , organizing grazing practices, enhancing the benefits from surface water resources (Rainfall and Runoff) and available ground water resources. The project activities almost doubled the carrying capacity of this area for four years.
- b) The project for improvement of arid lands carried out by the Authority for the Northwest Coast in collaboration with National Research Center (1980-87).
- c) The project for range areas improvement in 10,000 feddans west of Mersa Matrouh carried out by the Authority for the Northwest Coast and the DRC (1987-1992).

- ICARDA in collaboration with the DRC and ARC

ICARDA, DRC and ARC conducted a project in the Northern coastal areas of Egypt in 1995 entitled Resource Management in the Rainfed Areas of Egypt. This project included studies on agronomic practices, soil fertility, management of water resources and socio-economic aspects with synthesis of all the latter. The project also assessed the constraints and potentials of the studied areas.

- A project supported by UNDP and IDRC had started in (1992-1998) in the area of (Fuka-Matrouh) under the title “Coastal area management programme” with the objectives of planning the integrated management of coastal areas, sustainable development , modeling of decision making and building expertise in the field. The project activities included establishing of a database for the information pertinent to the project area, soils suitability analysis and environmental impacts assessment of the developmental activities.

4.1.2. Activities in North Sinai Coastal Areas

- During the 1950s and 1960s concerted efforts were conducted to develop and enhance the productivity of Wadi AlArish cultivated areas especially in its parts located within the coastal areas north of Sinai.

An earth dam was constructed (Al Arish Dam) to conserve 5.0 million m³ of wadi Al Arish water to be used for boosting productivity and increasing the cultivated area. Unfortunately the Dam's reservoir was silted quickly by the sediments transported by water since no proper measures were applied to minimize water erosion in the catchment. A new dam is being planned to conserve about 20 million m³ in an appropriate location further south with suitable measures for conservation and sustainability of the function of the new dam.

-JAICA in 1989 carried a rural development project in North Sinai with emphasis on the supplemental use of groundwater

-GTZ started a technical cooperation project “Rural Development of North Sinai”, in 1991. The aim of the project is to provide a general overview of the soils and land suitability in the North Sinai Governorate.

-The project for improvement of range areas in East Sinai in an area of 1000 feddans carried out by the Academy for Scientific Research and Technology in collaboration with the DRC.

-Experiences in fixation of sand dunes:

The varied technologies of mechanical, chemical and biological fixation of mobile dunes were tested and applied in several activities in the North Coastal areas including the following:

- a) The project in North Sinai (1960-1967) carried out by the Authority for Desert Development.
- b) Fixation of sand dunes in North Sinai carried out by Academy for scientific Research and Technology in cooperation with University of Alexandria (1984-1994).
- c) Utilization and fixation of sand dunes in local stakeholders Shiekh Zowied and Rafah areas in Northeastern Sinai (1980- till present).
- d) Programme for tree plantation along the major roads of North Sinai and the Authority for Development of Sinai (Ongoing).

In general despite the implementation of several projects for sand dunes fixation especially in North Sinai, the treated areas are far from adequate due to several reasons including the following:

- Lack of adequate numbers of transplants and materials used.
 - Lack of personnel and appropriate experiences.
 - Lack of participation of local stakeholders and their conviction and awareness of the significance of the problem.
 - Lack of adequate financial resources.
- The National Research Center carried out since 1990 a project for the introduction of salt tolerant and drought resistant varieties of cereal and forage crops to enhance the productivity of the cultivated areas in North Sinai.

- Use of desert genetic resources to combat desertification:

The flora of Egypt contains a considerable number of palatable species belonging to families: gramineae, leguminoase, cruciferae, compositae, chenopodicaea, labitatae and nitrarianceae. They are mostly considered as halophyte plants which could be efficiently utilized in several aspects as fodder, fuel, landscaping, sea-side dune stabilization, biological recovery of waste lands degraded by salinity or alkalinity, land reclamation, range rehabilitation and utilization of brackish waters. Since the conservation and utilization of plant genetic resources have become a priority in Egypt, scientists of the Desert Research Center (DRC) have successfully established a new gene bank at Sheik Zuwayid, North Sinai.

The facility has been conceived to address especially the optimum utilization of the plant genetic resources from dry and desert areas.

4.2. The Nile Valley and Reclaimed Desert Fringes

4.2.1 legislations

- Urban encroachment on fertile lands prohibited and city limits were marked. However, urban encroachment still continues (at a much lower rate). Recent surveys from (1992-1995) showed urban encroachment to have impacted around 20,000 feddans of fertile areas. This is attributed to expansion of the existing rural villages and towns in contradiction to the formulated law.
- In the early stages of desert soils reclamation in the fringes of the Nile Valley, surface irrigation was practiced widely in the newly reclaimed water logging areas which caused water logging and salinization even in coarse textured soils over a period of 15-20 years. Such conditions led to uprooting of fruit tree of their prime productivity with serious economic losses. Hence forth, a legislation was formulated prohibiting the adoption of surface irrigation practices in newly reclaimed desert areas. Such action was very beneficial in restoring the productivity of these areas, saving sizable water resources through the application of modern irrigation techniques, as well as, enhanced the income levels of the local farmers.

4.2.2. Soil improvement activities

Soil surveys carried by the Ministry of Agriculture showed and land reclamation showed that there is a great need for land improvement and soil conservation to combat a reported decrease in the productivity of the land in the Nile Delta and Valley (old & old new lands). In 1971, the Ministry of Agriculture established the Executive Authority of Land Improvement Projects (EALIP) as a semi-autonomous organization belonging to the Ministry of Agriculture (MOA).

EALIP was vested with overall responsibility of carrying deteriorated land improvement techniques in Egypt as follows:

The Nile water has an alkalinizing effect on the alluvial soil, especially on those that contain a large fraction of highly expanding clays. The area suffering from sodicity is estimated about 10% of the salt affected area. The application of gypsum is becoming a general rule and it is a common practice to add an average of five tons per feddan to the soils.

- Physical limitations of the soil profile are improved by sub soiling which improved the soil structure by creating a zone of fissuring and cracks, breaking up compacted layers and so improving the drainability of the soil. The activity has now become a routine procedure in soil improvement work in Egypt carried by EALIP.
- Lack of land leveling for the soil surface, this can be improved by carrying partial leveling and zero leveling carried by the use of laser beam. The adoption of such activity leads to saving about 25% of the irrigation water, and prevents secondary salinization.
- EALIP is responsible for clearance and maintenance of the open secondary and collector drains whereas the farmers should maintain their field ditches in proper working order, in actual practice; this does not occur and often after some years the system is in disorder.

The land improvement program is now covering the entire irrigated land of Egypt. Since the establishment of EALIP and until the end of March 1994, the following soil improvement activities were accomplished;

- Sub-soiling in an area of 3.638×10^6 feddans;
- Additional of 5.504×10^6 tons of gypsum to the soil.
- Land leveling using updated technology was introduced and carried by the laser beam in over 2.9×10^6 .
- An increase in the agricultural production exceeding 30% was reported.

4.2.3. Conservation of land Resources from pollution

The long standing traditions of rotational use of fertilizers in the old fertile valley soils was altered after the construction of the High Dam under the wrong impression that the lack of sediments load in the Nile water due to the construction of the High Dam will lower the fertility of the Nile Valley soils. This wrong impression led to the extensive use of chemical fertilizers, pesticides and agrochemicals amendments.

The extensive use of nitrogenous fertilizers led to excessive leaching of nitrates to the water table and further to the groundwater resources. The produced food products could be contaminated with pesticide residues and rejected as export commodities. Health and

environmental hazards are serious threats to the humans, animals, flora and fauna with adverse effects extending to the main areas where drainage water are discharges.

The Ministry of Agriculture and Land Reclamation carried out concerted efforts through research extension and public awareness efforts to curtail the use of pesticide and agricultural chemicals with possible polluting impacts. Introduction of Integrated Pest Management practices gained widespread endorsement and sharply reduced the total tonnage of applied pesticides.

The introduction of economic reforms and proper pricing of agricultural of inputs and products by the Ministry of Agriculture and Land Reclamation led to the improved and rational use of chemical fertilizers, thus minimizing the pollution hazards.

Such important conservation measures didn't curtail sources of soil pollution only but also it had its beneficial impacts on the pollution of water resources and the recycled agriculture drainage water.

4.2.4 Drainage improvement and conservation of water resources

The Ministry of Water Resources and Irrigation has been involved in continued activities to achieve improvement of drainage conditions, conservation of irrigation water in quantity and conservation of the shorelines. The following is a summarized review of the major activities:

Implementation of projects of open and tile drainage to prevent the degradation and desertification of the productive soils. These projects are of particular significance after the construction of the High Dam with perennial irrigation and cropping patterns of more than one crop per year.

The main benefits of these projects could be summarized in the following .

- 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.

- Tile drainage projects

Tile drainage was introduced in to a total area of 5.101 million feddans with 3.661 million feddans (areas) in the Delta and 1.440 million feddans in the Upper Egypt up till 30/6/2001 , with total expenditures of 2325 million L.E. This was carried out at a rate of 160,000 feddans/year (Over thirty years). The cost of implementing tile drainage is recovered over 20 year with two years grace starting from full implementation.

The present plan calls for the introduction of tile drainage in additional 1.3 million feddans till 2008.

-Open Drainage was introduced in 7.23 million feddans (4.962 in the Delta and 2.268 in the Upper Egypt).

-Conservation of water resources

- Establishing numerical and geographical databases for ground water and water resources of relevance.
- Development of innovative techniques for water harvesting and conservation of flood waters in varied locations in Egypt.
- Formulating regulations for the reuse of wastewater and means to protect ground water and other water resources from pollution.

- Combating of seawater intrusion

The following activities are being carried out to protect the shore-line areas of the Delta and certain important locations along the North-Western Coastal areas from sea water intrusion for the prevention of salinization of the productive agricultural soils and the conservation of the sea shore-line.

- Protection of Rashid shore-line.

- * Establishing a marine wall 5.0 kilometers long.
- * Establishing 5 beach heads to the east for protection.
- * Use of modern techniques in a trail area of 1.0 Kilometer length.
- * Protection of Balteem shore-line
- * Protection for a distance of 8.0 kilometers through four stages.
- * Protection of Ras- ElBar shore-line

3.5 kilometers were finished while the protection of additional 1.0 kilometer is ongoing.

Other areas include Gamasa, Buroulos, Ezbat El Barg, Port Said, AL-Arish, Alexandria, and Mersa Matrough.

-Protection of the River Nile and its branches from pollution

The Ministry for Water Resources and Irrigation prepared a survey for sources of pollution from industrial, agricultural and sewage sources. A national plan was formulated for the protection of water resources from pollution . Three stages of priorities were planned in sequence from the year 200-2017. Measures were planned for periodicals monitoring and application of pertinent legislations and environmental laws.

It was highly recommended to coordinate the proposed activities among the ministries concerned including Ministry of Environmental Affairs, Ministry of Planning and others.

4.2.5. Afforestation in the desert fringes

Significant efforts were carried out to create man-made afforestation in areas, as well as, along the canals and on the peripheries of farm lands in the newly reclaimed desert areas. Such activities provide protection of the farm lands and wood materials for industrial purposes.

4.3. Inland Sinai and the Eastern Desert

This agro-ecological zone received fewer activities to combat desertification which were mainly in the form of research investigations conducted mainly by the Desert Research Center (DRC) , Academy of Scientific Research and Technology , Agriculture Research

Center (ARC), National Authority for Remote Sensing & Space Sciences (NARSS) , and the local Governorates. These activities include the following:

4.3.1. Introduction of salt tolerant and drought resistant varieties of cultivated crops in addition to formulation of integrated management practices appropriate for limited availability of groundwater resources with low quality due to ionic balance and medium to high level of salinity.

The integrated management practices include the use of varied natural and synthetic amendments to calcareous and saline soils dominating in this zone.

4.3.2. Investigation of wind and water erosional processes as influenced by climatic, geomorphic features and human induced causes with particular emphasis on the varied location of the Sinai Peninsula. Fixation of dunes and combating of sand encroachment were carried out in limited pilot areas.

4.3.3. Investigation were conducted on the use of natural halophyte products pressed with relatively agricultural waste products to make nonconventional fodder materials with high nutritive used values to supplement the animals on the relatively poor natural rangelands. Such practices led to significant enhancement of animal production and associated products.

4.3.4. The DRC carried active investigations to search for additional soil and water resources, especially, underground water resources in dry wadies wide-spread in this agro-ecological zones. These investigations were conducted in wadies of large areas like Wadi Dara and others where significant groundwater resources with qualities that could be used for expansion of cultivated areas.

4.3.5. The DRC and ARC carried out field investigations of the macro vallies of Shalatine, Abo Ramad and Halaieb to investigate the appropriate and innovative techniques of harvesting and water spreading of flood and runoff waters which are lost in most cases to the Red Sea with its content of eroded soil materials.

4.4. The Western Desert, Oasis and Southern Remote Areas

Activities for combating desertification were concerned mainly on the management of soil and water resources in the Oases, as well as, fixation of mobile dunes and combating sand encroachment and its adverse impacts on farm lands and infrastructure.

4.4.1 Assessment of the soil and water resources (ground water resources) in quantity and quality were conducted for all of the major Oases. Measures to combat the over exploitation of ground water resources and to halt or minimize the rapid drop in state water level which caused reduction in extracted amounts of water and the sharp increases in costs and invested capital for the digging of new wells.

Overuse of groundwater combined with the inferior qualities of the prevailing soil source, physiography, and human induced mis-management practices caused serious salinity problems.

The DRC in collaboration with several doner agents and the local authorities carried out several investigations to curtail the salinity problems with innovative measures and projects. Lately, the Ministry of Water Resources and Irrigation have joined the efforts to alleviate the water logging conditions and salinity hazards.

4.4.2. The DRC had pilot areas for the demonstrations of sand dune fixation using varied techniques and saline water irrigation with considerable successes for chemical , mechanical and biological fixation.

4.5 Institutions

The main institutions in Egypt are:

a) Ministry of Agriculture and Land Reclamation, (MALR)

In the context of the Agricultural strategy in Egypt, which intend to verify the efficient use of its resources within a sustainable development process , MALR has a frontier role in combating desertification and environmental protection in general and in assessing, monitoring and rehabilitating the degraded land on particular.

Furthermore, MALR is responsible for planning and outlining strategies for extension and training. These responsibilities are explicitly or implicitly undertaken through many of the MALR affiliated administrations, authorities and research institutes. Among these;

- Desert Research Center (DRC)

DRC, is the focal point of UNCCD in Egypt. It is established in 1950 to undertake scientific and applied research for exploring, evaluating, and developing the natural resources in the Egyptian deserts.

It is also concerned with studies of the desertification process and drought phenomena and their environmental consequences , and proper means for alleviating and /or preventing their hazards.

DRC has four main divisions vis., i) Water resources and desert soils, ii) Ecology and dry-land Agriculture, iii) Animal & Poultry Production and, iv) Socio-economic studies. The center has central lab., satellite receiving station, gene bank in North Sinai, and experimental Research Stations.

- Agriculture Research Center (ARC)

Which aims at establishment and conduct research extension and implementation programmes in order to increase the productivity of the different agricultural area. ARC has 16 research institutes, 10 central labs. and more than 50 experimental research stations.

- The Executive Authority of Land Improvement Projects (EAIP)

EAIP is vested with overall responsibility to implement land amelioration programmemes in Nile Delta and Valley. The applied ameliorating treatments include: land leveling by laser bean, and gypsum additions to prevent alkalization.

b) State Ministry of Environmental Affairs (MSEA)

It is responsible for studies, legislations, national strategy , national action plan, preparing programmemes of all projects related to the protection of environment. It is also responsible for preparing proposals, measures, action instructions that should be undertaken by the concerned authorities to ensure the protection and improvement of environment. MSEA embraces the Executive Environmental Affairs Agency (EEAA), Departments of Nature Conservation, Forestry and Administrative Affairs (EAA).

c) Ministry of Water Resources and Irrigation (MWRI)

It is primarily responsible for irrigation and drainage water of the agricultural lands. Therefore, it is responsible for management and improvement of water resources utilization of River Nile and water protection from pollution, regulating the discharge of water, design,

implementation and maintenance of drainage system as well as the re-use of drainage water. These responsibilities and tasks have an explicit relationship with desertification issues. The MWRI comprises of Water Research Center (WRC) which embrace research institutes, training center and many of other authorities and departments, including High Dam Authority, Planning and Follow Dept, Maintenance Dept. and Drainage Contractors... etc.

d) Ministry of High Education and Scientific Research, (MHESR)
Academy of Scientific Research and Technology (ASRT)

It is responsible for supporting scientific research and applying modern technologies in all fields of development. It is also responsible of formulation a national policy for scientific research and generating adopted technologies necessary for supporting the national development plan. The academy comprises 13 disciplinary Councils and four interdisciplinary division comprising eminent scientists so as to ensure proper linkage among the different disciplines and various sectors of production and services. Among the important Councils, are, i) the Food, Agriculture and Irrigation and, ii) Environment Res. Council, which are concerned with the preparation, formulation and execution of resort programmes for management and efficient use of natural resources as well as those related to the environmental protection.

e) National Research Center (NRC)

It undertakes basic and applied scientific research, particularly in the fields of agriculture industry, public health and most of the essential elements of the national economy. The center comprises 15 disciplinary research branches including agricultural and environmental research branch, which undertake studies on the effect of production practices on environment and propose the technologies for preserving the ecosystems and avoiding environmental hazards.

f) Remote Sensing Center (NSC)

The center is concerned with the studies and application of modern space-technologies in preparing and follow-up the development projects in Egypt. It is also interested in detecting and monitoring many aspects of desertification, e.g., sand encroachment, plant cover and polluted areas.

g) Universities

Egypt has Governmental and non-Governmental Universities. These undertake education, scientific studies and researches related to the desertification issues. They also participate and organize workshops, seminars and meetings for raising public awareness of these issues on the national, regional and international levels.

h) NGO`s

There are about 50 out of 2000 NGO`s in Egypt, interested in the environmental affairs, in general and desertification issues in particular. Among these are, the Egyptian Society for Environmental Science, Soil Science, Environmental Protection and Human Rights...etc. These societies can contribute to conferences, seminars and meetings to raise the public

awareness and to support the private sector for joint implementation projects to combating desertification.

4.6. 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.

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.

5. LESSONS LEARNED

- The national agricultural projects should be designed to meet the food needs of the proposed and future generations, provide enough jobs, securing income creating human living and working conditions as well as maintaining and increasing productive capacity of natural resources and regenerative capacity of renewable resources without impairing ecological balance or destroying the socio-cultural capacity of rural communities or contaminating the environment. It is also essential to keep the agricultural sector more resilient against adverse natural and socio-economic factors to fulfil the targets of sustainable agricultural development and to strengthen the self – confidence of rural populations.
- Sustainable management of agricultural lands should maintain soil productivity in an ecological, economically and culturally sustainable systems. It must improve the physical chemical biological soil conditions for crops production and biodiversity, satisfy the needs of human beings in socially and culturally appropriate manner at national level and cover all costs of land users and society.
- The human induced processes of desertification are mainly physical, chemical and biological degradation plus water and wind erosion. These processes should be prevented and controlled to satisfy sustainable management. The problem of developing and implementing conservative measures for natural resources is that such measures are not well transferred and reproduced.
- Appropriate technology; it should be ecological productive, socially acceptable, economically productive, economically viable and, reduce degradation risk. In some executed projects these requirements are not fully met and disadvantages are not recovered in a proper manner. Therefore, technology transfer for land reclamation, improvement and conservation that does not cope well with Egyptian environments and soil characteristics needs to be revised and implemented if accepted to improve soil potentialities and productivity.
- The solution to problems of degraded lands must be geared to local needs. Programmes should coordinate activity at different levels to achieve sustainable agriculture development. The experience gained from particular project can be transferred to other sites only under specific conditions. This is not properly followed in some cases.
- Agricultural policies to promote sustainable development must be by identifying which aspects should be assisted or can be influenced.
- In this regard, soil degradation, land use and agricultural policy are affected by several factors, cropping area cropping patterns and cropping techniques, approaches in research, training and extension service, all these factors should be considered in technical options for sustainable development to meet the needs of farmers and policy makers. Technical options must achieve the minimization of soil erosion, conserve the physical and biological soil properties enable the soil to retain (water balance) conserve soil fertility and structure and sustain productivity.
- The role of private sector, stakeholders, women and youth, NGO'setc. should be enhanced to achieve sustainable development.
- The lack of infrastructure, financial support, laborsetc. has resulted in the less successes of such projects.
- Application of advanced technology and management principles developed in western countries particularly in rainfed agricultural areas and rangelands are not necessarily appropriate or feasible for developing countries. Most of the developing countries in Africa and West Asia have different environments and different socio-economic

infrastructures with varying levels of total wealth and resources, and although the ecological principles behind the technology remain constant, the actual application may involve different aspects of those principles in arid and semi-arid ecosystems of these countries. In general, overcoming technical constraints has proven to be more difficult than anticipated. This is at least partly due to the tendency to implement management systems as practiced in the donor countries.

- Due to social and ecological conditions involved in the arid and semi- arid ecosystems and the general lack of understanding of them, projects need to be long-term (i.e., 10-20 years). Changes within these systems occur slowly and projects that end after three to five years tend to confound the development process. This kind of “up-and-down” cycle of development should be avoided if long-term goals are to be met.
- Projects often established require a significant level of funding to support the recurrent costs after donor support ends. The ability for the host country to continue support (or find support) for the recurrent costs of any implementation activities beyond the anticipated funding period should be considered.
- Many development projects have been designed using the past belief in which one product is isolated and a solution sought. Other development projects for the poor countries often look at the short-term alleviation of hunger and political/military objectives. As a result, many development projects for poorer countries have not been designed to include the long-term needs of the total environment. A more holistic approach should be adopted during project planning phases, and project implementation to evaluation. Only in recent years social scientists have been involved in the so-called biological research areas. In the past, the social scientists were often “brought in after the fact” instead of being involved in the planning and early implementation phases. This was, in part, due to the academic training programme that most social and biological scientists received in the past. They have, therefore, had very little common background to allow for mutual communication. Fortunately, this problem seems to be diminishing but continued efforts must occur, especially in universities, to ensure that interdisciplinary teams work together in all phases of rangeland development projects. This approach is not easy and requires more time during the planning phase, but the long-term success of development in the highly diverse systems requires the border prospective that is obtained only by using this approach.
- The management programme designed by most experts, to address the balance in the relationship between animals and carrying capacity in the arid and semi-arid ecosystem are primarily concerned with the long-term production of the resources. On the other hand, the pastoralists are primarily concerned with survival, first in the short term and then in the long term. Survival for the pastoralist means not only his own personal survival but also the survival of his socio-cultural unit which relies upon the productivity of the herds. It is obvious that the two concerns overlap but they are centered on different priorities which are, in turn, based on different values. This conflict between technical experts and pastoralists will not be solved as both of them are not able to provide alternatives to overcome it, but it could be solved in the larger political process.
- A higher portion of training programme for native staff members of projects (particularly counterparts) should be organized under local prevailing conditions. In countries where the education system has not been developed to the level at which the training is possible, training programme should be selected to provide trainees with the backgrounds and skills that can be related to the ecological setting and

environment in which they will be working. This can be accomplished by providing projects with the flexibility to have the research portions of advanced degree training programme conducted within the home country. Major advisors in the universities should be encouraged to cooperate with the research centers.

- Efforts undertaken to solve arid and semi-arid ecosystems problems, in isolation of other favorable areas, have failed. However, as rainfed areas and rangelands provide meat, dairy products and other services to the urban population, it is unfair and unrealistic (both politically and ecologically), to try to implement improvements within these eco-systems only at the expense of local communities. Central governments are responsible for the formulation and implementation of policy, and also for the measures that influence the distribution of economic activity that develop some areas and marginalize others. At this level of organization and planning the rainfed areas rangelands could be improved and restored.
- As the effect of most projects are often seen long after the initial projects are completed, a long-term monitoring programme, prior, as well as during and after, implementation must be carried out regularly. In addition, many of both plant and animal species had been introduced and tested under normal or optimal conditions, while most arid and semi-arid areas experience frequent drought periods, so it is important to monitor management strategies through such periods of stress. Some failures of few development projects could have been avoided if sufficient testing had been done prior to implementation or if improved monitoring procedures had provided documentation of past mistakes.
- Multi Development Banks (MDBs) should refuse to finance activities, such as large-scale irrigation or open-pit mining that deplete the net resource base in arid and semi-arid zones. However, MDBs should actively support projects as fish farming, small-scale irrigation, rehabilitation of existing roads, small dams and dikes, artificial water ponds and small-scale hydro-electric power and negative environmental effects can be readily mitigated. It is time for MDBs to incorporate sustainable development goals into their lending policies, including: the timeliness and relative import of conducting environmental impact assessment: performing social benefit-cost analyses for every proposal: delegating a more active and independent role to official environmental department within the institutions themselves: and incorporating non-governmental organizations (NGOs) more fully in the evaluation process.

6. PROPOSALS FOR DESERTIFICATION ASSESSMENT, MONITORING AND INDICATORS

6.1. Desertification Assessment.

During the last decades, desertification assessment in Egypt has relied on field studies, with or without aerial photographs, through observatories network. Data set of these observations are reported as provisional reports of information to support decision making and/or policy development.

However, at present Egypt tends to develop its capacity for desertification assessment by applying the most progressive techniques, e.g., remote sensing (satellite imagery; and geographic information system (GIS) which help to produce thematic maps of various disciplines such techniques will facilitate.

The use and application of reliable information for at least ten years, periodical updating may be justified. Type of the maps include the following:

- Bio-physical cartography, including: quality and spatial distribution of climate, soil, water, vegetation, floral diversity, livestock and wild fauna.
- Socio-economic cartography, including: historic mapping of population settlements, ethnic group dispersion, administrative boundaries etc.
- Cartography of the interface between the biophysical and the socio-economic environment, including: land tenure, infrastructure, etc.

Digital format mapping is preferred to facilitate integration with GIS to define the various types of desertification in Egypt and / or to produce a compilation of desertification risk map. Such information can be used not only to assess the state of desertification phenomena, but also to evaluate their magnitude. It could be also used for developing policy priorities in integrated development projects in the threatened areas and provides a basis for planning more detailed assessments in hot spots.

The implementation of desertification assessment will be faced with a number of complexities which will need national, regional and international technical and financing assistance .

6.2. Monitoring

Evaluate the impacts through dissemination of information concerning climatic, physical, hydrological, biological, land use indicators, anthropogenic measures, socio-economic, biophysical, institutional and behavioral changes resulting from the application of action programmes to combat desertification at various special levels and determine whether they are goal-oriented or not. Monitoring inputs during NAP implementation together with time lag between cause and effect should also be considered in the impact monitoring.

In this regard, remote sensing technique has been successfully practiced for monitoring, follow up and evaluation of desertification indicators as follows:

- Mapping of surface water resources.
- Delineation and mapping of wastelands.
- Mapping of land degradation.
- Mapping of saline and alkali soils (salt-affected soils).
- Mapping of water-logged areas.
- Mapping of vegetation cover and land use.
- Mapping of hydro-geomorphology and ground water aquifers.

- Mapping of active and stabilized sand dunes.

Continuous monitoring by remote sensing, satellite imageries and ground truth are therefore efficient tools for identifying the principal desertification indicators such as vegetation cover, sand encroachment, surface water resources and distribution, salinity and drought problems. Accordingly, they can be used for early risk warning of desertification.

Data base of land use, vegetation cover, soils, surface and ground water resources, geomorphology and population could be prepared and integrated with socio – economic aspects, to figure out an efficient national plan to combat desertification for sustainable development geared to the long term.

Noteworthy to mention that identification indicators, criteria and the frequency interval at which monitoring is carried out should be carefully selected. Nevertheless, the selection of indicators is sometimes opposed by constraints such as availability of technology and infrastructure for collection, measurement and implementation of data essential for certain indicator.

It is also important to define the area that will be considered for monitoring and implementation and prepare thematic or spatial or non-spatial data base design that fulfil the target of monitoring and assessment. In this respect, unifying data base in regard to scale, projection system, accuracy, minimum mapable unit, etc. is a must to evaluate desertification hazard and consequently select the proper measure to combat desertification.

6.3. Indicators of Desertification

Indicators of desertification are meant to describe the extent and severity of the problem at national level. They would show the status of desertification at given time, the trend of the severity with time, and could also lead to the prediction of desertification impact. This will help policy makers appreciate the significance of desertification for the livelihood of people who live in the desertification – prone areas and the consequent impacts on the national economy and social and political stability of the country.

Some principles for indicators are that : i) they should be directly measurable, ii) the unit geographic reference must be specified, iii) the stage of desertification should be specified and iv) quantitative standards must be set wherever possible. It is necessary to provide sets of indicators reflecting national differences both in physical parameters and in social institutions.

Three sets of critical indicators must be taken into consideration, they are: 1) physical, 2) biological agricultural and 3) social. Physical indicators include climate, landforms, soil and water; biological indicators include flora and fauna; and social indicators address population dynamic, economic status and production and economic uses of the land.

The following is a brief presentation on the significance of principal indicators for desertification in Egypt.

- Climate

Coordination of rainfall information with other information on change such as measures of bare ground and dust storms are monitored. All contributors to climate and climate change such as solar radiation, ozone, carbon dioxide and sulphur dioxide are also monitored.

- Landforms

The variety of landforms reflect the effect of water and wind on the earth surfaces. Important indicators include arroyo cuts and fills, dune formation and migration yardang formation (irregular ridges formed by aeolian erosion), playa growth and dessication , pediment processes and mass wasting.

- Soils

Some of the quality of soil indicators are depth, salinity, alkalinity, pH, organic matter content, water logging, fertility, compaction and sealing, wind and water erosion and sand creeping.

- Water

Continuing declines in ground water level, the degradation of water quality and suitability of water for irrigation, human and urban use. Drainage, magnitude and continuity of water flows in a drainage basin (including sediment load) are also useful indicators. Irregular flow in streams due to upstream desertification, changes in distribution and amount of soil absorption and change in runoff volume, quality and patterns could be used as indicators as well.

- Flora and Natural vegetation

The biological, agricultural indicators include vegetation cover percentage, above ground biomass, harvested yield and distribution and frequency of key plant species. The most important biological indicators are the presence or absence and density of particular plant species, changes of cropping areas, vulnerability, marginization and overstocking of carrying capacity.

- Fauna

Fauna indicators include key species of wildlife as well as domestic animal populations. Insects, birds and some species of small animals particularly rodents can be identified as key indicators of desertification.

- Socio – economic

Socio – economic indicators include change in land use, settlement pattern, population number and growth of income (source and per capita), migration (seasonal and annual), unemployment, literacy and education level condition, ... etc.

Changes in land use

Irrigated agriculture farmlands

Dryland agriculture

Rangeland

Mining

Tourism and recreation

Settlement patterns

New settlement

Diversification of settlement

Settlement decline and abandonment

Human biological parameters

Population structure and rates

Public health indices and nutritional Status

Social process parameters

Redistribution patterns

Income patterns

Physical Indicators of Desertification

Indicator classes	Source of observation	Frequency of observation	Background data variables
Landform	Ground and remote	Annually	Soil and rock type
Soil Indicators Effective soil depth (changes indicate soil removal and sedimentation)	Ground and remote	Annually	Rainfall, slope of land, soil texture Soil structure. Wind speed, etc.
Soil organic matter	Ground(permit estimate of organic matter by inference from color)	Annually	--
Crusts	Ground and remote	Annually	--
Dust, duststorms and sandstorms	Ground and remote	Daily	Windspeed Temperature. Soil structure Geomorphology
Salinization, Alkalization	Ground	Annually	--
Climate	Ground and remote	Daily	--
Water Indicators Water, ground depth and quality	Ground	Annually	--
Water, standing open	Ground and remote	Annually	Area, depth and turbidity
Status of drainage	Ground and remote	Annually	Water flow and sediment load

Biological/Agricultural Indicators

<u>Indicator class</u>	Sources of data	Frequency of observation	Background data variables
Vegetation cover	Production % of bare ground/ground cover in dry season: aerial photos and observation, remote sensing	Annually and seasonally	% of ligneous/herbaceous plants, % annuals, perennials
Above-ground biomass	Chlorophyll content: remote sensing Production transects and quadrats: ground sample and lab analysis Preservation plots	Monthly/seasonally 3-10 year intervals long-term measure short-term index	Net assimilation Climate Soil type. Erosion Below-ground biomass %of ligneous herbaceous plants
Key plant Species	Potential vegetation communities Records, manuals. Ground observation of transects Utilization levels with low animal populations	List compilation: 6 months to one year	Range ecological condition and trend the effect of utilization by different animals
Yield	Grams of dry weight/square meter/year or season	Annually or seasonally	Short-term effect of fertilizers. Yield by species of plants in climi-ax community and seral community desired of the site

Biological/Agriculture Indicators (Revised)

Indicator Class	Sources of data	Frequency of observation	Background data variables
Animal Key species of wildlife: frequency and distribution	Arthropods, small mammals and birds	Annually or seasonally	Relation and competition with domestic herds
Population of domestic animals	Numbers and distribution of larger and small stock based on livestock management censuses	Annually or seasonally	Carrying capacity of range; physical and vegetation indicators
Herd composition	Composition of herds	Annually or seasonally	Physical and vegetation indicators determine diverse types of forage available. Variations in rainfall
Production	Live weight of animals at market milk, meat	Annual statistical review	Purchase of supplementary cereals

7. CONSTRAINTS

Combating desertification and sustainable development of Egypt are actually constrained by many factors; among which the most important are the following:

- Egypt is experienced to capacity deficiencies in many fields related to manage the UNCCD, to develop programmes that would promote the participation of developed countries and international organization, and encourage interested partners to provide financial support. This includes as well the informal process established and functioning for consultation and for harmonization of actions among partner countries. Provisions are to be critically defined and applied to facilitate local stakeholders's access to existing sources of funding, including adapted ways to mobilize national and external resources implemented.
- The cooperation of NAP of Egypt on the regional and sub-regional level is almost absent since the UNCCD does not fit Egypt to any sub regional group.
- Lack of clarification regarding land tenure and processes for resolving conflicts over access to rangelands dry and rainfed areas may provide insufficient security for pastoralists and farmers to invest their time and efforts in constructing soil conservation and land use measures.
- Dryland areas with their harsh environment are often politically and economically marginalized, thus receive less attention from central government.
- Poor integration of environmental, social and economic policies to conserve and improve natural resources .
- Social driving forces linked to land degradation need to be mitigated economically especially in regard to poverty alleviation or eradication until sustainable biomass production strategies recover their problems.
- Lack of infrastructure in some remote desertified areas.
- Rangeland of Egypt were allocated to the tribes living in the arid and semi-arid areas, with each tribe having a territory to the exclusion of invasion or encroachment by others . Over the second half of the twentieth century, land tenure arrangements have gone through considerable change due to many reasons. The civil law of 1948 had established state ownership (state domain) of all desert lands outside the Nile Valley and Delta, but the government still recognizes the usufruct rights of the Bedouins to the rangelands, though without due to allowance of the traditional tribal rights.
- Lack of well defined and clear land use systems (pattern ,policy, or plan) of arid and semi-arid areas that strike a proper balance between the various land use options without undue loss of environmental sustainability (e.g. range, rainfed cropping, tourism...etc.).
- Lack of central government commitment (or the concerned local Desert Governorates) for providing permanent financial resources required for conservation and sustainable development of range resources (rehabilitation, training, extension, seed multiplication of adopted promising range species,...etc.).
- Lack of a leader institution dedicated for planning, implementation of range conservation (including combating desertification), sustainable development and coordination of activities of range management and utilization among governmental authorities, donors, traditional users and other stakeholders.

- Lack of formal data base and shortage of some important quantitative and qualitative data concerning natural resources situation and trend.
- Collapse of the traditional insituations and proper management systems of natural resources in arid and semi-arid areas. However, the appropriation of rangelands and rainfed areas by the states and the confinement of herding communities into smaller grazing areas narrowed their traditional grazing access-options. Consequently, traditional practices, indigenous knowledge and management systems which were developed by local communities in response to their constraints, have broken down .
- Absence of a clear, proper and stable government policy regarding the management system of rangelands. However, the present policy which is common free open access grazing system does not permit any sustainable development of rangelands. This policy has created considerable uncertainty for the pastoralists over their traditional grazing rights, since every one can graze his animal when and where he pleases without any restrictions on the population of grazing animals and /or length of grazing periods. Private ownership of grazing herds and nationalization of rangelands (common open free access ranges) led to "a free rider" situation with individuals maximizing their own use of the range by increasing individual holdings, which still cause more continuous degradation of range resources .
- Absence of the active participation of the respective pastoral target groups in the activities concerning rangeland conservation and sustainable development.
- Lack of well trained manpower.
- Lack of integration and complementarity between animal / range, rainfed crop production systems and irrigated forage areas.
- Shortage of applicable research efforts to solve the problems of range livestock production system or to improve their efficiency. This limitation of research programmes has reduced the ability of extension services, where they exist, to provide much practical help to pastoralists and agro-pastoralists.

8. INTERVENTION PROGRAMMES

8.1. General Features

The general framework of Egypt's NAP to combat desertification embraces several supporting elements which should be strengthened to support NAP implementation. It also identifies some weak points of the country context, which need corrections and remedies in order to ensure efficient and successful output of NAP.

The salient features of the programme can be summed up in the following;

- It will address the basic roots of natural resources deterioration.
- Special efforts will be devoted to set-up a mechanism to ensure active coordination, among all bodies concerned with combating desertification.
- Additional legislations and regulations at the national, governorates and local levels will be needed
- The adoption of innovative technologies for halting desertification processes, utilization of incentives whenever possible and bringing about their prevention and abatement.
- Participation of local communities, targeted groups, stakeholders, and NGO's in planning, implementation, evaluation and monitoring.
- NAP to combat desertification is being tackled within the framework of the environment conservation strategy and its National Action Plan.
- Central government and local authorities commitment for providing an "enabling environment" to combating desertification is essential.
- NAP implementation will depend on long, medium and short term strategies and priorities.
- NAP would also be planned within a framework that ensure complementary development between areas and production systems and streamlines with efforts to reduce poverty and arrest / reverse land degradation.
- Achieving long term sustainability is essential, which depends on integrated plans based on realities, community aspiration and principles of sustainable utilization of resources.
- A holistic approach for conservation, development and sustainable use of resources is required. Maintenance of rehabilitated areas could only be achieved when coupled with sound management programme which secures conservation, development and sustainable use of resources.
- There is a common agreement that different ecological systems need to move toward environmental sustainability. This means developing sustainable production systems that maximize the positive synergies between the various elements of the ecosystem and reduce reliance on external inputs.
- Political commitment of the central government and local authorities decision makers are essential, especially in the following topics:
 - (a) Addressing clear land use policy in each agro-ecological zone.
 - (b) Enforcement of the existing and newly issued legislations and regulations needed to support efforts and activities of combating desertification in the different Agro-ecological zones.
 - (c) Allocating adequate permanent financing resources (annual budget in the executive 5-years working plans) required for combating desertification.
 - (d) Address tenure reform in both range and rainfed croplands for allocating communal ranges, common ranges, rainfed agriculture land and land for other purposes. This is a key issue to overcome the problems and conflicts between different uses and for

the active participation of local communities in the activities of combating desertification in such areas.

- (e) It is important for Egypt to obtain financial and technical assistance from concerned regional and international institutions as well as from other developed countries and donors, additional funds through GEF, the Global Mechanism (GM), World Bank, the International Fund for Agricultural Development, ...etc.).
- Further and more effective coordination, cooperation and collaboration with sub-regional, regional and international activities in the field of combating desertification are needed.
- Up-grading the capacity of the local community, NGO's, institutions and all partners in the various aspects of desertification control is essential prerequisite for NAP success.

8.2. Programmes for Combating Desertification

8.2.1. Thematic Programmes

8.2.1.1. Desertification Assessment and Monitoring in Egypt

Background

Desertification assessment and monitoring in Egypt are urgent due to large scale of the affected areas. To identify and control the areas affected by desertification, Egypt has been distinguished into four zones based on their agro-ecological conditions and applied modern technologies, e.g., remote sensing and GIS techniques for identifying the hot spots in these zones. In general the components of assessment and monitoring brings together the following elements:

- Existing technical capability, the quantity and quality of available human resources and the capacity to control and process useful information.
- Strengthening of national multi-sources, multi-scale georeferenced data collection, processing and observation system.

The Egyptian Environmental observation and Assessment Device, (EOAD) proposed a project of implementation in cooperation with OSS and other donors and agencies including the following components;

- Environmental monitoring on various levels based on relevant monitoring devices.
- Environmental early warning, via the reinforcement of set up of early devices.
- Implementation of devices of monitoring and evaluation of national and sub regional action programme.

Justification

- The core objective consists of increasing income basis of the population through minimizing risks brought by the impact of desertification.
- Cultivate areas suffering from desertification on a significant scale, as resulted from changing patterns of land use combined with harsh climate events.
- The participation of local stakeholders in the planning, execution of the activities to combat desertification is not pronounced.

Objectives

- Measuring the types and degrees of desertification and monitor its extension in the four agro-ecological zones in Egypt.
- Providing the decision makers with relevant analyses of the desertification processes from biophysical and socio-economic angles, and to provide a basis for work on appropriate development of public policies in the areas affected by desertification.
- Focusing on social and economic issues that influence the development process in the different areas.
- Producing thematic maps and creation of relevant indicators to inform stakeholders and decision-makers regularly with the scope of the desertification phenomena and provide them with an objective basis for making related plans.
- Setting up a system to monitor the impact of desertification.
- Assessing the problems on basis of the criteria and techniques adopted particularly to determine what and where land use leads to desertification.
- Quantifying the extent, intensity of land degradation on special scale and some indications on temporal scale.

Plan of Action

The main activities of the project could be outlined in the following points:

- Data collection from the field (measurements and observations) generally rounded out with data from remote sensing.
- Cartographic production using the obtained data in the relevant fields, e.g., climate, soil, vegetation, livestock , socio-economic, ...etc.
- Installing a network for monitoring the desertification types and degrees in the four agro-ecological zones in order to cover the spatial and temporal variations.
- Constructing a set of biophysical and socio-economical indicators for desertification assessment in each agro-ecological zone.
- Developing cartographic products and models to install the early warning system for combating desertification.
- Establishing a website that provide information on the desertification phenomena in Egypt.
- Organizing two national workshops at the beginning and at the end of the project activities.
- Presenting periodical (annual) reports on the implemented activities and a final report on the project.
- Arranging a training programme for the targeted groups inside and outside Egypt.

Proposed Duration

Desertification assessment and monitoring for the country will be carried out at three levels: national, provincial and on sites representing the local level. On the national and provincial levels, the plan of action will be revised every five years. Monitoring aims at (a) assessing extent, rate and intensity of desertification and, (b) evaluating impact of corrective measures.

Implementing bodies:

- Desert Research Center (DRC).
- National Authority of Remote Sensing and Space Science, (NARSSS).
- Executive Environmental Agency Affairs EEAA, (Ministry state of Environmental Affairs).
- Agriculture Research Center (ARC).

- Academy of Scientific Research and Technology (ASRT).
- Local authorities and Concerned NGO's.

Requested Budget

Budget during the first five years is 15 million, 5 million US\$ for establishing the nation-wide network, 10 million US\$ for running the system at 2 million US\$/year.

The major expected outputs will be

- Creating desertification information system at national level based on georeferenced data and information.
- Creation digital base maps for different applications together with thematic maps for various disciplines of desertification.
- Obtaining data flow on desertification phenomenon through website and data network.
- Developing monitoring corrective action programme.
- Providing necessary information about desertification phenomenon for the policy makers and the executive leaderships in all managerial support.
- Strengthening the national bodies concerned with desertification assessment and monitoring.
- Local people will be involved in the monitoring of the desertification impact through the role of NGO's and mass media.

As mentioned before, all the proposed intervention projects will be financed either by the central government (annual budget) as well as the concerned regional, international institutes, developed countries, donors, GEF, IFAD and World Bank.

In this respect, it is important to devote special effort to set-up an effective mechanism to mobilize financial resource and technical support for successful implementation of proposed intervention.

8.2.1.2. Project Title: Capacity Building

Background

Since the last quarter of the 20th century, Egypt has witnessed intensive development and use of its natural resources to accommodate the economic needs of the rapidly increasing population. As a result, environmental problems including degradation of both renewable and non-renewable resources increased at accelerated rates. In response to the heightened awareness of acuteness of these problems and their negative impacts on environmental quality, economic development and health welfare of its population, the country has embraced the concept of sustainable development, whereby conservation of resources, environmental protection and economic development go hand in hand. These efforts included the set-up of irrigation and drainage projects in the Nile Delta and Valley, land and range-rehabilitation, stabilization of dune-sands in the North and North-west of delta,...etc. Concurrently many relevant institutes have been developed.

Presently, Egypt has considerable potential capacities to manage the environment in general, and to address issues and problems in the areas of desertification in particular. This is mainly due to the presence of multitudes of Universities, Academic and Research Institutions as well as centralized and local governmental reserve organizations and authorities. More than 50 research centers and institutions affiliated to many ministries are involved in pertinent research and technology development. Most of these bodies have training centers and/or provide training programmes having explicit or implicit relationships with the environmental

conservation. The Information Ministry and Media are increasingly getting role in public awareness and sensitizing the civil society to participate in formulation and implementation of desertification activities. A number of NGOs have been developed to deal, either directly or indirectly, with desertification issues and problems.

The UNDP in collaboration with the Ministry State for Environmental Affairs (the national focal points for UNCBD and UNFCCC) and the Desert Research Center, Ministry of Agriculture and Land Reclamation (the national focal point for UNCCD) has prepared document on "Self Assessment on National Capacity Building Needs in Egypt to manage the Global Environment Issues". The objective of such project is to help the different stakeholders in Egypt, measure and assess their capabilities, detect their points of strength and weakness, define their priorities and constraints with regard to global environmental management.

The project will explore the crosscutting capacity constraints that are the root causes hindering or undermining the abilities of the country to effectively implement the Rio conventions and develop a model for other conventions to be effectively implemented.

Also, the project will build an existing framework strengthening and linkages to enhance convention implementation, in particular to galvanize high-level support.

Using a participatory approach, the project will aim to broaden stakeholders involvement and determine how to decentralize capacity building in three thematic areas. An enabling environment will be created to allow an effective dialogue about the three thematic areas as it pertains to the Egyptian context, applying the principle "think global and act local". The project will review past, ongoing and planned initiatives whether through national and/or international resources with the aim to assess capacity building constraints, thereby complementing and building on existing experiences to avoid duplication to effort and capitalizing on lessons learned, particularly with regard to capacity building initiatives.

Preliminary assessment made by representatives from the three conventions, indicates that Egypt is experiencing capacity deficiencies in all levels, including overburdened, underused and migration of capacities. It is also evident that capacity efforts to date have, a) focused on developing strategies, policies and action plans, b) focused on building institutional capacity in public sector, especially at the central level, c) have given less attention to the individual and systemic capacity. In this respect systemic capacity is the context of environment in which individuals (skills/expertise) and institutions operate. The overall economic, political socio-cultural, general infra-structure, inter- institutional articulation, laws and administrative measures, d) pursued sectoral rather than cross-sectoral approaches and, e) insufficient participation of wide range of stakeholders or capacity building in the local grassroots level particularly gender.

Therefore, a formulation of national plan for capacity development is crucial. In such plan the cross-cutting constraints having highest priority are:

- Institutional development in the ministries having activities or participate in the three thematic area.
- Broaden and decentralize capacity building to ensure greater involvement of the local grassroots levels.
- Develop qualified manpower in all fields.

Project objectives

The objective of the project is to build up the necessary capacity to be implemented in Egypt in an effective, efficient and sustainable manner. The project will identify priorities and needs for capacity building to address the global environmental issues in particular desertification, with the aim of catalyzing domestic and/or externally assisted actions to meet those needs.

Super imposed on all these are:

- Efforts will be made to develop the synergies between the thematic areas and wider concern for environmental management and sustainable development in Egypt.
- Employing a holistic approach to capacity building, the project will address the needs at systemic, institutional and individual levels, whereby the identification of capacity building will remain ongoing processes.
- Advanced priority will be given to address the cross cutting capacity constraints that are the root causes gendering the ability of the country in implementing the conventions.
- The project also aims at compiling past, ongoing and planned initiative building on the existing experience and avoid duplication of efforts.

Project Activities

- a) Establishment of project steering committee, headed by the president of DRC (implementing body), establish a project management unit from representative of the focal points of the three conventions (PMU).
- b) Preparing and adoption of the preliminary outlines of the strategy and action plan of the National Capacity Needs Self Assessment.
- c) Develop a specific work plan and TOR of all inputs, participants and activities.
- d) Production of awareness raising materials.

The main national obligations under UNCCD are to give due priority to combating desertification and mitigating the effects of drought, establish strategies and priorities within the framework of sustainable development plans and /or priorities, address the underlying causes of desertification and pay special attention to socio-economic factors contributing to desertification process, promote awareness and facilitate participation of local populations with the support of NGOs. Considerable emphasis on the local communities in the rainfed and rangeland areas to ensure effective participation in managing their natural resources, particularly in the following fields.

1- Capacity building for watershed management and development

This sub-project aims at:

- Training for watershed users on the technical aspects of in-situ soil and moisture conservation techniques, operation and maintenance of community individual civil work, farming systems, dairy and livestock management.
- Training Bedouin and farmers to take up new and improved methods of land use.
- Training in extension methodology.

2- Capacity building for rangeland management and stabilization of sand dunes;

This sub-project aims at:

- Awareness raising in the field of desertification control in general and rangeland management and sand dunes fixation in particular.
- Providing specialized training courses to the staff working in desertification control planning, rangeland rehabilitation and management and sand dunes fixation. Other training courses will be tailored to enhance capacities of the NGO's and local communities to participate in field actions: nurseries, afforestation and conservation of the planted dune areas.

Work plan

The proposed plan will include;

- Training and extension.
- Workshops.
- Production of booklets, leaflets, brochures and fliers.
- Media campaigns.
- Field days

Duration : 5 years.

Implementing bodies:

- Ministry of Agriculture and Land Reclamation via, its affiliated centers (DRC, ARC,etc.) and Authorities .
- Ministry of Water Resources and Irrigation.
- Universities and Scientific Institutes.
- Ministry State of Environmental Affairs.
- National Research Center.
- NARSSS.

Budget 15 million US\$.

8.2.2. Programme for Irrigated Agriculture

Background

The general objective of this programme is the modernization of Egyptian Agriculture in the Nile Valley and Delta through increasing the agricultural productivity per unit water and land upon efficient use of these resources, cultivating high – yield varieties and reducing the unit cost of production, thereby alleviating poverty in such dense population zone.

The program relies on two main sectors i.e. water resources and land resources. For the water resources, Egypt has practiced the irrigated agriculture since long time ago and learnt how to control and manage the Nile water through an intense irrigation and drainage networks. As the water quota is now below 1000 m³ per capita/year, water availability is considered a primary stress to all activities.

The Ministry of Water Resources and Irrigation (MWRI) devotes tremendous efforts in balancing the water supply and demand. Since the water resources are limited and cannot be indefinitely increased, the only option is to adopt water demand management policies and strategies aiming at using water more efficiently through national programmes.

Policies and practices are usually influenced by the type of problems, constraints, social dimensions, cultural values, economic considerations, environmental concerns, and political support. Equitable water management ultimately depends upon a concern for fairness in distribution of water at the individual level. It is, therefore, deemed necessary to define the common water management problems, and constraints that hinder development and improvements. This programme will be executed mainly by two Ministries namely; the Ministry of Water Resources and Irrigation and the Ministry of Agriculture and Land Reclamation with their affiliated authorities. Two main areas of issues are evident in degradation of irrigated farmlands:

- A- Balance between irrigation and drainage that would maintain fertile soil environment and reduce hazards of water-logging, salinization and alkalization. This area remains among the Ministry of Water Resources and Irrigation, and its affiliated bodies, e.g., Egyptian Public Authority for Drainage projects and Water Research Center and its affiliated institutes.
- B- Maintenance of fertile soil structure and reduce hazards of alkalization. This will require adding suitable soil amendments (e.g., gypsum, sulfur, organic matter, ... etc.).
The area among the Ministry of Agriculture and Land Reclamation and its affiliated institutions, especially the executive Authority for Land Improvement projects (EALIP), Agricultural Research Center (ARC) and Desert Research Center (DRC).

This programme is continued and the GOE annually allocates most of the required budget while the remainder comes from international financing organization (loans). It includes many integrated projects, among them are:

8.2.2.1. Project Title : Irrigation Improvement

The stated primary goal of the IIP is to increase irrigation water use efficiency and agricultural productivity in Egypt's old lands. Increasing irrigation water use efficiency is used in a broad sense with a connotation of improving irrigation water management rather than in the sense of the traditional definitions of water use efficiency.

This is to be accomplished by implementing a series of interventions at the irrigation delivery system and on-farm levels, designed to remove irrigation-related constraints to increase agricultural production, and considering a full range of technical, economic, environmental and social factors impacting irrigation water management.

Objectives

- Strengthen the institutional capacity to continue irrigation improvements with limited expatriate assistance.
- Develop a rational, interdisciplinary approach for planning, designing, and implementing the renovation of specific canal commands identified in the development plans.
- Develop an Irrigation Advisory Service (IAS) to provide water management technical assistance to farmers and water user groups.
- Organize water user associations (WUAs) in all IIP areas to provide farmer input to the improvement process, communicate local concerns to government officials, coordinate water scheduling on improved water courses, perform maintenance, and resolve disputes.
- Establish policies and procedures for recovery of a portion of irrigation system operation and maintenance costs, and 100% of costs of farm level improvements.
- Increase agricultural production and farm income by improving the irrigation infrastructure, facilitating a more equitable distribution of water and improving on-farm irrigation management.
- Improve the long-term sustainability of irrigation, through take-over of the operation and maintenance responsibility for the tertiary level irrigation system by the farmers, and establishing cost sharing arrangements for tertiary level investment costs.
- Strengthen the institutional planning and implementation capacity of the irrigation sector.
- Avoiding spillages into drains at the tail of branched canals.

- Reducing conveyance losses in branched canals.
- Reducing over-irrigation at the head of meskas (small canals), and spillages into drains at the tail.

Description of IIP package components

The IIP package includes a combination of physical and institutional improvements to the main irrigation delivery system and the farm level irrigation delivery and application systems, as described below.

- **Renovation and Improvement of Branch and Distributary Canals:** main delivery system branch and distributary canal improvements provided by IIP are primarily physical infrastructure enhancements to increase conveyance efficiency and improve the equity of water distribution; these include:
 - Rehabilitation/renovation of deteriorated canal cross sections, renovation/construction of tail escapes at the end of these water courses to prevent irrigation water spillage directly to drains, and the installation of automatic downstream water level control structures. These downstream control gates provide water “on demand” to downstream water users, opening when downstream withdrawals increase, and closing when they decrease, thus preserving water.
 - Volumetric control of deliveries to branch and distributary canals: this is to be achieved by installing baffle sluice-gate distributors at the heads of these canals.
 - Conversion from rotational flow to continuous flow, to provide farmers with greater flexibility in timing of irrigation to meet crop water requirements (as compared to the rigid and current rotation system). This is achieved through the two types of structures; downstream control gates and distributors.
 - On principle, the same volume of water should enter the canal command area under both flow systems (e.g., in the case of a two-turn rotation, the continuous flow rate should be one-half of the rotational flow rate, and in the case of the three-turn rotation, the continuous flow rate should be one-third of the rotational flow rate).
 - Small canal (Meska) improvement by converting from below grade (low level) earthen ditches with multiple pumping/lifting points to elevated and lined, or buried low pressure-pipe. These improved meskas served by a single head pump lift enable farmers to be able to turn water by gravity flow into their farm fields through slide gate or valve turnouts. Benefits include the reduction of operation and maintenance costs, and the nearly complete elimination of seepage losses at meska level.
 - Organization of farmers along meskas into Water Use Association (WUAs), with support from MWRI through the Irrigation Advisory Service (IAS).
 - Operate and maintain improved Meskas (notably operating the single point lift pump).
 - Improve water delivery at Meska level, i.e., increase the equity and efficiency of water use, by notably scheduling turns among water users and resolving disputes.

Duration : 5 years

Budget : 300 million US\$

8.2.2.2. Project Title : The Integrated Irrigation Management Project (IIMP)

Definition and scope of this project can be outlined in the following;

- a) Develop a framework for integrated water management planning and programming in selected areas, considering water quantity and quality management through inter-agency and stakeholder consensus.
- b) Improve institutional, financial and environmental sustainability of water services through intensive user and private sector participation in the investment, and operation and maintenance, at the district/branch canal levels and below and, improved water quality management practices.
- c) Increase farm income through improved agricultural production based on efficient and sustainable use and management of water and land resources

The envisaged technical project components can be formulated as follows:

- a) Preparation and implementation of integrated command area water management plants through corresponding institutional development and support.
- b) Establishment, expansion and upscaling of water user organizations at tertiary (Meska) and secondary (branch) canal .
- c) Rehabilitation and improvement of irrigation and drainage infrastructure and facilities.
- d) Environmental management.
- e) On-farm demonstrations for improved water use environmental management.

The project which foresees multiple stakeholders involvement would require further development and evolution of water user organizations within command areas as well as the formulation of effective joint planning and management arrangements at the command area level.

For the social assessment of the project, the issues that follow from this project design are the means to achieve farmer and stakeholder participation, particularly through Water Users Associations (WUAs) in the following:

- Investment, operations and maintenance activities at the district, branch and tertiary or Meska levels.
- Rehabilitation and improvement of irrigation and drainage infrastructure.
- Water management planning and programming.

Water quality management:

These goals include some replications of achievements of the existing IIP project, particularly those related to work at Meskas with assistance of WUAs and the incipient

Branch Canal WUAs, but they go beyond current achievements in ways that will challenge the new project.

The IIMP interventions are almost all on the established irrigation areas or “Old lands”, except for Tomas and Afia. Old lands cover about 3.5 million acre (1,470,000ha) in the Delta and about 2.0 million acre (840,000ha) in the valley, giving a total of about 5.5 million acre (2,310,000ha)

In fact, the elements of IIMP that affect both the areas already improved by IIP and the proposed expansion areas will affect 14% of the Egypt’s old lands.

For social assessment, the expansion of current efforts into new areas requires estimates of the current level of efforts and review of the IIP approach.

Duration: 5 years

Budget: 350 million US\$

8.2.2.3. Project Title: Land Improvement

Many authorities are responsible for improving the deteriorated soils in Egypt, e.g., Executive Authority for Land Improvement Projects (EALIP), General Authority for Rehabilitation Projects and Agricultural Development (GARPAD), Egyptian Public Authority for Drainage Projects (EPADP), and Agricultural Research Center (ARC). Each has a certain responsibility to do for a time and take off.

Nevertheless the EALIP, established 1971 and affiliated to the Ministry of Agriculture and Land Reclamation (MALR) has entrusted with the overall responsibility of all types of land improvement all over the irrigated agricultural areas in the country. It plays a central role to implement the strategy of the government for better utilization, conservation and restoration of land productivity. It has a yearly plan to improve one million acres all over the country. The improving programme includes the following:

- Application of gypsum for improving the productivity of sodic soil,
- Subsoiling to improve the soil physical properties, including the break up of the hard pans, and soil compaction within the root zone.
- Land leveling and reshaping for better water management.
- Improvement of drainage for salinity and water-logging control.

The EALIP has about 5500 of qualified staff, 10 laboratories and large inventory machinery, equipments distributed at the Headquarter and its 25 regional and 45 sub-regional offices.

It also has soil management information system including GIS facility. It is reported that the increase in agricultural production ensuing the land improvement programme approached 30%.

Duration: 5 years.

The annual cost of such project is 50 million US \$.

8.2.2.4. Project Title: Water and Land Pollution Control

Background

A plan to combat desertification processes in the Nile Delta and Valley agro-ecological zone have several components already being implemented by Ministries of Water Resources and Irrigation (rational use of water resources and minimization of conveyance and fields losses), as well as the Ministry of Agriculture and Land Reclamation (Land improving, minimizing urban encroachment on productive land, improving agronomic management practices and curtailing the excessive use of agricultural chemicals through integrated pest management, research activities, expert systems and integrated information systems for varied crops.

However, other major efforts could be carried out through the presently proposed National Action Plan. These would complement the ongoing efforts to survey and monitor the locations and impacts of industrial pollutants discharged to the water resources, polluting the high-value productive land as well as lakes and marine environments. These objectives could be achieved through the establishment of a geo-referenced data base of pollution sources, types of pollutants discharged to water, extension and migration of pollution, impacts on affected soils, methods and technologies to treat, minimize and curtail the discharge of industrial pollutants and efficient techniques to rehabilitate polluted soils.

Plan of Action

- Compile and process information, knowledge and data from the varied sources pertinent to location of industrial factories, nature of their activities that produce pollutants, location of discharge points to water, amounts of pollutants, migration of pollutants and impacts on resources base.
- Establish a GIS based information system to project, analyse and apply modality to the compiled data to act as a support system for decision making, monitoring and planning of actions to combat and mitigate pollution processes emanating from industrial activities.
- Offer personal training at varied levels as a part of institutional capacity building in disciplines related to the activities of the project.
- Offer access to the compiled data, knowledge and experiences to interested stakeholders from industry, investors, private sector and NGOs.
- Identify hotspots and priorities of mitigation actions.
- Exchange knowledge and experiences with comparable national and regional organizations in the Arab Region and foreign institutions.

Expected Outputs

- Establishment of a GIS based information system to act as support system for decision making, monitoring and planning of actions to combat and mitigate industrial pollution processes of surrounding land and water resources.
- Offer appropriate training and capacity building, activities of varied levels.
- Identification of hotspots and priorities of actions to combat the pollution processes.

Project Duration: 5 years.

Estimated Budget: 8 million US \$.

8.2.2.5. Project Title: Environmental Pollution in Wadi El-Rayan Depression.

Background:

Scarcity of water is considered as the most important issue for agriculture development in Egypt. To alleviate water shortage, the reuse of agricultural drainage water is necessary and vital. The volume of drainage water escaping annually to the sea or north lakes is about $13.937 \times 10^9 \text{ m}^3$. These amounts will decrease in both quantity and quality while the national programme of irrigation development is progressing, and hence the final quantity to be used will be about $4.8 \times 10^9 \text{ m}^3$.

Two methods have been carried out for reusing drainage water. The first is referred to as the blending strategy. This strategy involves mixing the saline drainage water and the good quality water in certain ratios to achieve an irrigation water suitable to the salt tolerant crops. The second method is using drainage water solely. El-Salam Canal project is based on the first method; however, wadi El-Rayan project depends on the solely use of drainage water for irrigation.

Wadi El-Rayan project includes the three newly formed lakes that receive a portion of Fayoum drainage water since the completion of El-Rayan tunnel in 1973. The project had been planned to reclaim about 12000 acres. The Ministry of Agriculture and Land Reclamation reclaimed about 4700 acre during 1998-1999. This area is home to some 1935 households where the water of the first lake is used in irrigation.

The reused agricultural drainage water, if improperly executed, can cause pollution for soil and other environmental components. Danger is posed to land by chemical pollutants in drainage water as the direct result of population growth and the concomitant need of food production. These pollutants may reach groundwater after passing through the soil. The pollutants include anions such as nitrates and chlorides, heavy metals and organic-metal complexes.

It is necessary to evaluate the present state and extent of environmental pollution resulting from reused agricultural drainage water and to take the necessary steps to minimize its impact. Therefore, it is vital to monitor and assess the interactions of the pollutants with the environment to develop remedial methods for polluted sites, and to define strategy for preventing and minimizing future pollution in existing agricultural lands and the extension areas.

The present project aims to identify the pollution due to reused agricultural drainage water and to achieve appropriate soil, water and crop management to mitigate its adverse environmental impacts. In addition, establishing a support monitoring and management unit and raise the awareness of farmers and stakeholders with desertification issues in general and pollution in particular.

Objectives:

- To monitor and assess the risk of environmental pollution resulted from reused drainage water at short and long-term levels.
- To select a management scheme that will minimize the pollution risk in irrigated agriculture with drainage water.
- To raise awareness on the hazards of reused agricultural drainage water.
- To up-grade the capacity building of local communities and stakeholders of Wadi El-Rayan depression with special attention to the woman role.
- To prepare a data base on environmental pollution due to reused drainage water.
- To increase incomes of local people through sustainable development.

- To formulate and verify the proper management practices of soil-water-plant system for controlling chemical pollution at the farm level.
- To perform an economic study of the potential impacts of agricultural drainage water reuse on water use efficiency, farm returns and equity among users.
- To improve the socio-economic conditions of settlers communities through mitigation of pollution risk and achievement of sustainable agricultural development.

Plan of work

The present project includes the following main activities:

- Collection and processing of the results of the previous studies as well as evaluation of pollution related information in Wadi El-Rayan depression.
- Monitoring and evaluating the short and long-term effects of reused agriculture drainage water on soil stability and productivity, water quality, plant growth and crop yield.
- A minimum of 20 farms will be selected for application of appropriate use and management of soil, water and crop in order to minimize pollution risk and increase agriculture production.
- Providing training courses to upgrade the skills of settler on monitoring and minimizing environmental pollution risk through:
 - a- regular seminars, and meeting with farmers.
 - b- participatory workshops with cooperative organization and,
 - c- develop a management information system and its manual operation.
- Evaluation of the impact of reused agriculture drainage on the economic value of water and soil units.
- Develop marketing channels for high value and value-added agricultural products.

Expected Outputs:

- 1- Database on the extent and intensity of pollution risk in Wadi El-Rayan.
- 2- A master plan of soil, water and crop management for controlling risks and achieving sustainable agricultural development.
- 3- Establishment of a unit for monitoring and assessment of environmental pollution due to the drainage water reuse.

Duration: 5 years.

Estimated Costs: 5 million US\$.

8.2.2.6. Project title : Safe use of treated sewage water for Afforestation

Background

The sustainable use of land and water resources is directly linked to food security, public health, and economic and social benefits. In many cases, the treated municipal wastewater represents an important water resource that could form a valuable national resource if properly and effectively used.

On the other hand, the uncontrolled municipal sewage discharge is one of the most serious forms of environmental pollution, and represents a clear threat to both human health and to sustainable development. In the majority of the low-income countries worldwide the sewage effluents are normally disposed off through direct discharge into waterways, rivers, lakes, or to the sea, mostly without treatment.

Therefore, addressing the threats of uncontrolled municipal wastewater discharge has been identified as a priority action in the 1995 Global Programme of Action.

With the increasing population growth, over the past decades, the need for effective waste water collection, treatment and safe disposal become a must. Therefore, treated waste water as a potential resource and its options for sustainable reuse have been studied and implemented.

To minimize the risks and hazardous effects associated with the reuse of treated waste, water the policy of the Ministry of Agriculture and Land Reclamation (MALR) was devoted, to only allow treated waste water to be used for irrigating timber trees plantains planted in desert areas to combat desertification, and decrease pollution which are reflected on social, environmental, economic benefits in different ways.

Ministry of State for Environmental Affairs/Egyptian Environmental Affairs Agency (EEAA) .

Project Area

The project will be conducted in some selected desert lands close to waste water treated plants, particularly remote areas to dispose wastewater prevent its hazardous effect.

Specific objectives of the project

- 1- Reduction of pollution loads in the marine, coastal, desert environment and to combat desertification.
- 2- Protection of coastal and marine habitats and biodiversity.
- 3- Increase availability of water for development.
- 4- Reduce CO₂ concentrations in the atmosphere.
- 5- Build and enhance capacity of local and national expertise.
- 6- Use of innovative and effective approaches in municipal waste water management.
- 7- Insure long - term sustainability of the afforestation roject through the use of the income generated from the forest's timber wood and the associated supplementary projects.

Implementing bodies

- 1- Ministry of Agriculture and Land Reclamation, Desert Research Center.
- 2- Ministry of State for Environmental Affairs.
- 3- Ministry of housing, Utilities and Urban Communities.
- 4- Ministry of Water Resources and irrigation.
- 5- Ministry of Health.
- 6- Concerned desert Governorates.
- 7- Relevant research institutions. (Desert Research Center)
- 8- NGO`s.

Plan of Work

The project will be implemented in some desert governorates including; Site selection, nursery establishment, production of seedlings, plantation of timber trees, forest maintenance and management. The project also intends to monitoring and evaluating the benefits out of the project.

Expected outputs

- 1- Consuming the treated sewage water in planting forests and improving environmental circumstances and, combat desertification.
- 2- Establishing wood industries and adding new income source from secondary products like silk worm which produces silk and robes from Sisal and biodiesel oil from Jatropha.
- 3- Creating new job opportunities for youth.
- 4- Protection of resources from pollution.
- 5- Green belts protection of new cities from wind erosion.

Proposed duration **5 years .**

Estimated budget **20 million \$**

8.2.3. Programme for Rehabilitation, Conservation and Sustainable Use of Range Resources

General Guiding Principles

- Maintenance and continuity of rehabilitated areas could only be achieved when coupled with sound management programme and a holistic approach which secure conservation, development and sustainable use of range resources.
- The major challenge is how to put in place rangeland management systems which ensure sustainability of rangeland resources in the face of the wide variations in both temporal and spatial dimensions. It is recognized that in order to achieve such endeavor, comprehensive survey, assessment, monitoring and evaluation programmes of range resources acceptable and understandable by policy makers as well as resources users must be developed and implemented.
- Planning for integration of pastoral system into the broad agricultural domain, after long years of marginalization is needed and expected to be a long term action.
- To achieve long term sustainability and integration process, consistent and well co-ordinated efforts of the government (or governorates), international, regional and national organizations, research centers and the active participation of target communities, NGO's, suitable legislations, sufficient knowledge of local traditional practices, indigenous knowledge, socio-economic situation and trends, and community goals must be considered.
- Policy and programmes of interventions should be multidisciplinary in character and should be process driven. They should also attempt to cover a minimum threshold of critical objectives focused on improving the productivity and resilience of rangelands.

Main Objectives

The ultimate aim of this programme is not only to arrest degradation of the rangelands and to improve its production through the application of some measures (i.e. protection of range, reducing population of grazing animals ... etc.), but the main purpose of all activities

of the programme is to arrive at realistic management approach. The primary objective of this approach is to maximize sustainable production from rangelands by maintaining its long term productivity (use within carrying capacity).

This programme is divided into two phases, i.e a pre-planning and preparatory phase, and an implementation phase.

The Pre-Planning and preparatory phase

This phase is of 1-2 years duration. During this period the following issues will be addressed and developed

- Secure strong governmental commitment to :
 - (a) Address land use policy, defining conditions and regulations for allocating land to communal ranges, common ranges, rainfed agricultural land , and land for other uses .
 - (b) Address tenure reform of both range and rainfed crop lands; this is a key issue that requires attention to overcome the problems and conflicts between different users.
 - (c) Allocate permanent financing resource (annual budgets) required for conservation and development of rangeland resources .
- Development, planning and implementation of measures for rangeland conservation should be vested in one organization having the resources and capacity to define policies and objectives of sustainable development of rangeland resources, developing the suitable basis for integrating range livestock-rainfed cropping and irrigated agriculture systems .
- Preparing the plan of rehabilitation of degraded range areas, conservation and sustainable use of range resources.
- Preparing the other sectoral supporting projects of the “National Action Programme”.
- Dividing each of the main rangeland zones of Egypt (i.e., the North West Coastal zone, Sinia, Shalateen and Halayeb) into a suitable number of grazing units (GU). The grazing unit (GU) is a community group having both geographical and social connotations. Geographically, it is a part of rangelands of known boundaries including the traditional grounds of the various tripal pastoralist groups having the right to graze within its boundaries. Socially, it comprises all pastoralist groups living within its boundaries.
- Forming Grazing Authority (GA) for each grazing unit and establishing “Directorate Of Rangeland (DOR)”
- Forming a “National Committee”(NC) consisting of representatives of institutions and organizations having experience in applied research, development and management of arid zones, representatives of other local concerned organizations, leader of local communities and other stakeholders. This National Committee must be headed by specialized leading institution and must have definite authority and responsibility towards the proposed programme of conservation, sustainable development and use of rangeland resources.
- Defining authority and responsibility of (GUAs), (DORs) and (NC).

The implementation Phase (the second phase)

This is a long-term phase of 15-20 years duration. It consists of successive 5-yr executive working plans having defined targets, each aiming at further progress in targets of the preceding plan and introducing new targets for the following ones.

Each of the 5 yr plans will include projects, each has a set (or a package) of suitable measures for rehabilitation of degraded ranges, improving, conservation and sustainable use of rangeland resources through the following elements:

- Rehabilitation of degraded ranges by different means (natural revegetation, artificial reseeded, inter-seeding and/or planting of seedlings of fodder shrubs).
- Grazing management for conservation and improvement of range vegetation cover.
- Conservation of soil and water resources of rangeland resources.
- Other supporting projects (practices, activities,etc) such as:
 - a) Preventing uprooting of green plants and providing alternative resources of energy for heating
 - b) Limiting the cultivation areas to sites with pronounced and adequate supply of soil moisture and/or good supplemental irrigation water.
 - c) Establishment of fattening centers in the adjacent irrigated cultivated areas (irrigated farms).
 - d) Establishment of seed propagation stations.
 - e) Providing an effective extension services programme.
 - f) Conduction of appropriate training and capacity building programme.
 - g) Developing applicable research programme.

This programme includes the following projects:

8.2.3.1. Project Title : Artificial Revegetation of Depleted Ranges

Background

Some depleted ranges can be restored by different means, i.e., revegetation, artificial reseeded and planting of seedlings of fodder shrubs and trees.

Revegetation is based on checking current cause or causes of depletion, and carrying some modifications in the management approach for allowing secondary succession to develop range condition to satisfactory levels. Improved management, particularly, light grazing or a suitable rest period for plants from grazing must be provided to restore vigor and accelerate the spread of the remaining desirable forage plants. Adequate seed production and seedling establishment is important, but vegetative spread through tillers, rhizomes or stolons is equally important for many forage plants.

Providing rest period from grazing, reducing stocking rate, changing season of use, initiation of special grazing systems, manipulate the composition of grazing herds and improving distribution of animals may be sufficient for range recovery. Natural restoration may need to be enhanced by land treatment (i.e., water spreading) or by noxious plants control. When sufficient desirable forage plants are remaining, natural revegetation is cheaper than artificial revegetation except where extended periods of non use are required. However, when insufficient desirable forage plants remain, consideration must then be given to artificial revegetation.

Artificial revegetation by reseeded and/or planting of seedlings of fodder shrubs is costly, but can significantly increase forage and livestock production and net income when located in the right sites, when properly done, and when well managed. Successful range reseeded requires stepwise planning. A few spectacular success in moist (high rainfall) years frequently encourages range seeding to be made with inadequate planning, only to result in failures in average or below average years.

Minimizing the risk of failure and maximizing the potential for successful seeding and improvement could be achieved by the following :

- Using proven and tested techniques implemented in Egypt and in other countries in the region having similar ecological condition .
- Sites with high potential , but currently of low forage production could be reseeded ; these sites offer good favorable cost-benefit ratio. Selection of the more favourable sites for reseeded will be more successful and more profitable. In general, each range site represents aggregate summary of rainfall, soils, topography, elevation and native vegetation.
- Seeds of indigenous tested forage species are selected to introduce promising species that could also be used.
- Seeding must be restricted to areas where vegetation cover had been deteriorated, but still have good soil potential to support reseeded species.
- As availability of soil moisture is a limiting factor, it is worthy to develop water harvesting and water spreading system and carry out reseeded in the same sites or carry out reseeded in range sites which receive run-off water from adjacent catchment.
- Seeded areas must be protected from grazing till the seedlings are well established.
- Seeding species must be of good forage value, well adapted to site environmental condition and tolerant to the prevailing stresses. The use of indigenous knowledge of local communities of the key forage species that used to grow in the area is a good basis for selecting adapted species.
- Mechanical land treatment such as contour furrowing and contour pitter seeders could be used in the seeding process for more successful germination and seedlings establishment. However, these two seeders could create shallow depressions which can trap some of runoff water, other seeds and surface fine materials which create a micro-environment for germination and seedling growth .

Justification

Many range areas had lost most of their perennial forage species under the pressure of continuous overgrazing, uprooting of shrubs and expansion of rainfed cultivation. Loss of perennial vegetation cover enhanced the growth of invader species (annuals and other noxious plants) of low forage value; decreased the quantity of available grazable plants and greatly diminished livestock production. The density of remaining desirable forage species in these ranges is not sufficient to improve its vegetation cover and increase its forage production by natural revegetation methods.

Main objective of the project

- Re-vegetating the bare range areas (or abandoned rainfed cropland) by perennial forage species to improve the quality and quantity of forage production particularly the native forage species which would not naturally become established.
- To expand the grazing season.
- To minimize wind and water erosion.
- To increase the net return of livestock production.

Suggested areas to be artificially revegetated : 10,000 acres in the western coastal sub zone in two locations (5000 acres each) and 5000 acres in the north east of Sinai.

Activities

- Compile document and process data and outcomes of previous activities concerning natural and artificial revegetation of depleted ranges in Egypt and other neighboring countries having similar environmental condition.
- Formulation of revegetation plan (by seeding and/or planting of seedling of forage shrubs). This includes setting of priorities of promising areas, promising species,

methodologies and suitable equipments needed. Providing needed training of personnel, required seeds and seedlings of shrubs and infrastructures needed (fields of seed multiplication, nurseries, vehicles,... etc.).

- Ensuring effective participation of all stakeholders.
- Implementation of field operations (seeding – inter - seeding and/or transplanting of seedling shrubs, using suitable equipments, e.g., contour farrow seeders, contour pitter seeders,... etc).
- Protection of the revegetated areas from grazing for 2-3 successive years (till the plants are well established).
- Assessment, monitoring and evaluating the outcomes of field operations.
- Application of control and proper grazing systems to secure sustainable use and improvement of range resources.
- Installation of applicable research programme.

Project Duration: 5 years (including 2-3 years of protection from grazing) after field operations had been completed.

Estimated budgets : About 15 million US\$ during the first five years.

Anticipated outcome:

- Rehabilitation of 15000 acres through artificial revegetation during the first executive 5 yr plan.
- Improving vegetation cover of perennial forage species, increasing forage production of good quality and increasing livestock income.
- Securing sustainable use and conservation of rangeland resources.

8.2.3.2. Project Title :Conservation of Soil and Water Resources

Background and Justification

Accelerated soil erosion falls into two general categories, wind erosion and water erosion, The primary causing factors are the soil fragility, the degradation of natural vegetation due to overgrazing, uprooting of woody plants and extension of cultivations in the marginal rangeland areas. The severity of erosion is dependent upon soil erodibility, fluctuations in weather and the intensity of grazing and removal of vegetation cover.

Likewise, soil compaction is a serious problem in many cultivated areas and some locations of rangelands. Its extension and intensity vary with the kind of soil, the amount of organic matter, the soil texture, the kind and weight of the tillage equipments and the moisture content of the soil when tilled or grazed. Compaction lowers crop yields, decreases the rate of water infiltration and increases runoff and erosion thus, inpedes root growth. Consequently, surface runoff is increased, plant growth is reduced and crops become more susceptible to weather variabilities.

Surface crusting is a major structural feature of many rangeland areas in arid and semiarid regions. Crusting increases runoff and erosion and hinders seedlings emergence. This phenomenon is most common when soils are low in organic matter, high in silt or high in exchangeable sodium and bare of vegetation cover. These are also conditions that make soil susceptible to accelerated wind erosion. Inappropriate cultivation practices and overgrazing increase soil crusting by exposing the soil to the impact of raindrops which effectively destroys the original soil structure.

Objectives

The main objectives of the project are:

- Reducing wind and water erosion of soil to maintain soil fertility and secure its structure stability.
- Conserve water resources of rangelands and increase water use efficiency.
- Increase water availability for range plants which could be reflected in increasing density of vegetation cover, its forage production and its nutrition status.
- Increase livestock production.

Suggested areas: Wadi El- Arish; South West Sinai, Wadi Hederba and Wadi Halayeb in Shalateen - Halayeb district.

Activities

- Compile and process information, knowledge and data from the varied resources pertinent to conservation of soil and water resources of rangelands (in Egypt and other countries of similar condition).
 - Assess the negative impacts of over exploitation and mis-management of soil and water resources of rangelands.
 - Formulation of the master plan of soil and water conservation including controlling of wind and water erosion for securing soil fertility and stability and increasing water use efficiency.
 - Setting priorities of locations and field operations.
 - Providing needed training for local communities, and providing field equipments.
 - Implementation of field operations such as:
 - Good vegetation management of watershed areas.
 - Construction of sizeable dams, gully plugs, contour terracing and contour trenches, contour furrows, contour pitting, establishing water harvesting and water spreading facilities.
 - Controlling wind erosion through maintenance and improvement of shrubby vegetation cover through natural and artificial revegetation, stabilization of sand sheets and sand dunes by different means (mechanical, chemical, physical and biological methods).
 - Assessment, monitoring and periodic evaluation of field operations.
- **Project duration** : Five years.
- **Estimated costs:** 20 million US\$
- **Anticipated outcome**
- Maintaining soil stability and soil fertility.
 - Conservation of water resources, increasing soil moisture content and amount of available water for plants.
 - Increasing the length of grazing season.
 - Increasing forage yield and livestock production.

8.2.3.3. Project Title : Grazing Management

Background

Sustainable production from a given range unit is dependent upon proper grazing management (systems) and use of the resources within the carrying capacity of the system. Of fundamental importance are: **(1)** grazing the range with the proper kind/or kinds of animals, **(2)** keep intensity of range utilization within the proper use factor, or balance animal number with forage resources, **(3)** grazing at the correct season or at the proper growth stage of key range plants and, **(4)** obtaining proper distribution of livestock over the range .

There are principles of scientific management that can be used to conserve range resources, improve them and insure sustainable yield of goods and services from rangeland. In order to apply these principles, grazing use must be planned and applied. Several planned grazing systems are available to improve and sustain range production.

The first consideration in planning range use systems is to ensure that the basic plant and soil resources are used in such a way that they continue to be sustainably productive under the grazing system employed. The selection of a particular system will depend upon the kind of vegetation, the physiography of the range, the kind of animals and the management objectives of the operator.

Justification

Any range whether in good, fair or poor condition should be improved, sustained and maintained through proper use. This requires some kind of stable land tenure system and control of grazing. The problem of rangelands in Egypt (similar to their counterparts elsewhere in the Near East and other developing countries) is that the grazing system in use is “ common opportunistic free open access “, with no control of space, time nor number of animals .

Lack of control is therefore the major cause of continuous overuse which does not permit any sustainability .

Objectives

- The major goal of grazing management systems are: to improve plant communities, improve livestock performance, soil stability and watershed management (increase infiltration, decrease run-off and soil erosion).
- Restoring vigor of forage plants, allowing plants to produce seed, good use and more uniform utilization; and increasing animal production.

Although grazing systems differ greatly in details, but all (except continuous grazing) have two features in common: a period of rest to allow forage plants to grow; and a systematic grazing schedule among different parts of the range.

Location of the project

The north coastal zone, Sinai and Shalateen-Halayeb district.

Activities

- Collecting, compiling and processing of the available data on different resources relevant to:
 - * Vegetation cover of rangelands, (different plant communities, their floristic composition and vegetation cover).

- * Different range types of each ecological zone (key forage sp., forage production and the suitable grazing season).
- * Livestock population, number and size of herds, and their composition, their feed requirement as well as location and distribution of watering points and veterinary centers.
- Formulation of a master working plan concerning the application of the proper grazing system in the different grazing zones. One or more of the differed rotational, rest rotational and seasonal rotational grazing systems could be applied. In all cases, it is essential to adjust the number of grazing herds to the proper carrying capacity of the range and secure good distribution of livestock on the range area.
- Providing supplemental feed from outside the rangeland to overcome the gap between the current forage production of range and the feed requirement of grazing livestock.
- Providing additional watering points (if needed).
- Assessment, monitoring and evaluation of range conditions and trends as well as the productivity of livestock.
- Installing training programme.
- Ensuring participation of local communities.
- Creating applicable research programme.

Project Duration

This project is of long term nature and will be a main part of each executive 5 yr working plans.

Budget: 5 million US \$ during the first 5 yr working plan.

Anticipated outcome

- Increasing forage and livestock production.
- Conservation and improvement of range resources.
- Securing sustainable use of range resources for the present and future generations.

8.2.4. Programme for Rainfed Agriculture

In Egypt, considerable areas have potentials for rainfed farming (about 3.0 million acres) located in the northern and eastern coastal subzones as well as in Halayeb and Shalateen within the south eastern part of the Eastern Desert. Nevertheless, the actual rainfed cultivated areas does not exceed 0.6 million acres, in North Sinai and NWCZ of the country. Although the rainfed farming may not appear significant relative to the total irrigated agricultural land, it is very important to the local communities. It is also believed that better and sustainable use of the available natural resources as well as the adoption and execution of appropriate research, training and extension programmes would double or thrice the current levels of agricultural production in these areas. Also, the development of rainfed areas would contribute to the improvement of demographic situation, alleviation of the unemployment problem and the other related socio-economic issues.

Since the fiftieth of the last century, the Government of Egypt (GOE) had devoted efforts to develop the rainfed areas and reclamation of the other remote areas, and established the General Authority of the Desert Development (GADD), which took the responsibility to implement comprehensive governmental programme for Bedouin settlement and range rehabilitation. Moreover, there are many other development projects financed either by the GOE and /or supported by international organizations, e.g., FAO, GTZ, WFP,...etc. Among

them, the Matrouh Resource Management project (MRMP) started in 1993 and financed by IDA, World Bank and GOE, which adopted and implemented a programme for sustainable development of natural resources management in NWCZ. The project also intended to encourage the participation of local community in management their natural resources. The GOE are planning to continue this project was depending upon its national budget. The GOE has also projected to extend Al Hammam canal to Al Dabaa area (about 150 km west Alexandria) to carry Nile water required for supplemental irrigation of an area of about 60000 acres.

The current programme will be executed in collaboration, cooperation and integration with the range management and other NAP's programmes and intends to consider the following:

- Addressing land tenure issues of rainfed and rangeland areas and issuing other needed legislations.
- Expanding and developing the activities of water harvesting and storage of rain water.
- Land use planning of the rainfed areas .
- Improving watershed management techniques and utilization.
- Expanding the cultivated areas and increasing the crop yield via supplemental irrigation, activities.
- Developing the suitable techniques for supplemental irrigation.
- Adopting research programme for plant breeding to produce tolerant species and varieties characterized by short life and more adapted for the prevailing conditions, e.g., drought, heat and salinity stresses.
- Combating the deterioration of natural resources particularly wind and water erosion. Encouraging the participation of local community in managing their natural resources.
- Providing tailored training, extension and education programme to cope with the nature and traditions of the local community.
- Alleviating poverty and improving family income
- Implementation of this program remain under the responsibility of :
 - oMinistry of Agriculture and Land Reclamation and its affiliated institutes and Authorities
 - oMinistry of Water Resources and Irrigation and its related institutes.
 - oLocal Authorities.

This programme includes the following Projects:

8.2.4.1. Project Title: Land Use Planning

Background

Land allocation and utilization in the northern coastal zones are the subject of varied land use demands and pressures. Among these demands are; rehabilitation of range areas with its associated animal carrying capacity, decentralization activities, expansion of touristic resorts and areas to be irrigated by El-Hamam canal, expansion of rainfed cultivated cereals and infrastructures for urban, travel and emerging industrial activities, including oil and gas industries. These different land uses have variable impacts on desertification processes in these coastal zones.

It would be of great significance to establish a GIS system that would compile, process and display, in a geo-referenced way, all such varied categories of land use. The establishment of such a GIS data system would be a decision support tool and a very important mechanism for assessment of positive and negative impacts of varied land use

categories on desertification processes active in that zone. In addition, this will enable formulating and testing of different scenarios and options for future land use plans with the use of modeling techniques. Finally, such a data system will help in monitoring the changes in magnitude and direction of desertification processes and impacts on the resources base.

Plan of Action:

- Compile document and process data and outcomes of previous research activities in the northern coastal areas.
- Establishment GIS data systems utilizing the available basic, equipment, facilities and expertise.
- Organize and standardize the available data and its entry in the established GIS data system.
- Assess the integrated impacts of present land use activities on desertification processes using indicators and modeling appropriate for desertification conditions of the northern coastal zones.
- Use the established data system to identify hotspots and assign priorities for actions to combat ongoing desertification processes.
- Use the established data system to formulate options and scenarios for future land use activities with the participation of the relevant stakeholders.
- Periodical reporting on the implemented activities.
- Convene a national workshop for all collaborating institutions and relevant stakeholders to review the outcomes.
- Offer training and capacity building activities relevant to the project activities.

Expected Outputs:

- Establishment of a GIS data system with compiled geo-reference data for developmental activities, land use and interrelated desertification processes, which would be valuable for assessment and monitoring purpose as well as decision-making.
- Generated maps and knowledge could be part of a large effort of visualization and virtual reality to facilitate policy dialogue and stakeholders participation concerning issues related to the sub-region.
- Identification of hotspots and priorities for combating desertification.
- Formulation of a master plan for combating desertification in the northern coastal zones to guide its development and to contribute to the sustainable development of Egypt.

Project Duration: 5 years

Estimated Budget: 10 million US \$.

8.2.4.2. Project Title: Experimental Cloud Seeding under Egypt is Conditions

Background:

The desertification is a common term for land degradation in low rainfall and seasonally dry areas of a region. This problem can be viewed as a process and resulting condition. Key characteristics include the degradation of natural vegetation cover without having the chance to grow again due to the less availability of water resources. Few statistics exist on the extent of the problem. However, according to dregne's classic (1983) study, 81% of Egypt's productive land including crop lands and rangeland were then affected by desertification.

Global climate change, or global warming, has the potential of exacerbate the desertification problem in the Middle East and North Africa. For example, major climate change model agrees that the Mediterranean and North Africa will be adversely affected by climate change. Average temperatures are expected to increase and while there is some disagreement over wheather precipitation will actually increase or decrease, there is a general agreement that warming will increase evapotranspiration levels, and cloud clusters over Ethiopian plateau are subjected to oscillation leading to a decrease of the rains reaching Tana Lake and providing the Nile floods. The result will be less water for people and crops.

The proposed project focuses on cloud seeding to overcome desertification and aridity of some localities. Different experiments of cloud seeding will be implemented over the vulnerable districts. The area will be subdivided into different regions of homogenous meteorological conditions. The characteristics of rainfall and clouds in addition to the controlling factors such as air masses and major pressure system will be taken into consideration to identify the meteorological characteristics of different districts. The project aims at overcoming the severe waves of aridity especially in localities far from Nile water.

One of the aims of the project is to improve air quality over the localities of high atmospheric pollution. In order to fight the air pollution episodes, another target of the project is to fight the heavy rains leading to flash floods by seeding the heavy clouds before reaching vulnerable inhabited areas.

Project Area

The experiment will be carried out to test the cloud seeding processes over Toshki. The process will also be repeated over the Northern Coast and Red Sea Coast

Specific objectives of the project

1. Combat Desertification in the Egyptian desert.
2. Provide a method for water quantity support using natural phenomena.
3. Fight the heavy rains leading to flash floods by seeding the heavy clouds before reaching vulnerable inhabited areas.
4. Improve air quality over the localities of high atmospheric pollution, in order to fight the air pollution episodes.
5. Increase availability of water for development.
6. Build and enhance capacity of local and national expertise.
7. Use of innovative and effective approaches to grow plants in the desert.

Project partners

1. Ministry of State for Environmental Affairs (Egyptian Environmental Affairs Agency)
2. Ministry of Defence
3. Ministry of Civil Aviation
4. Ministry of agriculture and Land Reclamation.
5. General Authority of Meteorology.
6. NARSSS.
7. Other partners

Plan of Work

The project's overriding purpose is two-fold:

- First: to develop collaborative specialists in artificial rains
- Second: to undertake a state of the art collaborative examination of cloud seeding and fighting air pollution episodes

The following steps will be followed to implement the project

- 1- Gathering of meteorological data that describe the main air masses invading the area during different seasons of the year. In addition, rainfall rates and cloud characteristics during the different months of the year will be collected.
- 2- Testing the ability of different weather conditions to provide clouds that produce rainfall when seeded.
- 3- Chemical studies and tests of the compounds used as nuclei of condensation will be performed.
- 4- Cloud seeding experiments will be carried out from earths surface and aeroplanes.
- 5- More than one experiment will be carried out to test the cloud seeding processes over Toshki. The process will be repeated over the Northern Coast and Red Sea Coast.
- 6- Comparative studies and validity tests will be performed to evaluate the results of different methods of cloud seeding and different chemical substances. Economic studies will also be performed to evaluate the impacts of artificial rain process

Expected outputs

1. Combat Desertification in the Egyptian desert.
2. Reclamation of new lands in desert areas.
3. Provide new job opportunities for youth.
4. Reduce air pollution.

Proposed Duration: 3 Years

Estimated budget: 20 million US\$

8.2.4.3. Project Title: Improving livestock Performance

Background

In Egypt, feeding represents a major component in cost of livestock production due to limitation in range lands and the scanty of rainfall. This issue is reflected on the relatively small populations of different livestock species compared to human population.

On the other hand, livestock owners lack experience in formulating animal rations as they are accustomed to feed pelleted feed mixtures, which were subsidized by the government for long time ago. Meanwhile selling feed ingredients were restricted to the manufactures only.

In recent years, subsidy was released and all feed ingredients become available in the market. Meanwhile, a lot of agricultural byproducts become available. However, due to the lack of know how, most owners still tied with the traditional feeding system depending on mixture pellets and wheat straw though both rank as the most expensive feeding materials.

Moreover, manufactures work for processing low cost rations depend on replacing parts of natural protein with ammonia sources, besides replacing part of energy by treated roughage materials. These rations though costless but sold in similar prices to normal rations.

Rather more, dependence on nutritionally balanced feed mixtures minimizes the opportunity of farmers to include the available agricultural byproducts or residues neighbor to them for feeding animals.

Deficient and high priced animal feeds, in addition to low productivity of animals and poor health and veterinary situations share together in increasing cost of production, a matter that affects benefit gained from keeping animals. This is reflected on the inability to compete the prices of animals imported from countries rich in rangelands and able to export low price animals.

Project objectives

- Improving the nutritive value and feed conversion efficiency of local available feed materials.
- Improving animal productivity through cross breeding and selection programmes.
- Improving animal health and veterinary care.
- Maximize small holders profitability on economic basis.

Plan of work

- Conservation of green fodders by making silage.
- Saving losses in feeds by introducing new models of feeders.
- Advising breeders on tool to formulate the least cost ration and the efficient feed allowances for their animals.
- Improving animal productivity through cross breeding, and veterinary services, extension and selection programmes, ... etc.
- Implementations of field days at locations that benefit from the project packages.

Duration: 5 years

Budget : 2.5 million US\$

Expected outputs

- Technologies related to feed processing and treatments will reduce about 35 % in feeding animals; which will increase the net profits of small holders.

- Saving at least 20% losses in feeds by introducing new models of feeders.
- Improving animal health and veterinary care would decrease the losses of mortality and low animal productivity .
- Improving animal breeds will enhance the production traits of the local sheep and goat breeds that would increase the value of the improved animals.
- Animal feeds and products (meat, milk,... etc) will be available at reasonable prices all round year.
- Enhancement of the capacity building of the locals (farmers , technicians,... etc)
- Increase the investments in the field of animal production

8.2.4.4. Project Title: Improving Small Ruminants Production in North Sinai.

Background

Egypt is suffering from shortage of raw materials which are very necessary for animal production and other agricultural activities. Such preliminary raw materials could be obtained through the proper utilization of locally produced marginal resources. The annual feed requirements of livestock in Egypt are about 14 million tons of TDN, (total digestible nutrient) while the available is only 10 million tons. Thus the shortage is 4 million tons of TDN.

A recent assessment revealed that there are more than 742 million tons (on dry weight basis) of agriculture residues produced annually in Egypt. Agriculture residues, if recycled and treated properly so as to maximize their nutritive value may serve to narrow this feed gap. However, a wide range of methods for improving the feeding value of agriculture residues as animal feed materials has been recognized. Therefore, the ultimate goal, in this respect, is to provide more nutritious feeds for animals to improve their productive and reproductive states.

North Sinai Governorate is an arid region lacking enough water resources. The depletion of locally grown cereals by-products as well as pastures and rangeland resources increased the reliance concentrates and imported feed and threaten the survival of the small-scale livestock sector.

The stress of low quality water supplies makes livestock more susceptible to diseases. Although, the small ruminants (Awassi sheep and Shami goats) can sustain large losses in weight/condition after weaning, the drought has resulted in the following:

- Increased numbers of barren female leads to reduction in lambing rates.
- Reduced growth rates leading to a reduction in carcass quality and weight.
- Decreased milk production.
- Increased occurrence of clostridial disease, pseudotuberculosis, contagious ovine and caprine pleuropneumonia and both endoparasitic and ectoparasitic diseases especially scabies.

Additionally, inadequate veterinary health care plays an important role in the deterioration of livestock sub-sector. There is short supply of medication and vaccines. Consequently, less than 25 percent animals are vaccinated in routine. Due to rangeland resources depletion, the stock movements increased to search for alternative pastures. This stock movements increase the tragedy because it contributes to increase the threat of diseases spreading, which can result in further losses.

Vast majority of the livestock owners are mostly poor people, therefore, range and livestock development will improve their standard of living and such efforts will help in poverty alleviation because the livestock is the important source for their income.

Objectives:

Generally, the project aims at assisting the government and the small-scale stockowners of North Sinai in protecting their animals, from stresses by the recurrent droughts, the spread and introduction of diseases as well as enhance their nutritional status which, in turn, improve the animal health and their productivity. The project will focus on strengthening and supporting both veterinary and nutritional services, to assist them in gaining more understanding the prevailing animal health situation in the area and to control diseases, in addition to teach Bedouins how they can improve the nutritional status of their animals and optimize the use of agriculture residues as animal feeds. The project will emphasize on;

Specific Objectives:

- Strengthen the disease surveillance and monitoring systems with regard to major livestock diseases.
- Increasing the capability of the veterinary and nutrition aspects in North Sinai, on research and farm levels.
- Improving the feeding and nutritional status of animals through utilization of biotechnology for agriculture residues, fodder shrubs, natural ranges,etc.
- Improving animal management.
- Transferring and dissemination of some applied, feasible and simple technologies.

Plan of action

Activities to be undertaken include the following:

- The recruitment of project staff .
- Procurement of vaccines, veterinary drugs and mobile veterinary clinic.
- Evaluation of technologies at: a) research level; b) on farm level.
- Transfer some technologies related to animal feeding and nutrition to Bedouins (Men-Women) and dissemination assessment.
- Providing proper approaches for protection of livestock from endemic diseases and mal-nutrition.
- Conduct two training courses and fields days for community based, primary animal Health care workers in North Sinai.

Project Duration: 5 years.

Proposed Budget

2.5 million US \$.

8.2.4.5. Title: Soil Erosion Control.

Background

The fragile ecosystem in the NCZ is subjected to soil erosion by wind and water. The most fertile topsoil of rainfed cultivated areas has been eroded, leaving less productive subsoil to produce crops. Thus, crop yields will continue to decline, providing less protection to the soil surface and putting more pressure on the already fragile ecosystem.

To achieve the sustainable rainfed agriculture, it is essential to control wind and water erosion to minimize its impact. Therefore, it is vital to assess the soil loss due to water and wind erosion, and to develop conservation methods for affected sites to maximize the income of rainfed agriculture through achieving its sustainable development.

The main goal of this project is to assess soil erosion levels and to implement the most effective erosion control systems for maximizing rainfed agriculture role in food production

Objectives

- Evaluation and monitoring soil erosion rates by water and wind in different locations of NCZ.
- To initiate awareness of soil erosion hazards.
- To identify the most effective and efficient soil erosion control methods.
- To implement expedient soil conservation measures to achieve sustainable rainfed agriculture.
- To prepare a database on soil erosion in rainfed areas of NCZ.
- To raise capacity building with special attention to enhance the women and youth role in combating desertification and poverty alleviation.
- To perform economic evaluation of efficient soil erosion control on farm and national levels in rainfed agriculture.

Plan of work

The project will be implemented in different phases, each of which will comprise several activities. The phases are as follow:

- 1- Assessment of water and wind erosion rates in some selected sites; e.g., in East and West Mersa Matruh, Al Arish and Al Maghara in North Sinai.
- 2- A minimum of 20 farms (2 acres each) will be selected in the NW and NE coastal areas, to the application of different management practices such as soil mulching, strip cropping, intercropping, contour cropping, applying organic matter, amendments and integrated balanced fertilization, contour and appropriate tillage system, supplemental irrigation, and automated irrigation system Other mechanical measures such as different types of dams and dykes; terraces and cisterns will also applied.
- Providing periodical training courses to upgrade the skills of Bedouins and extension staff on assessment of soil erosion and optimum management practices to achieve sustainable rainfed agriculture development.

- Economic evaluation of the income of applying efficient erosion control methods to formulate the strategies of sustainable rainfed agricultural development in NCZ.

Duration : 5 years

Budget : 15 million US\$

Expected outputs

- Database of the extent and intensity of soil erosion and mapping of wind and water erosion levels in NCZ.
- Manual and audio-visual materials for demonstration and training programmes.
- More information on soil erosion dynamics, hazards and expedient effective and efficient soil erosion control methods.
- Integrated management package to control soil erosion by wind and water and to achieve sustainable rainfed agriculture.
- Bedouins and more specifically women and adolescent will be excess information to social care and development services with responsible quality.
- Training of about 500 specialists, technicians and native bedouins in the field of conservation and sustainable management of rainfed agriculture.
- Establishment of five pilot areas managed and utilized on basis of scientifically based soil conservation programme.

Project Duration :- The project lasts five years

Budgets: 15 million US \$

8.2.5. Programme for Sand Dunes Stabilization.

Background:

Egypt, located in the arid and hyperarid zones, is suffering from many aspects of desertification. Sand accumulations cover about 160000 km², i.e., about 16% of the total country area. These accumulations are located in the northwestern coast (5000 km²), northeastern coast (4000 km²), Kattara&Siwa depression (1000 km²), middle and southern oases (4500 km²), Wadi El-Natron and West Delta (500 km²), the Great Sand Sea (135000 km²), East Delta (500 km²) and Fayoum&Wadi El Rayian (3000 km²).

The dominant types of dunes are the longitudinal and barachan in the Western Desert. The traverse, crescentic, star and, longitudinal in North Sinai and the oolitic sand ridges in the northwestern coastal area.

Shifting dunes are particularly detrimental to agriculture on the two sides of Nile-Delta and along the

western windward margin of the Nile Valley between Beni-Suef and Assuit. They also threaten the western desert oases and the coastal communities. Shifting dunes threaten many of the agricultural settlements, and socio-economic activities. They also have negative impact on health, environment in addition to high annual costs for repairing and maintenance of roads and other elements of the infrastructure.

Objectives

The programme aims at:

- Formulation of a master plan for fixing sand dunes, including priorities and hot spots for phasing activities.
- Adopting and executing the most efficient and economically feasible techniques for dune fixation.
- Providing training and other elements of capacity building on personnel, institutional and community levels.
- Securing the participatory role of all relevant stakeholders in the various processes of planning and implementation of the programme.

The programme of sand dunes stabilization could embrace many projects, out of which the following are illustrative and replicable:

8.2.5.1. Project Title :Control of Sand Encroachment on High Dam Lake

Background

High Dam Lake is exposed at several sectors to sand encroachment, which is blown from the western and north-western directions. The active winds which have velocities more than 15 km/hr, frequently blown from the North and northwest. The hazardous impact of such winds and the ensuing sand movement on the lake are accelerated by many environmental factors, among them

- The favourable morphological setting conditions of the lake for the shifting sands derived from plains.
- The extremely arid conditions (rainfall is almost zero) and the prevalence of high wind speed in the area. The annual average days of windstorms causing hazardous sand drifts approaches 75 days.

Project Objectives

The project aims to control sand movement to the High Dam Lake via establishing successive green belts crossing wind direction. The project will also contribute to improvement of the local climate and environmental conditions of the area.

Work Plan

- On basis of the prevailing conditions, e.g., wind direction, velocities and consequently the rate of sand movement, implementation techniques will be identified.
- The plant species will be those of drought resistance and suitable for the prevailing hyperarid conditions (e.g., *Acacia* sp., *Tamarix* sp., date palm.) Also, small farms (20 to 50 acre each) could be established around the proposed water source for irrigation. It is suggested that such farms will be cultivated with vegetables and fruits.

- It is worth to mention that both surface and underground water supplies are available in the project area. The former could be exploited from the lake while the latter can be taken via wells.

Proposed duration 5 years.

Estimated budget 25 million US \$.

8.2.5.2. Project Title :Stabilization of Dune Sands in Siwa Oasis.

Background:

Siwa oasis, which is located at the northern edge of the Great Sand Sea, 300 km south west of Mersa Matruh City is one of the main closed inland depressions in the Western Desert. It lies within the extremely arid conditions where the average annual rainfall does not exceed 9 mm. Irrigated agriculture is the main activity under which about 4000 ha of palm and olive are grown. Irrigation water comes from more than 1500 flowing springs and shallow to medium wells having salinity range from 1500 to 8500 ppm. Traditional gravity (surface) irrigation system is practiced. The unused saline water of naturally flowing springs and the agricultural drainage water are poured into four main lakes, namely; Siwa, Aghormy, Zeiton and Khamisa. The daily drained water is estimated at 90000 m³ in summer and 165000 m³ in winter. Such surge amount of water has resulted in continuous uprise of water-table, consequently serious problems of water-logging, soil salinization, pollution and public health have been emerged. Moreover, the migration of sand dunes from the southern and western directions seriously threaten the agricultural activities, irrigation & drainage constructions, transportation and communications as well as other aspects of socio-economic development in the oasis

Special attention has been geared to desertification control in Siwa oasis, where considerable and integrated activities have been carried out by many national and international organizations. Among these efforts are the reuse of agricultural drainage water, either directly or blended, with high quality water from deep wells, improving the efficiency of irrigation and drainage networks and biological drainage.

Project Objectives

- Controlling sand encroachment along the southeast fringes of the oasis (about 100 km long), using the mechanical, chemical and biological measures.
- The use of agricultural drainage water in the biological fixation method, in order to alleviate the drainage problem and improve the agricultural production.
- Transforming mobile dune areas into productive fields.
- Creating income generation opportunities which could alleviate poverty and unemployment in the local community.
- Training technicians, specialists and local inhabitants on the different methods and techniques of dune stabilization; encouraging the local community participation in planning and implementing the project will be considered.
- Applied research programme in the field of sand dune fixation and management of the stabilized area will be one of the aims of the project.

Proposed duration: 5 years

Estimated budget: 15 million US \$.

8.2.5.3. Project Title: Stabilization of Shifting Sand Dunes in North Sinai

Background

Sinai covers an area of 61000 km² (i.e.,6% of the total country area) between Lat. 27° 15 and 31° 10 N. and Long. 23° 10 and 30° E. It is located within the great arid belt crossing North Africa and South Asia. Such aridity is manifested in the degradation and/or scarcity of vegetative cover, eroded soil surface, salinity of soil, low quantity and quality of groundwater, expansive area of sand dunes,... etc.

In the last decade the government of Egypt has formulated a master plan for the integrated development in Sinai till the year 2017, including activities of agriculture, industry, tourism,... etc. The agricultural activities involved;

- Maximizing the utilization of natural resources.
- Introducing more than 3.5 billion m³ of mixed Nile and agricultural drainage water to reclaim about 160000 ha in North Sinai.
- Improvement of the degraded rangeland.
- Processing of agricultural, livestock and fishery products.
- Adopting the agricultural development programme for the area between ElArish-Rafah. Such area which covers about 100000 ha, is the most promising area for rainfed agriculture in Egypt, where annual rainfall reaches, on average, 250 mm. Fruit trees is the main crop in the area. Also, the plastic tunnels and trickle irrigated vegetable crops are increasingly spreaded in the area.

However, these efforts are confronted with many constraints. Among them are the shifting sand dunes which cover more than 5000km² in the coastal zone, and the land degradation due to the over-stocking beyond the carrying capacity of the area.

Project objectives

The project aims at:

- a) Formulating a master plan for controlling the shifting sand dunes in North Sinai.
- b) Establishment of 2 pilot areas (100 ha each) for stabilizing sand encroachment using the biological measures and develop the appropriate management of the planted area.
- c) Training of employees and local inhabitants on management and techniques of dune fixation.

- **Project duration:** 5 years.

- **Estimated budget:** 20 million US \$.

Summary of the intervention programmes for combating desertification

Programme	Agricultural Zones			
	North coastal zone	Nile Valley and Delta	Inland Sinai & Eastern Desert	Western Desert
Thematic programme				
a) Monitoring & Assessment	*	*	*	*
b) Capacity Building	*	*	*	*
Irrigated agriculture		*		*
Rehabilitation of rangelands	*		*	*
Rainfed agriculture	*		*	
Sand dunes stabilization	*			*

Summary of intervention projects and their Budget (in first five years plan)

Programmes and Associated projects	Budget million US\$
1. <u>Thematic Programme</u>	
1.1 Desertification assessment and monitoring	15
1.2 Capacity building	15
2. <u>Irrigated Agriculture</u>	
2.1. Irrigation improvement	300
2.2. The integrated irrigation	350
2.3. Land improvement management	50
2.4. Water and land pollution control	8
2.5. Environmental pollution in Wadi El Rayan depression	5
2.6. Safe use of treated sewage water of afforestation	20
3. <u>Rehabilitation of Rangeland</u>	
3.1. Artificial revegetation of depleted ranges	15
3.2 Conservation of soil and water resources	20
3.3. Grazing management	15
4. <u>Rainfed agriculture</u>	
4.1. Land use planning in the North Coastal Zone of Egypt	10
4.2. Experimental cloud seeding under Egypt's Conditions	20
4.3. Improvement livestock performance	2.5
4.4. Improving small ruminants production in North Sinai	2.5
4.5 Soil erosion control	15
5. <u>Sand dune stabilization</u>	
5.1. Control of sand encroachment on High Dame Lake	25
5.2. Stabilization of dune sands in Siwa Oases	15
5.3. Stabilization of shifting sand dunes in North Sinai	20

9. RECOMMENDATIONS

Within the framework of preparing NAP to combat desertification five workshops were held, two of which represent the agro-ecological zone of the Western Desert (New Valley Govt. and Siwa), the third was confined to the agro-ecological zone of the North coastal area (North Sinai Govt.), the fourth was concerned with the agro-ecological zone of the Nile Valley and Delta (El Behaira Govt.) and the fifth dealt with the agro-ecological zone of the Red Sea Govt. The workshops addressed and discussed the major problems relevant to sustainable development with particular emphasis on desertification issues and their impact on each of concerned zones. The audience represented the relevant ministries, institutions, authorities, NGO's and local communities. In light of these workshops, conclusions and recommendations that were figured out were taken into consideration in reformulation and orientation of the concerned projects.

The following are the most prominent recommendations:

- The vital importance of assessment of desertification type, extension, degree and its main active factors prevailed in each ecological zone. Preparation of concerned maps to identify hot spots with active degradation processes and assignment of priorities for combating desertification. Advanced priority must be given to protect the ecosystems in each zone from land deterioration due to salinity water logging and seawater intrusion in the fertile soils of the Nile Delta region and sand encroachment, particularly in desert Oases, coastal belts and other areas.
- Development of the proper utilization and management policy of water resources through updating of the previous studies, establishing of data bases, optimizing use of water resources, time and schedule of irrigation, reuse of drainage and waste water and providing alternatives for maximizing the economic return per water unit. Use of modern technologies for determining the main characteristics of each groundwater aquifer, its maximum capacity and safe yield.
- Use of non-conventional water resources (agriculture drainage water, secondary treated waste water and treated sewage) to cultivate non edible crops such as fiber crops, and industrial plants, ornamentals and afforestation of timber trees.
- Proper harvesting of rainfall and flash floods to increase water potential and prevent risk hazards.
- Selection and adoption of the most appropriate soil reclamation, management and conservation practices of the productive lands to sustain productivity and development. Effective service and capacity building of land owners and stakeholders provide a good and in this regard.
- Assessment of the current cropping patterns and providing new cropping packages (suitable for each agro-ecological zone) of high competing ability in the national and international markets, high economic return and of low water requirements.
- Assessment, conservation and maximizing the benefits of the natural plant resources in arid and semi-arid areas particularly forage crops and medicinal plants spreaded over these zones.

- Improving livestock production through increasing unconventional feed stuffs, providing more effective animal health care and increasing efficiency of reproduction by different breeding methods.
- Supporting and enhancing the role of different research and executive institutions, organizations and stakeholders, particularly, those of relevant ministries, public agencies, NGOs, CBOs, private sector and local administrative authorities.
- Supporting the current efforts for capacity building of different societies, local communities and organizations relevant to combating desertification and socio-economic development.
- Maximization of the role of women in different activities of socio-economic development, in particular, those concerned with combating desertification.
- Supporting and development of the current youth efforts in the different development aspects particularly those projects initiated by the coastal and desert governorates, the New Valley, Matrouh, North and South Sinai and Red sea regions.
- Continuation of the current efforts to solve the problems of land tenure and optimizing the legal position of people who invest common land to encourage them for more sustainable development.
- Increasing the number of nurseries needed to produce seedlings of trees and shrubs required for afforestation, stabilization of sand dunes, shelter belts and windbreaks.
- Conservation and improvement of rangeland resources in the coastal belts and other inland areas through formulation of meaningful policy and application of measures that ensure the optimum utilization, sustainable development and management of resources (proper carrying capacity and grazing systems, rehabilitation of depleted range areas by reseeding, establishment of water harvesting and water spreading constructions, supplemental feeding, formulation of range co-operatives and fattening center for small ruminants in the cultivated areas, secure the participation of all pertinent stakeholders in all stages of planning, implementation and management of rangeland resources).
- Promotion of public awareness campaigns dealing with environmental issues (particularly desertification) using all available media.
- Studying the traditional practices and indigenous knowledge of local communities and incorporate them in projects of combating desertification for increasing the benefits of utilization of the valuable biological resources available.
- Development of plant species and varieties tolerant to stress conditions (drought, salinity, low soil fertility, etc....) to be planted in rainfed areas and areas irrigated by low quality water.
- Conservation of the aquatic ecosystem in the coastal areas and inland to sustain and improve its production and increase the net income of local associations.

- Adopting policies for preventing or at least minimizing the migration of local communities (particularly youth that have particular professional skills) from rural areas to urban areas through sustainable land use that encourage planning on scales large enough to maintain the potential of ecosystems and giving titles for land ownership in newly reclaimed land.
- Adopting an efficient monitoring programme for assessment and implementation of NAP to combat desertification in the different agro-ecological zones.
- Designing an indicative cropping pattern for each ecological zone based on climatological conditions, soil characteristics and water resources availability in terms of quantity and quality..
- Adopting proper policy to produce clean agriculture production in isolated desert areas (i.e., Siwa oasis and Sinai) through application of organic cultivation, biological fertilizers and integrated biological pest control.

NAP Endorsment

This document was endorsed in the meeting held by H.E. A. El Leithy, Minister of Agriculture and Land Reclamation in the presence of H.E. M. Abo-Zied, Minister of Water Resources and Irrigation and H.E. M. Goerge, Minister of State of Environmental Affairs, as well as all members of the National Coordination Committee including, representatives of concerned ministries, Chairman of Agriculture Research Center, Desert Research Center, Executive Environmental Affairs Agency, Academy of Scientific Research and Technology, Natunal Authority of Remote Sensing and space science, representatives of parliament and NGO's, beside a group of professional experts in the concerned fields of desertification. Also, the Scientific Committee members of National CCD participated in the presentation of NAP facts and figures.

In this regard, the comments raised up during such meeting were included in this document.

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B. Main Working Papers

1- Water resources and activities of Ministry of Water Resources and Irrigation for improving their utilization in Egypt

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2- Soil Resources in Egypt

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3- Flora, Natural vegetation and range resources

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4- Elements of Agricultural production in Egypt

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5- Causes, Processes and impact of desertification

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8- Soil Conservation measures to combat desertification

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9 -Egyptian Activities to combat desertification

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10 - Proposals for Desertification Assessment; Monitoring and Indicators

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Supporting working papers:

1- Climate of Egypt

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2- Status of Desertification, with special emphasis on the main systems of ground water aquifer in Egypt

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3- The Role of Agriculture Drainage in Combating Desertification

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4- Land Improvement Activities in Egypt

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8- Wildlife resources

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9- Biodiversity and Aforestation

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10- A study case on the sand dune fixation West of Benisweif Governorates

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11- The current of legislation related to desertification

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12- Socio-economic Aspects in relation to desertification

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