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REGIONAL ASSESSMENT OF DESERTIFICATION IN THE ECWA REGION

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## I. INTRODUCTION

The member countries of the United Nations Economic Commission for Western Asia (ECWA) faced with extremely adverse climatic conditions coupled with long neglect and misuse of the available natural resources, are now going through a widespread and very advanced phase of desertification. It is estimated that about 98% of the region's entire surface area is under the effect of one process of desertification or another with varying degrees of severity.

Manifestations of desertification in the region are reflected by deterioration and salinization of the soil, silting and salinization of surface waters, water and wind erosions, increased dust storms and sand-dune formation, denudation of forests and rangelands, lowering of the ground water table, decreased productivity of land, etc.

Whereas that fragment of desertification caused by man's long misuse of his natural resources such as the removal of vegetative cover from forests and rangelands, deterioration of soil structure and water quality, water logging, reduced productivity of land, etc. can be significantly remedied through persistent efforts, desertification due to prolonged adverse natural factors may be only partially ameliorated with immense efforts and considerable expenditure.

A problem of such magnitude will require equally enormous national, regional and international efforts just to check its momentum, and much more to reverse its trend.

Realizing the universality of desertification in many parts of the world and its detrimental effects on the productivity and usefulness of the available natural resources and on the well being of the human race in general, the United Nations was prompted to hold an international conference in 1977 at Nairobi, Kenya, in order to discuss and propose ways and means to tackle this very difficult problem. This Conference adopted a Plan of Action to Combat Desertification (PACD), which was to be implemented by the year 2000.

The seven-year period 1978-1984 had been chosen for the implementation of the immediate actions required and as an indication of the time at which a first general assessment of progress could be made. The year 1984 was, therefore, to be a year of stock-taking.

The UNEP work plan for the writing of the documents required for the general assessment of progress in the implementation of PACD called for the preparation of regional assess-

ments by the UN Regional Commissions. This study represents ECWA's contribution toward this assessment.

The ECWA region covers about 4.73 million km<sup>2</sup>, distributed over 13 Arab countries.(1) Physiographically, it consists of mountains, steppes, flood plains, coastal plains, marshes, sand-dunes and deserts. Desertification phenomenon in the region is manifested by degradation of natural vegetative cover, wind and water erosion, deterioration of soil structure, decreased soil organic matter, salinization and alkalization, waterlogging, and excess toxic substances.

The climate over the greater part of the ECWA region is characterized by scanty rainfall which is unevenly distributed over the growing season with severe fluctuations from year to year. The temperature climbs as high as 45 Deg.C or more over the greater part of the region during the summer, though it drops below freezing for a longer or shorter period during winter in many localities. The high air temperature, accompanied by low relative humidity results in a very high rate of evapo-transpiration. This condition makes water basic ecological factor limiting agricultural production and causes aridity in most parts of the region.

The ECWA countries are exerting great efforts to expand and modernize their economies with a view to maximizing self-sufficiency in food and other agricultural products through the implementation of their economic and social development plans. Their national development efforts, however, are constrained by the limited natural resources and the degradation of the available resources.

There are large differences in development potential among the ECWA countries due to differences in their natural resources endowments. The region may be divided into the following three sub-regions on the basis of quality and quantity of the available resources.

#### The Gulf and the Arabian Peninsula

This sub-region includes Bahrain, Democratic Yemen, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates and Yemen Arab Republic. It is characterized by a comparatively low agricultural and livestock potential, with the exception of the higher

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(1) The ECWA countries are: Bahrain, Democratic Yemen, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, United Arab Emirates, and Yemen Arab Republic, in addition to Palestine Liberation Organization.



rainfall areas in Oman, Saudi Arabia and Yemen Arab Republic. On the whole, the sub-region is very arid and agriculture depends mainly on irrigation from flood water and the underground reservoirs. It is in this sub-region that relatively large nomadic population exists and that the problem of desertification due to overgrazing is most serious.

### The Fertile Crescent

Countries in this sub-region are, Iraq, Jordan, Lebanon and Syrian Arab Republic. It has a comparatively high agricultural and livestock potential, except for Lebanon and Jordan, where agriculture is developed but the potential is low. The sub-region has a semi-arid conditions and depends on rainfall and on rivers and underground aquifers for irrigation.

### Egypt

This country has a relatively highly developed agriculture but the potential is low. It depends for irrigation almost entirely on the river water and is characterized by aridity and sedentary type of livestock production.

## II. REGIONAL RESOURCES CHARACTERISTICS(1)

A. Land Use1. Cultivated lands

Out of the ECWA region's total land area of 472.4 million ha, only 3.9 per cent or 18.5 million ha are under cultivation, i.e., under arable lands and permanent crops. Land under cultivation in the ECWA region as a whole has increased by 4.7 per cent over 1961/1965-1978, which, however, masks larger changes on both sides of the equation within the countries.

In the Gulf and Arabian Peninsula, out of the 300 million ha of total land area, only 1 per cent or 3 million ha are under cultivation, of which 161,000 ha are under permanent crops. The major part of this sub-region's cultivated lands lies in Saudi Arabia and the Yemen Arab Republic. Over the 1961/1965-1978 period, there has been a total of 27 per cent increase in cultivated area for the sub-region as a whole, or an annual increase of 1.85 per cent. Countrywise, the percentage increases were 57 per cent in Saudi Arabia, 50 per cent in the United Arab Emirates, 36 per cent in the Yemen Democratic Republic and 11 per cent in the Yemen Arab Republic.

In the Fertile Crescent, the land under cultivation constitutes 12.7 million ha or 17.4 per cent of the total land area of 72.8 million ha. The area under permanent crops is less than a million ha. About 86 per cent of this sub-region's cultivated land lies in Iraq and Syria. While the land under cultivation in this sub-region has remained almost constant over the period 1961/1965-1978, it has increased by 12, 16 and 26 per cent in Iraq, Jordan and Lebanon, respectively, but decreased by 14 per cent in Syria.

In Egypt, the cultivated land covers 2.8 million ha or 2.8 per cent of the total land area. Of the cultivated land, 2.7 million ha are arable land, while 139,000 ha are under permanent crops. The cultivated area has increased by 11.4 per cent or 0.83 per cent annually over the 1961/1965-1978 period.

Per capita arable land in ECWA region has declined by about 40 per cent over the period 1961/1965-1978 from 0.30 ha to 0.18

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(1) ECWA, The Joint ECWA/FAO Agriculture Division, The State of Resources and Management in the Agricultural Sector of the ECWA Region, (E/ECWA/AGR/WG.12/3), 1981.

ha. Significant declines have occurred in all countries of the region over this period.

## 2. Irrigated lands

The irrigated lands in the Gulf and the Arabian Peninsula sub-region constitute about 0.7 million ha or 23.3 per cent of its total cultivated land. In the Fertile Crescent sub-region, the irrigated lands extend over 2.4 million ha, or about 19 per cent of its total cultivated land. This reflects the large size of rainfed agriculture in these two sub-regions. Crop production in Egypt is entirely dependent on irrigation.

The irrigated land in the Gulf and the Arabian Peninsula has increased by 48 per cent or about 3 per cent annually over the period 1961/1965-1978. Main increases have occurred in Democratic Yemen (183 per cent), United Arab Emirates (67 per cent), Saudi Arabia (46 per cent), and Yemen Arab Republic (31.4 per cent). In the Fertile Crescent, the percentage increase over the same period was 20 per cent or 1.4 per cent annually. Countrywise, the increases were: 73 per cent in Lebanon, 49 per cent in Jordan, 30 per cent in Iraq. In Syria, however, there was a decrease in the irrigated land of 10 per cent. Egypt had an increase of 11 per cent over this period.

## 3. Cropping pattern

The total crop harvested area in 1979 in the ECWA region was 11.6 million ha, of which 8.9 million ha or 77 per cent were under cereal, 0.85 million ha or 7.3 per cent under vegetables, 0.72 million ha or 6.2 per cent under fibre crops, 0.48 million ha or 4.1 per cent under pulses, 0.29 million ha or 2.5 per cent under fruits and spices, 0.19 million ha or 1.7 per cent under oilseed crops, 0.1 million ha or 0.9 per cent under roots and tubers and 0.06 million ha or 0.5 per cent under beverages.

Of the total regional crop harvested area, 59 per cent is located in the Fertile Crescent, mainly in Iraq and Syria, 28 per cent in Egypt and the remaining 13 per cent in the Gulf and Arabian Peninsula, primarily in Yemen Arab Republic, Saudi Arabia and Democratic Yemen.

While a few countries in the region have shown a decline in yields of cereals and cotton, most countries have shown an increasing trend. Syria has achieved the highest annual growth rates of yields of cereals and cotton of 9.3 and 3.4 per cent respectively.

## 8. Land Cover

### 1. Forests and woodlands

Forests and woodlands occupy an area of 7.8 million ha in the ECWA region or a mere 1.6 per cent of the total land area. About 73 per cent of the forests and woodlands are located in the Gulf and the Arabian Peninsula, mainly in the two Yemens and Saudi Arabia, and the remaining 27 per cent are located in the Fertile Crescent primarily in Iraq and Syria. Forests in Egypt cover an area of about 2000 ha only.

Forests and woodlands have declined by 3.8 per cent in the Gulf and Arabian Peninsula and by 18 per cent in the Fertile Crescent over the period 1961/1965-1978. In Saudi Arabia the decline was 5.2 per cent, in Democratic Yemen 5.4 per cent, in Iraq 23 per cent and in Lebanon 20 per cent.

### 2. Grazing lands and forage resources

There are about 115 million ha of permanent pasture in the ECWA region, which remained constant in the past two decades. The 8 million ha of forests and woodlands are also grazed to varying extent. The largest part of these rangelands (89 per cent) lie in the Gulf and Arabian Peninsula, of which 83 per cent are located in Saudi Arabia. The remaining 11 per cent of the region's rangelands are located in the Fertile Crescent. Egypt has no permanent pastures and livestock production there is based on sedentary and mixed farming systems.

About 70 per cent (331 million ha) of the ECWA region's total land area is listed under the category of "other lands", which include in addition to built-on and covered areas, both wasteland and unused but potentially productive land. For the most part, these areas provide some seasonal grazing. About 57 per cent of these lands are located in the Gulf and Arabian Peninsula, 29 per cent in Egypt and 14 per cent in the Fertile Crescent.

Various natural vegetation types exist in the region's rangelands, depending chiefly on the amount of rainfall, soil type and texture, elevation and topography. Broadly, these rangelands may be divided into mountain, steppe, desert, and littoral ranges.

#### a) Mountain ranges

These ranges, which receive about 500 mm of rain annually, generally exhibit a close herbaceous cover of natural perennial grasses, legumes and herbs, especially in the alpine meadows. These ranges, which occur mainly in the mountains of

Lebanon and Iraq, if excessively grazed, are invaded by thorny unpalatable shrubs and in some localities poisonous vegetation.

b) Steppe ranges

They occur generally below 1000m elevation and receive 200-500 mm of rain annually. Vegetation in these ranges is less dense and consists of shrubs, grasses, legumes, and herbs. Steppe ranges are extensive in Iraq, Syria and Jordan, often adjacent to rainfed cereal lands.

c) Desert ranges

In general, there is no sharp distinction between steppe and desert vegetation until where the annual rainfall drops below 150 mm. The perennial vegetation in the desert ranges is restricted to depressions and valleys and there is, therefore, a broken vegetative cover over the surface. The cover of annual grasses may be extensive on sandy sites, but the shrubs are the most dominant, while only the most drought resistant grasses and legumes can survive here and there. Extensive desert ranges are located in Saudi Arabia, Iraq, Egypt, Jordan and Syria.

d) Littoral ranges

They are found in coastal areas around the Arabian Gulf and along the Indian Ocean and the Red Sea. The ground cover is primarily composed of deep rooting shrubs and grasses. On deep sands, such vegetation also makes use of shallow water table. Extensive saline areas, covered with saltbush vegetation, are found in Saudi Arabia, the two Yemens, Kuwait, the United Arab Emirates and Southern Iraq.

In addition to the extensive natural ranges described above, there are large tracts of fallow lands on both rainfed and irrigated lands, with as much as 6-8 million ha in the Fertile Crescent, which provide substantial forage when these lands are not under crops. These fallow-lands provide early winter and spring grazing. The stubble of the cereals also provide grazing in the summer.

Despite considerable contribution of forage from cultivated lands, the bulk (70-80 per cent) of feeding requirements of range livestock, however, is supplied by rangelands. Furthermore, rangelands are also important for harvesting water and preventing soil erosion.

Due to the seasonal availability of forage on much of the rangelands in the region, which is dictated by the variability in amount, distribution and frequency of rainfall, the tradi-

tional pattern of range use is that of nomadic or transhumant grazing.

Nomadism is the regular movement of people involving whole families with their livestock in search of grazing and water, which is characteristic of bedouin tribes in Iraq and Saudi Arabia. Transhumance is the seasonal movement of people and their livestock along traditional migration routes between winter sites in the valleys and plains to summer grazing areas usually in the mountains. Such tribal movements that are undertaken from a village, settlement, farm or camp where agriculture is practiced, are found in Jordan, Syria and northern Iraq. There are also transhumant sheep and goat breeders who operate in steppe areas between true deserts and settled cultivated lands with which they are often closely associated as they own rainfed cereal lands there. This type of transhumance is also common in Jordan, Iraq, Syria and Lebanon. In true desert areas of the region, sedentary sheep and camel raising tribes are found, who operate from a village oases and who may, as in Iraq and Syria, cultivate riverside lands on the Upper Euphrates and lower Tigris rivers.

### C. Livestock Resources

The total livestock population in the ECWA region was estimated in 1980 at about 65 million heads, of which sheep accounted for 51 per cent, goats 24 per cent, cattle 17 per cent, horses, asses and mules 6.4 per cent, and camels 1.4 per cent. Of the total livestock population, 54 per cent is located in the Fertile Crescent, primarily in Iraq and Syria, 30 per cent in the Gulf and Arabian Peninsula, mainly in Saudi Arabia and the two Yemens, and 16 per cent in Egypt.

Cattle population, including buffaloes, is mainly concentrated in Egypt (44 per cent) and in Iraq (30 per cent), while other countries with significant cattle population are Yemen Arab Republic (9.4 per cent), Syria (7.6 per cent) and Saudi Arabia (4.5 per cent). Sheep concentration is evident in the Fertile Crescent (70 per cent), mainly in Iraq and Syria, while goat population is concentrated in the Gulf and Arabian Peninsula (50 per cent), mainly in Saudi Arabia and the two Yemens, and the remaining half of goat population is distributed as 40 per cent in the Fertile Crescent and 10 per cent in Egypt.

While livestock population in the Gulf and Arabian Peninsula measured in terms of sheep heads over the period 1961/1965-1980 had declined in the Yemen Arab Republic, it has increased by more than 110 per cent in Saudi Arabia, 77 per cent in Oman, 44 per cent in Qatar and 18 per cent in Yemen Democratic Republic. In the Fertile Crescent, while the livestock population has declined in Lebanon and Iraq, it has increased by

52 per cent in Syria. The increase in Egypt was about 2 per cent.

Livestock production is an important sub-sector of agriculture in all countries of the ECWA region with the exception of the small Gulf States. Most farmers in the region depend upon livestock for food, additional income and work power. As for a large nomadic and transhumant population in a number of countries in the region, livestock is a major source of livelihood.

Livestock sector in the region has remained relatively neglected over the past decade and did not receive a fair share of investment allocations. Only in recent years has this trend been somewhat reversed and significant investments have been made in modern, intensive livestock development, especially in dairy cattle and poultry. The pastoral and sedentary livestock systems, however, though raising most of the livestock, have remained largely neglected. The general pattern of livestock production throughout the region, with the exception of modern dairy enterprises, is more or less similar. The levels of production both for milk and meat are generally low which amount to 20-25 per cent of those usually obtained in developed livestock economies.

#### D. Water Resources

The total available water resources in the Gulf and Arabian Peninsula are estimated at 8.71 billion m<sup>3</sup>, of which surface water is 3.93 billion m<sup>3</sup>. The annual ground water use is estimated at 3.95 billion m<sup>3</sup>, while recharge is only 2.74 billion m<sup>3</sup>. The present total water use is estimated at 5.75 billion m<sup>3</sup>, of which 4.4 billion m<sup>3</sup> is used for irrigation. The future water potential of this sub-region is estimated at 22.76 billion m<sup>3</sup> for ground water and 5.2 billion m<sup>3</sup> for surface water.

In the Fertile Crescent, the total available water resources are estimated at 64.93 billion m<sup>3</sup>, of which the surface water is 60.28 billion m<sup>3</sup> and ground water 4.4 billion m<sup>3</sup>. As the amount of recharge being estimated at 2.8 billion m<sup>3</sup>, an exhaustion of 1.6 billion m<sup>3</sup>, therefore, occurs in ground water reserves annually. The present water usage is estimated at 52.34 billion m<sup>3</sup>, of which 47.47 billion m<sup>3</sup> are used for irrigation. The future potential water availability in the sub-region is estimated at 98.53 billion m<sup>3</sup>, of which 93.7 billion m<sup>3</sup> are from the surface water.

The main source of irrigation water in Egypt is the Nile River discharge which is shared with the Sudan. According to the Nile Water Agreement of 1959, Egypt's share is 55.5 billion m<sup>3</sup> annually, which will increase to 57.5 billion m<sup>3</sup> after the completion of the Jongli Canal. Some ground water is also used for irrigation in the New Valley, the fringes of the Nile banks,

the oases, wadi El Salhia and Sinai. It is estimated that the ground water could provide more than 0.5 billion m<sup>3</sup> for the future development of the Nile and Delta lands.



### III. SOCIO-ECONOMIC AND POLITICAL INFLUENCES ON DESERTIFICATION(1)

Socio-economic conditions of people in the agricultural sector play an important role in determining whether or not a proper utilization and sound management of agricultural resources can be applied. In the ECWA region losses of available agricultural resources caused by the human misuse are great. Man made elements of degradation are several and can cause serious consequences.

#### A. Destruction of Natural Forest Cover

Not too long ago extensive areas in the region were covered with natural forests. Excessive cutting of wood for fuel and timber and expansion of cultivated lands in recent past, however, have led to the destruction of these forests over vast areas. Consequently, degradation processes of these forests have increased. It is reported that until some decades ago a greater part of Syrian territory was covered with natural forests but most of it was cut down in recent times. Similarly, Jordan's mountains were covered with forests, which were cut down to build and operate the Hijaz railway. In the Yemen Arab Republic uncontrolled cutting of trees is still going on, since wood is still the most important fuel material for domestic consumption. Such practices have caused enormous wastes of soil, water and wood resources.

#### B. Overgrazing

Overgrazing is an important factor in the deterioration of natural plant cover. Overgrazing results from several factors that include changes in stocking capacity and congestion. Also, changes in migration routes as a result of distribution of services and marketing opportunities, leads to overgrazing. The borders of the countries neighbouring the Hamad Basin(2) have been subjected to heavy animal concentrations and intensive grazing, since these areas have become stock reserve zones for several countries. In this zone, animals are moved illegally in all directions according to prevailing prices. This across border marketing and rapid transportation of animals with newly

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(1) Cf. ECWA, Joint ECWA/FAO Agriculture Division, The Status and Management of Agricultural Resources in the ECWA Region, (E/ECWA/AGR/83/6), 1983.

(2) Hamad Basin is a watershed encompassing lands from Iraq, Saudi Arabia, Jordan and Syria.

acquired transportation facilities increase the chance of overgrazing on border and other areas.

Overgrazing leads to considerable changes in plant communities in rangelands. It decreases the number of plants of good forage value and increase plants of unpalatable species and of low value. Changes in the type of grazing animals can also produce changes in plant communities. For instance, the reduction of camels on rangelands has increased thorn bushes which are unpalatable to other animals.

### C. Land Use and Cropping Pattern

The present land use over large areas leads to significant losses in agricultural resources. Growing of crops and fruit trees is carried out with little regard to land suitability or capacity, which certainly affects the continuity, productivity and economic returns. Manifestations of land misuse are found in many areas and include such practices as the cultivation of field crops on steep slopes, while fruit trees are planted on flat alluvial plains. In some areas, citrus trees are grown on highly saline soils in spite of inferior growth and symptoms of nutrient deficiencies. Large areas of marginal rainfall and poor soils are cultivated for wheat, while barely would be more suitable and economical.

Sowing of half of the rainfed area each year is a dominant practice regardless of rainfall conditions. In general, farmers are still reluctant to substituting fallowing by legume/cereal rotation, believing that such a practice is harmful to cereal production.

In very few countries in the region have soil surveys and land classification advanced enough to the level of compiling data necessary for proper land use planning. While fragmented areas have been surveyed and classified as a pre-requisite for certain projects, an overall national plan can rarely be found in most countries of the region.

The extension of dry cereal farming into marginal lands in many countries of the region has destroyed valuable range areas, especially in the steppes. Since crops can be harvested economically only once every five years on those marginal lands, many areas are abandoned while the soil is stripped of its original vegetative cover and subjected to erosion and invasion by unpalatable plants, which results in serious degradation of the grazing areas. In the final analysis, the increase in dry farming in the sub-marginal steppic lands has multiplied the effects of overstocking through a shrinkage in the area of the rangelands.

### D. Agricultural Practices

Crop rotation followed in many areas could be improved to preserve soil fertility, increase soil moisture, curtail weed infestation and produce larger and diversified crops. In some areas, no crop rotation what so ever is followed. In certain cases this could be attributed to fragmentation of land holdings or the system of land leasing as in Jordan. In other cases, as in the coastal zone in Syria, the farmers' desire to gain quick profits leads to cutting down of forests and a continuous cultivation of tobacco until land is exhausted and abandoned.

The use of farm machinery that is not suitable to the physical characteristics of soils prevailing in a given area could cause rapid deterioration of soil properties, increase erosion and reduce crop yields. In areas of rolling topography, plowing is seldom carried out along contour lines, a practice which is conducive to loss of rainfall water and gradual soil erosion. Plowing against contour lines is done either due to the ease of operation or to conform with the orientation of fragmented holdings which makes it difficult for the farmer to follow contour lines.

In most countries, the level of farm mechanization has to be increased to compensate for the gradual migration of farm labour and farmers to more profitable urban jobs and opportunities within the country or outside national borders. New designs and modifications of existing machinery should be encouraged to meet demands and specifications relevant to soil conditions, crop growth pattern, and farming conditions of rainfed areas.

### E. Urban Encroachment

The expansion of cities and villages has caused a significant loss of agricultural resources in several countries of the region. Highly fertile and productive arable lands have been encroached upon as a result of population pressure and lack of land-use planning. Irrigated areas are suffering from urban encroachment on a scale greater than rainfed areas. The loss is significant in Egypt, Syria and Jordan. It is estimated that 10 per cent of total arable land in Jordan has been lost to urban development, about 25,000 feddans of fertile arable land are lost to urban development every year in Egypt, and in Syria sizeable areas have been lost, particularly around Damascus.

In most countries of the region, urban encroachment on limited agricultural lands threatens future agricultural resources and production. Most countries have passed some legislation to control and coordinate urban expansion, but regulations have been difficult to implement due to the pressure caused by rising residential land values.

National governments in the ECWA region are aware of the alarming dimensions of natural rangeland degradation. Responses to this problem vary from one country to another but largely include: protection of natural rangelands by fencing, improving range management, improving the water supply situation, settling pastoral nomads, and passing appropriate legislation to protect rangelands.

As for the forest lands, several governments in the region have taken some measures to halt further degradation of natural forest cover such as passing legislation prohibiting: goat grazing, indiscriminate cutting, shifting cultivation, fencing of threatened areas, reforestation of denuded forest lands, afforestation of suitable plains, establishing fire control facilities, soil and water conservation practices such as check dams, stone terraces and contour ditches on sloping lands.

#### IV. POPULATION: CHARACTERISTICS, DISTRIBUTION, DYNAMICS

The ECWA countries have been undergoing a very rapid population growth in recent years. The rates of natural population increases for the region in 1980 were in the range of 3.2-4.7 per cent(1). This rapid population growth was brought about by the sudden per capita income increases, especially after the 1974 petroleum boom. As a consequence, living standards were raised and health conditions improved, resulting in higher birth rates, lower infant mortality and fewer deaths among the old people.

The higher levels of income in most of the oil-exporting countries in the ECWA region, together with the unusual gap between social and economic aspects of development, have had important demographic consequences affecting the supply and distribution of population and labour force. The over abundance of capital resulted in great financial surpluses, creating, in turn, a rapid development in construction, touristic, commercial, educational, health and other services that tended to concentrate in the capitals and other major cities.

Migration of increasing numbers of farmers and farm labourers to urban centers within countries or outside national borders to more profitable jobs and opportunities led to a continuous attrition of agricultural labour force which significantly affected the efficiency of agricultural operations and practices as well as agricultural production. Due to lack of labour and suitable machinery, harvesting of crops and fruits, in certain areas, is becoming a difficult task, sometimes resulting in crop abandonment.

The ECWA countries which were predominantly composed of rural communities in the recent past, are being transformed very rapidly into urban societies. For example, Iraq, a major oil exporter and an important agricultural country in the region, which was only 36 per cent urban in 1947, became 51 per cent urban in 1965, 66 per cent urban in 1980, and is expected to have an urban population of 72 per cent and 78 per cent in the years 1990 and 2000, respectively(2).

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(1) UN/ECWA, Population and Development in the Middle East, 1982.

(2) UN/ECWA, The Population Situation in the ECWA Region - Iraq, 1980.

## V. CURRENT STATUS OF DESERTIFICATION

The unfavourable environmental conditions prevailing over most parts of the ECWA region combined with prolonged misuse and mismanagement of the available natural resources had led to the lowering of productivity levels of these resources and to the present state of desertification. Since studies have not proved the occurrence of any abnormal climatic changes in the region since the fifth millennium B.C., it can be safely assumed that the present state of desertification is attributable mainly to the human neglect and misuse of natural resources from the ancient times to the present(1)

Desertification phenomenon in the region is reflected by severe deterioration of forests and rangeland covers, decreased productivity of the agricultural lands, the drop in the level of ground water, the decrease in wild-life population, the increase in storm flooding, the increase in sand-dune formation and in the incidence and severity of sand storms, and in the lowering of income levels and the disruption of the demographic structure in areas affected by desertification.

In order to evaluate the dynamics of desertification quantitatively in respect of both the hazard and the process, a suitable methodology was to be adopted. Therefore, an FAO/UNEP project was initiated in August, 1980 with the objectives of developing methodology whereby to assess and map the causes and dynamics of desertification in relation to its current status, rate and risk. Accordingly, desertification has been classified into eight categories, each with four impact classes. Desertification categories are(2):

1. Degredation of vegetative cover
2. Wind erosion
3. Water erosion
4. Deterioration of soil structure
5. Reduction in soil organic matter
6. Salinization and alkalization
7. Waterlogging
8. Excess toxic substances.

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(1) UN/ECWA, Some Aspects of Desertification and Their Socio-Economic Effects in the ECWA Region, presented to the Un Conference on Desertification, Nairobi, 1977.

(2) T. Boyadgiev, FAO/UNEP Project on Desertification Assessment and Mapping, ECWA/FAU/ACSAD Expert Meeting on Management, Conservation and Development of Agricultural Resources in the ECWA Region, Damascus, May 1981.

The proposed classes (degrees) of desertification are: slight, moderate, severe, and very severe.

The soil map of the World prepared jointly by FAO/UNESCO offered sufficient information for the evaluation of the present state of desertification at the country and regional levels.

Based on the Soil Map of the World, data related to the present status of desertification in the ECWA region was obtained and recorded as in table 1. From these data, it can be seen that 98 per cent of the total land area of the region is subject to one sort of desertification process or the other. While the percentage area affected by desertification in each country of the ECWA region differs, so do the processes resulting in this phenomenon. There are 65 per cent and 35 per cent of severe and very severe, and slight and moderate classes of desertification respectively. The break-down of the processes and classes of desertification by countries is summarized in table 1.

Table I. Current Status of Desertification in the ECWA Region  
(Assessment based on the Soil Map of the World)

Countries	Wind Erosion			Water Erosion			Salinization			Cementation			Total Deserti- fication Area	Deserti- fication in %
	Slight & Severe Moderate and V. Severe	Slight & Severe Moderate and V. Severe	Slight & Severe Moderate and V. Severe	Slight & Severe Moderate and V. Severe	Slight & Severe Moderate and V. Severe	Slight & Severe Moderate and V. Severe	Calcar- eous	Gypsum	Total Deserti- fication	Total Land Area	Deserti- fication in %			
Bahrain	-	-	-	-	-	-	-	-	60	-	-	60	62	96.8
Egypt	1746	16422	3122	15089	5418	1942	55402	-	99141	-	-	99141	99545	99.6
Iraq	1431	635	4691	-	1322	6679	16771	8600	40129	8600	-	40129	43397	92.5
Jordan	733	-	5578	1846	106	74	1124	161	9622	161	-	9622	9718	99.1
Kuwait	421	-	-	-	-	209	379	591	1600	-	-	1600	1782	89.8
Lebanon	-	-	858	-	-	-	68	-	926	-	-	926	1023	89.0
Oman	466	84	-	3226	-	290	15507	786	20359	-	-	20359	21246	95.8
Qatar	-	171	-	136	-	113	680	-	1100	-	-	1100	1100	100.0
Saudi Arabia	52058	40414	8123	44296	-	6002	52058	1384	203346	1384	-	203346	214969	94.6
Syria	-	-	4501	1171	532	-	4518	6276	16998	-	-	16998	18411	92.3
U.A.Emirates	984	1868	-	322	-	1089	1295	-	5558	-	-	5558	8360	66.5
Yemen AR.	2731	902	654	11427	-	-	3380	-	19094	-	-	19094	19500	97.9
Yemen DEM.	2746	1438	369	3011	-	-	15469	4885	27916	-	-	27916	33297	83.8

Source: T. Boyadgiev, Ibid.



## Physical Indicators of Desertification

### A. Deterioration of the soil structure

This category covers 187.4 million ha, or 42.3 per cent of the total area affected by desertification processes, of which 29.4 per cent have a severe and very severe cementation, and about 12 per cent have an accumulation of gypsum in the form of powder, sand crystals or crust. Gypsomorphy is particularly important in Iraq, Syria, Kuwait and the Yemen Democratic Republic. About 53 million ha or 28.3 per cent of this area are subject to a rather slight calcareous cementation. Such form of desertification is less critical, and in several countries the lands exhibit good conditions for an increase of the biological productivity, especially if protective measures are applied. Jordan is an example of this phenomenon.

### B. Wind erosion

Area covered by this form of desertification is about 125.25 million ha or 28.1 per cent. The total surface affected by eolian ablation and accumulation, however, is much larger covering about 208.31 million ha or 46.7 per cent. But this additional area has also been affected by other processes of desertification such as salinization, soil structure deterioration, water erosion, and is, therefore, classified under various processes of desertification. Actually, it is the eolian accumulation that gives the desertic appearance to the landscape of the ECWA countries.

### C. Water erosion

It is quite important in the hilly and mountainous zones and in denuded areas with frequent storm flooding and covers an area of 108.4 million ha, or 24.3 per cent, mostly severely and very severely eroded, with about 27 million ha only slightly and moderately affected by erosion. The countries seriously affected are Saudi Arabia, Egypt, the two Yemens, Jordan, Syria and Lebanon in that order.

### D. Salinization and alkalization

Desertification caused by salinization covers about 24 million ha, or 5.3 per cent. However, the area affected by soluble salts, covers additional 95 million ha. Salinization, affecting chiefly Iraq, Saudi Arabia, Egypt and United Arab Emirates, occurs in alluvial plains, coastal plains and in some depressions which are the backbone of the agricultural production.

Finally, it is important to note that the area with severe and very severe classes of desertification is larger than that

with slight and moderate classes, depending on the processes. The percentages of areas with severe and very severe classes of desertification of the total area affected by the same process are as follows: wind erosion 50 per cent; water erosion, salinization and calcareous cementation 68-74 per cent; gypsic cementation 82 per cent.

## VI. ASSESSMENT OF PROGRESS IN THE IMPLEMENTATION OF THE PLAN OF ACTION TO COMBAT DESERTIFICATION

In order to assess the progress in implementation of the PACD at the country level, the United Nations Environment Programme (UNEP) prepared in July 1982 a Desertification Questionnaire. This questionnaire is in three parts. Part I seeks information on the main characteristics of the drylands at the country level. Part II aims at obtaining details on the status and trend of desertification, and Part III solicits data on activities to control desertification since the United Nations Conference on Desertification, 1977.

The United Nations Environment Programme (UNEP) had forwarded these desertification questionnaires to member countries of the ECWA region, requesting their governments to co-operate in filling in these questionnaires and thus assist in the assessment of desertification in the region. The assembled statistics, however, were largely incomplete and fragmentary. Therefore, supplementary information was gathered from available sources as referred to in the text.

### Socio-economic Characteristics of the Drylands as Indicators of Desertification

#### A. Population - growth, composition, dynamics

The population situation in the ECWA region is characterized by high rates of growth, due to high birth rates coupled with decreased mortality, and by large and rapid intra-country and intra-regional movements. Table II shows total population, rural population as percentage of total population, annual growth rates, and life expectancy at birth for 1970 and 1980.

Table II. Total Population, Rural Population (in percentage of total population), Annual Growth Rates, and Life Expectancy for ECWA region for the years 1970, 1980

Countries	1970				1980			
	Total Population (000)	% Rural Population	Annual Growth rate in %	Life Expectancy	Total Population	% Rural Population	Annual Growth Rate in %	Life Expectancy
Bahrain	210	21.0	2.9	63.2	344	16.0	5.5	63.1 - 65.6
Egypt	32020	54.4	-	-	41963	50.4	2.6	55.8
Iraq	9356	46.6	3.1	53.0*	13072	40.2	3.3	57.0
Jordan	2299	33.8	3.5	58.6	3244	25.8	5.0	65.6
Kuwait	744	1.8	6.1	68.6	1353	1.7	6.9	69.4
Lebanon	2469	19.7	1.2	63.5	2658	9.9	1.1	67.3
Oman	654	67.3	2.7	-	984	61.7	4.7	50.9 - 69.9
Qatar	111	-	9.0	-	237	-	8.8	63.1 - 68.1
Saudi Arabia	5745	66.0	-	-	8960	60.1	6.3	53.4 - 69.2
Syria	6258	51.1	3.3	64.0	8977	47.5	3.5	65.0
U.A. Emirates	223	-	-	-	983	-	13.9	65.6 - 69.9
Yemen A.R.	4835	79.3	-	-	5812	75.0	1.9	41.5
Yemen D.R.	1497	64.7	2.5	43.5	1858	58.6	2.2	45.2

Source: 1. FAO, Production Yearbook Vol. 35, 1981.

2. UN/ECWA, Demographic and Related Socio-Economic Data Sheets for Countries of ECWA Region, 1982.

\* For 1975.

The annual growth rates of population have risen in the past decade (1970-1980) in all ECWA countries, with the exception of the two Yemens, Lebanon and Qatar, where they remained more or less constant. The annual rate of growth for 1980 is over 3 per cent in all countries of the region, except in the two Yemens, Egypt and Lebanon. High rates of population growth of 13.9, 8.8, 6.9 and 6.3 per cent are recorded for United Arab Emirates, Qatar, Kuwait, and Saudi Arabia respectively. These high rates of growth in population are contributed chiefly by the large increases in number of the non-national immigrants seeking profitable job opportunities in those countries.

Life expectancy also rose significantly within the past decade in all countries of the region. The highest rise, 7 years, occurred in Jordan, while Iraq and Lebanon each gained about 4 years within the same period. Life expectancy of 65-70 years is attained in Kuwait, Qatar, United Arab Emirates, Jordan, Lebanon and Syria. Yemen Arab Republic with 41.5 years, and Yemen Democratic Republic with 45.2 years, have the lowest life expectancy in the region.

Generally, the percentage of rural population has decreased in all countries of the ECWA region. The decline in rural population in the last decade was caused mainly by migration to urban centres within the countries and to the oil-exporting countries. Within only one decade, the rural population declined by 5 per cent in the ECWA region. While predominantly rural few decades ago, most of the ECWA countries have now large urban populations. Only the two Yemens, Saudi Arabia, Oman and Egypt have greater number of rural population than urban as of 1980.

Hyper arid zone rural communities are limited mainly to Saudi Arabia, Yemen Arab Republic, Iraq, Jordan and Syria, while those of the arid and semi-arid environments are found in the Fertile Crescent sub-region(1) and the two Yemens. Sub-humid rural population are restricted mainly to the zones in the Fertile Crescent countries with relatively high rainfall.

The rural live-stock owners of nomadic characteristics are found in hyper-arid and arid areas of Saudi Arabia, Jordan, Iraq and Syria. The numbers of nomads in Jordan and Syria, being 60,000 and 350,000 respectively, remained unchanged in the past decade. In Saudi Arabia, nomadism has decreased by about 47.5 per cent, from 194,000 to 102,000 in the past decade.

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(1) Fertile Crescent Sub-region includes Iraq, Jordan, Syria and Lebanon.

Sedentary-type rural livestock farmers are found chiefly in Egypt, and to a lesser extent in Lebanon, Jordan, Syria, Iraq, Qatar and Yemen Arab Republic. Their numbers remained relatively constant within the 1970-1980 period(2).

B. Land use and land cover

In order to evaluate quantitatively the role of socio-economic activities of rural communities in the ECWA region, interpretation was made of the available data on arable land, irrigated land, permanent crop, permanent pasture, and forests and woodlands as indicators of desertification trend in the last decade as shown on table III.

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(2) UNEP Desertification Questionnaires.



1. Arable lands

The arable lands in the ECWA region have increased by a negligible 54 000 ha from 18.250 million ha in 1970 to 18.304 in 1980. The largest increase in area of arable lands occurred in Iraq, Saudi Arabia, Jordan and Yemen D.R. The largest loss in arable land area was recorded for Yemen A.R., Syria, and Egypt. The arable lands in Lebanon, Kuwait and Bahrain remained constant. The following shows the extent of arable land in 1980 as a percentage of that in 1970, and the percentage of annual increase or decrease by countries.

Countries	Extent of arable land in 1980, % of 1970	Percentage of annual increase or decrease
Lebanon, Kuwait, Bahrain	100	0
United Arab Emirates, Yemen A.R., Syria, Egypt	85.7-97.4	-0.26-1.50
Oman, Iraq, Jordan	105.8-112.5	+0.55-1.20
Qatar, Saudi Arabia Yemen D.R.	123.8-200.0	+2.15-7.20

An increase in area of arable lands in the arid and semi-arid zones may be interpreted as an indication of the fight against desertification, provided that such an increase is not attained at the expense of lands formerly occupied by natural vegetative cover.



## 2. Permanent crop

The area covered by permanent crops has increased significantly in the ECWA region in the past decade by 342,000 ha or 36.7 per cent; an annual rate of increase of 3.15 per cent. All the ECWA countries realized increases in areas of permanent crops, but the largest increases were obtained in Syria, Iraq, Egypt, Lebanon and Jordan. The increases in area of permanent crops by countries are summarized below:

Countries	Area of permanent crop in 1980 as a percentage of area in 1970	Percentage of annual increase
Syria, Iraq, Egypt, UAE	134.8 - 174.6	3.10 - 5.75
Lebanon, YemenAR, Oman	115.0 - 127.1	1.40 - 2.45
Saudi Arabia, Jordan, Yemen DR	105.2 - 106.5	0.50 - 0.65

An increase in area of permanent crops may be considered as an indication of the fight against desertification.

## 3. Permanent pasture

The area of permanent pasture remained constant in all the ECWA countries within the past decade, with the exception of Syria where an increase of 825 000 ha or an average annual increase of 0.90 per cent was realized. The increase in pasture area in Syria was partly due to the abandonment of agricultural practices in marginal lands of the cereal rainfed zone. The total area of permanent pasture in all the ECWA region amounted to 114.94 million ha in 1980.

#### 4. Forest and woodland

The area of forest and woodland in the ECWA region has declined in the past decade by 518 000 ha, or an average annual decrease of 0.65 per cent. A decrease of 367 000 ha, or an average annual decline of 2.30 per cent occurred in Iraq. A decrease of 2.75, 0.4, 0.16 per cent annually in forest and woodland area occurred in Lebanon, Yemen DR and Saudi Arabia respectively. Forest and woodland area in other countries of ECWA region remained unchanged.

#### 5. Irrigated land

The area of irrigated land in the ECWA region increased by about 500 000 ha or 0.85 per cent annually within the last decade. The largest increase in area of irrigated land occurred in Iraq. It amounted to 273 000 ha or an annual gain of 1.72 per cent. Other major annual increases were obtained in Yemen DR 5.75 per cent, Yemen AR 1.60 per cent, Saudi Arabia 1.50 per cent, Syria 0.95, Jordan 3.35 per cent and Lebanon 1.95 per cent.

The increases in area of irrigated land were due to increased reclamation activities in potentially arable land and the expansion in irrigation projects in respective countries in the region within 1970-1980 period. The increase in the area of irrigated land may be considered as an indicator of the fight against desertification.

#### C. Cereal production

The total cereal (wheat, rice, barley, maize) production in the ECWA region has increased by 3.52 million metric tons, from 10.34 million metric tons in 1970 to 13.86 million metric tons in 1980. Syria alone accounts for more than 71 per cent of this increase in the total cereal production for the region. Syria's cereal production soared from about 1.21 million MT in 1970 to 3.72 million MT in 1980 or an increase of 207.44 per cent. Egypt, the largest traditional cereal producer in the region, also realized significant increase within the same period. Its production increased by 1.1 million MT, from 6.538 million MT in 1970 to 7.629 million MT in 1980 or about 16.7 per cent. Cereal production in Iraq, another traditionally major cereal producing country in the region, however, has declined by 34 000 MT. Jordan, too, had a decrease in cereal production of 54 000 MT over the same period. Saudi Arabia was among the gainers in cereal production, as it increased its production in 1980 over that in 1970 by 53 000 MT.

Production of wheat, rice and maize registered gains within this period, while that of barley had a slight decline.

Table IV. Cereal production in ECWA Countries in 1970 and 1980

Countries	1970					1980				
	Wheat	Rice	Barley	Maize	Total Cereal	Wheat	Rice	Barley	Maize	Total Cereal
Bahrain	-	-	-	-	-	-	-	-	-	-
Egypt	1509	2566	93	2370	6538	1796	2500	102	3231	7629
Iraq	1080	268	692	9	2049	1100	250	575	90	2015
Jordan	127	-	25	-	152	60	-	38	-	98
Kuwait	-	-	-	-	-	-	-	-	-	-
Lebanon	39	-	6	15	60	28	-	7	8	43
Oman	2	-	-	-	-2	1	-	-	-	-1
Qatar	-	-	-	-	-	-	-	-	-	-
Saudi Arabia	101	2	13	4	120	150	3	16	4	173
Syria	825	1	375	8	1209	2086	-	1587	47	3720
U.A. Emirates	-	-	-	-	-	1	-	-	-	-1
Yemen A.R.	28	-	153	16	197	70	-	48	48	166
Yemen D.R.	12	-	4	5	21	15	-	2	15	32
Total	3723	2837	1361	2427	10348	5307	2753	2375	3443	13879

Source: FAO Production Yearbook, No. 35, 1981.

Production details of the four major cereal crops for 1970 and 1980 by countries are shown on table IV. However, summary of the combined cereal production in 1980 as a percentage of that in 1970 and the annual percentage increase or decrease by countries is as follows.

Countries	Cereal production in 1980 as % of 1970	Percentage annual increase or decrease
Syria, Egypt, Yemen DR. Saudi Arabia	116.7 - 307.6	+ 1.55 - 11.91
Iraq, Lebanon, Jordan Yemen AR.	64.5 - 97.4	- 0.3 - 4.30

An increase in cereal production reflects a picture of a better utilization of the available natural resources.

#### D. Livestock production

An increase in livestock population of 10.611 million heads has been realized in the ECWA region within 1970-1980, representing a rise of about 19.5 per cent, or an annual increase of 1.80 per cent. The combined population of meat producing livestock has increased by about 10.3 million heads or about 20.14 per cent in the same period, while that of the pack animals has increased by 320 000 heads or about 9.5 per cent. Syria, Saudi Arabia and Yemen Arab Republic had the largest gain in livestock population within the 1970-1980 period, amounting to 3.913, 3.708, and 1.644 million heads respectively. Other countries in the region with a sizable livestock population increment are Yemen DR, Egypt, Jordan, Oman and Kuwait. Only Iraq and Lebanon had a decrease in livestock population of 173 000 and 53 000 heads respectively.

Important contributors to the increase in total livestock population in the region were the increases in sheep population by 5.788 million head and in goat population by 3.855 million head. Cattle and buffalo increased by 425 000 and 271 000 head respectively. The only decline among the meat producing animals was in camel population, which decreased by 58 000 head. While horses and mules decreased by 76 000 and 55 000 head respectively, donkeys population increased by 451 000 head.

Table V. Livestock production in ECWA countries for 1970 and 1980

Countries	1970					1980					Total L. S.	Total Go.	Total Sh.	Total As.	Total Mu.	Total Cam.	Total Ho.	Total L.S.		
	Ca.	Bu.	Cam.	Ho.	Mu.	As.	Sh.	Go.	L. S.	Ca.									Bu.	Cam.
Bahrain	-	-	-	-	-	2	13	15	-	-	-	-	-	-	-	-	-	7	15	22
Egypt	2108	2014	120	34	6	1361	2030	1166	8839	1912	2346	99	9	1	1706	1593	1451	9117		
Iraq	2633	280	262	98	59	349	12000	3233	19114	2618	228	242	65	28	450	11650	3660	18941		
Jordan	39	-	13	7	6	47	736	413	1261	37	-	13	3	4	27	938	490	1512		
Kuwait	5	-	10	-	4	-	87	68	170	11	-	5	-	-	-	155	106	277		
Lebanon	87	-	1	4	-	28	233	357	714	56	-	-	2	4	10	145	444	661		
Oman	68	-	11	-	-	24	71	148	322	141	-	6	-	-	25	114	240	526		
Qatar	5	-	8	-	-	-	34	40	87	10	-	10	3	-	-	46	56	125		
Saudi Arabia	225	-	107	1	64	95	1883	735	3046	400	-	160	3	6	113	4100	1972	6754		
Syria	516	1	10	70	-	240	5866	759	7526	768	2	7	53	41	242	9301	1025	11493		
UA Emirates	16	-	100	-	-	-	94	257	467	26	-	59	-	-	-	132	342	559		
Yemen AR	842	-	57	3	-	565	2799	6530	10796	950	-	107	3	-	730	3150	7500	12440		
Yemen DR	80	-	167	-	-	108	688	1077	2120	120	-	100	-	-	165	980	1350	2715		
Total	6624	2295	866	217	139	3017	26523	14796	54477	7049	2576	808	141	84	3468	32311	18651	65088		

Source: FAO Production Yearbook, Vol. 35, 1981.

Ca. = Cattle; Bu. = Buffalo; Cam. = Camel; Ho. = Horses, Mu. = Mules; As. = Asses  
Sh. = Sheep; Go. = Goats; L.S. = Livestock.

Details of the distribution of livestock types and numbers by the countries of the ECWA region are shown on table v. A summary of the livestock population for the 1980 as a percentage of that in 1970 and the annual percentage increase or decrease for the decade by countries is as follows:

Countries	Livestock population in 1980 as % of 1970	Percentage annual increase or decrease in decade
Iraq, Lebanon	92.58 - 99.09	- 0.01 - 0.80
Egypt, Yemen AR, UA Emirates	103.15 - 119.90	+ 0.30 - 1.80
Jordan, Yemen DR, Qatar	128.07 - 143.68	+ 2.50 - 3.70
Saudi Arabia, Kuwait, Syria	152.00 - 221.73	+ 4.25 - 8.30

while an increase in livestock population is economically a positive achievement, it may further deplete the already over-grazed pastures and rangelands.

#### E. Grazing intensity

The grazing intensity expressed by number of heads per hectare, is an indication of both the available animal food and of the risk of the degradation in the grazed land. Considering food requirements of 1 sheep = 1 goat = 0.2 cattle or buffalo = 0.2 camel, the grazing intensity in the ECWA countries expressed in number of sheep heads per hectare of arable and pasture lands for the years 1970 and 1980 was as follows:

Countries	Animal Heads / Hectare	
	1970	1980
Bahrain	3.00	4.40
Egypt	8.95	9.20
Iraq	3.52	3.32
Jordan	1.15	1.22
Kuwait	1.70	2.53
Lebanon	4.12	3.52
Oman	0.60	1.02
Qatar	2.73	3.86
Saudi Arabia	0.05	0.10
Syria	0.66	1.04
United Arab Emirates	4.50	4.41
Yemen Arab Republic	1.43	1.69
Democratic Yemen Arab Republic	0.32	0.37

It appears that, with the exception of Iraq and Lebanon where it had decreased slightly, grazing intensity had increased from 1970 to 1980 in all other countries of the region. Unless a sound range management policy is applied and supplementary feed is provided, the increase in livestock population may lead to further degradation of the already depleted vegetative cover in the grazing land.

## VII. DESERTIFICATION TREND

### A. Desertification by Major Land-use Types

#### 1. Rain-fed cropland

According to the responses to desertification questionnaires which were received from governments of the ECWA countries, analysis was made of desertification in the rain-fed croplands in relation to processes, causes and consequences. While desertification processes may differ from one country to another, those common in rain-fed croplands of the ECWA region with their estimated relative importance by process are summarized below:

Desertification Process	Estimated Relative Contribution to the Total Desertification Process
Wind erosion	31
Decline soil fertility	23
Water erosion	21
Salinization	18
Soil crusting	7



Just as desertification processes may somewhat differ from one locality to another, so do the causes of these processes. Common causes of desertification in the rain-fed croplands and their relative importance are shown below:

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Causes	Estimated Relative Contribution to the Desertification Process
Climate (26%) and prolonged drought (14%)	40
Erroneous cropping practices	22
Unsuitable terrain	19
Population pressure	16
Short fallows	3

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Successive seasons of crop failure or continued decline in yields as a result of desertification of the rain-fed croplands eventually lead to the abandonment of agricultural activities in an area, and in extreme cases to out migration.

## 2. Rangelands

The relative importance of various desertification processes in the rangelands is estimated as follows:

Desertification processes	Estimated Relative Contribution to the Total Desertification Process
Deterioration of Veg. cover composition	28
Lowering of Veg. cover density	28
Wind erosion	19
Denudation of water points	14
Water erosion	11

Common causes of desertification in the rangelands and their relative importance are as follows:

Causes	Estimated Relative Contribution to the Total Desertification Process
Increased number of livestock	31
Restricted grazing land	16
Introduction of permanent water points	16
Fuelwood gathering	12
Insufficient man-made water points	11
Restricted livestock movement	6
Inadequate natural water points	4
Burning	4

When the degradation of rangelands continues, the sequence of the inevitable consequences will be a change in seasonal grazing pattern, a change in the settlement pattern of rural community, a decline in the number of livestock, and, eventually, the abandonment of the rangelands.

### 3. Degradation of forests

Causes leading to degradation of forests and their relative importance are as follows:

Causes	Estimated Relative Contribution to the Total Desertification Process
Clearing for cropping	29
Cutting for fuelwood	27
Clearing for grazing	20
Charcoal production	9
Forest fires	7
Felling for timber	6
Clearing for construction and highways, etc.	2

The consequences of forest degradation are the opening of the crown canopy, decreased stocking density, increased coppice/high-forest ratio, decreased density of surface vegetation with the resultant increases in run-off and water erosion.

## B. Desertification of Major Irrigation Projects

Iraq, one of the leading irrigation countries in the region, reported two of its irrigation projects, Al-Khalis and Dujaila, with a combined area of about 200 000 ha as being affected by desertification in the past decade. Irrigated by river diversion and producing cereal crops, alfalfa and cotton, the two projects have suffered from excessive salinity, water erosion and degradation of soil structure caused by improper application of irrigation water and poor land management.

Egypt, another major irrigation country, is also suffering from desertification of its irrigated lands due to the causes described above, with similar consequences.

In Jordan, the Al-Jafr (Ma'an) project of 245 ha, producing alfalfa and vegetables; and the Ba'al-Beck, Labwe and Ain Ahla fruit producing projects in Lebanon with a total area of about 1000 ha, are suffering from lowering of water table due to excessive tapping.

Irrigation projects in Oman, Qatar and the two Yemens, relying on wells and flood water, are suffering from salinity, water erosion and water-logging due to excessive pumping and the intrusion by sea water, resulting in the decline of soil quality and subsequent decrease in yields.

## C. Deterioration of Major Surface Storages

Not much can be done about reducing the amount of evaporation from surface water in the ECWA countries or to reduce the concentration of soluble salts in these waters.

Where potential evaporation from free water surface being 2000-3000 mm per annum, as is the case in most ECWA countries, (1) the amount of water lost from surface water through evaporation is immense. When, for instance, each square meter of a reservoir or a basin loses 2-3 cubic meters of water annually, an amount of 2-3 million cubic meters of water will be lost each year from every kilometer square of surface water.

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(1) Assessment of the Water Resources Situation in the ECWA Region, E/ECWA/NR/L/Rev.1, 1981.

Saudi Arabia reported that excessive losses of water due to evaporation and seepage occurred in the earth dams at Jizan and Abha with the total storage capacity of about 140 million m<sup>3</sup> which were constructed specifically for ground water recharge.

In Syria, Palmyra, Qanateer and Salama dams with total storage capacity of about 7 million m<sup>3</sup>, which were built to provide water for livestock and irrigation, are suffering from decreased storage capacity due to seepage, sedimentation, and lack of rain water.

The earth dams at Tikand in Yemen Arab Republic with total storage capacity of 1-3 million m<sup>3</sup> are threatened by flooding or collapse due to faulty design and siltation.

The hand dug surface reservoirs, diversion dams and natural springs in the Yemen Democratic Republic, which are reserved for domestic use, livestock, irrigation and replenishment of ground water, are threatened by excessive evaporation and seepage with consequent drying out and abandonment.

#### D. Deterioration of Major Aquifers or Ground Water Basins

It is a well known fact that the ECWA countries which have no surface water resources have been depending entirely on the utilization of ground water for their domestic, industrial and agricultural requirements. While ground water in these countries, and in other countries of the region for that matter, has accumulated over a long period of time, the rapid rate of exploitation accompanied by a low rate of natural recharge, has exhausted most of the aquifers in the area as manifested by the continued lowering of water table.

Since statistics regarding the size of aquifers, the rate of pumping, water quality and the amount of natural and artificial recharges are lacking, the assessment of the degree of deterioration of the ground water aquifers can only be expressed qualitatively.

Yemen Arab Republic has reported that its unconfined aquifers in Sana'a and Saada, with a good quality water, have been over-exploited. Likewise, the confined aquifer in Wadi Tihama, with its saline water, has been exhausted and deterioration of the irrigated soil has resulted. In the confined Eastern artesian Basin, coastal plains and Hadramout Basin of Yemen Democratic Republic, intrusion by sea water due to excessive pumping has occurred.

Water table in the aquifers of Hijaz - Saudi Arabia - have been sinking with a consequent salinity and sea water seepage.

In the Wadi Adai and Burani Basin, both of a good quality water, and the Coastal Seeb area - Oman - over exploitation has resulted in the lowering of water table and sea water intrusion.

The unconfined and the artesian aquifers of Qatar have deteriorated qualitatively as well as quantitatively with the resultant soil salinization due to over exploitation.

The confined as well as the unconfined aquifers of Bekaa Plain in Lebanon, with good quality water and comparatively high water tables, have been somewhat exhausted by excessive utilization.

In Syria, the artesian wells in Damascus, Hums and Aleppo have been also suffering from over exploitation.

#### E. Impact of Major Droughts

The ECWA countries normally go through continuous five months (May - September) dry period each year, with the exception of the two Yemens, Oman and the south-western portion of Saudi Arabia, where some monsoon effect is felt in the summer months. In addition to the above mentioned yearly dry period, however, many areas in the region go, from time to time, through an abnormal dry spells during the normal rainy season which cause damage to natural vegetation, livestock and crops and disrupt the demographic structure of rural communities.

In Saudi Arabia, the drought period of 1955-1963, covering an area of 350 000 Km<sup>2</sup>, caused a loss of 90% of the area's cattle, camel and sheep population with 40% loss of lives in a community of 200 000 people.

In Yemen DR, the drought of 1974-75 with 30% of normal rainfall caused 80% and 90% failure by area and crop value respectively, and a loss of 100 heads of livestock with 1500 people affected, of whom 110 and their livestock moved out of the area. Also, in Yemen DR, another drought period occurred in 1979-80, with only 40% of normal rainfall and covering about 25 km<sup>2</sup>, causing 90% and 85% failure by area and crop value respectively and creating shortage in grain and forage resources. Consequently, death of 90 heads of livestock and out migration from the affected area by 100 people occurred.

Yemen AR, also, reported occurrence of two drought spells during 1974-75 and 1979-80, covering 50 Km<sup>2</sup> and 30 Km<sup>2</sup> with rainfall amounting to 15% and 20% of normal respectively. As a consequence, a loss of 25% of livestock and 75% failure by area occurred and 1000 people out migrated in the first drought, and 20% of livestock died, 300 people of the affected population of 2000 out migrated in the second drought.

Syria suffered from drought in 1972-73 in two locations with a total area of about 200 Km<sup>2</sup>, where the amount of rainfall was 30% - 50% of the normal. The drought affected about 3000 people and resulted in 25% - 40% failure by area, but there were no reports of any loss of lives or livestock, nor was there any out migration.

Oman, too, had droughts during 1974-78 period with rainfall ranging from 30% to 47% of the normal in several parts of the country. No loss of lives or livestock occurred but the abandonment of the affected areas was reported.

## VIII. MEASURES TO COMBAT DESERTIFICATION

### A. Projects Forming Part of Measures to Combat Desertification

Since desertification processes and causes and their impact on the national economy differ from one country in the region to another, the approaches and the methods applied towards fighting the phenomenon also differ in accordance with priorities relative to conditions in each individual country.

In Iraq, salinity in arable lands has been receiving significant attention for sometime. The Land Reclamation Organization in the Ministry of Irrigation is now implementing a five-year plan for the reclamation of saline soil in irrigated land of 100 000 ha through the installment of drainage and soil amendment facilities.

While still at the identification stage, the Sharqiya Region Project in Oman is aimed at sand stabilization, rangeland improvement and safeguarding land productivity. Sponsored by UNEP, the project will cost \$2.719 million and will take 4 years to accomplish.

Saudi Arabia has been, for some time, exerting valiant efforts towards combating the formidable desertification processes in the country with significant positive results. It has been fighting the phenomenon on several fronts; afforestation, shelterbelts, dam construction, ground water survey, sand stabilization, etc.

Syria is undertaking two 15-year development projects concurrently in connexion with the steppe rangelands and forests. The Directorate of Steppe Rangelands and the Directorate of Forests, with an estimated total cost of \$400 million, are planning to plant about 18 million forage plant seedlings, mostly the perennial Atriplex Spps in an area of 12000 ha and to plant another 25 million seedlings, including forest tree species, in additional 12000 ha each year. The two projects, benefiting 5 million people, will improve rangelands and forest conditions, stabilize soil and improve the environment.

In Yemen Arab Republic, FAO, UNDP and IBRD, have collectively co-operated in 1980-82 in implementing projects in Dhamar, Khamlan and Hudaida aimed at establishing forestry and range management research and an integrated rural development project at a combined cost of about \$4 million.

Yemen Democratic Republic has completed a two-phase, 1972-1975 and 1977-1982, Improvement of Crop Production Project at a cost of \$7 million with the assistance of UNDP/FAO. Actions involved were research intensification, crop management,



post harvest technology, sand-dune fixation, and shelterbelts and amenity planting.

**B. Projects Aimed at Creating Additional Employment and Income in Drylands**

In Lebanon, the Institute of Agronomic Research is installing a 2-year meteorological station project in central Beka'a Valley with a proposed investment of \$500 000. This project which will monitor an area of about 942 Km<sup>2</sup>, will benefit a community of 60 000 people and will create jobs for 50 persons.

Another project is also being undertaken in Lebanon, the Green Plan Afforestation in the Lebanese mountain ranges to the east and west of Beka'a Valley with a total area of 1350 Km<sup>2</sup>. It will benefit a community of 22 000 people and create jobs for 1000 persons.

In Oman, the Ministry of Agriculture is establishing Date Processing and Packing Plant at Rustaq - Nizwa area with a proposed investment of about \$3 million. It will create 150 jobs with an annual income of \$3166 for each. The above ministry is also establishing Banana Ripening and Packing Plant with a proposed \$1.75 million investment, which will provide an annual income of \$ 5220 for each worker in the plant.

The Syrian Department of Steppe Rangelands has initiated a 10 year (1980-1990) Development of the Steppe Rangelands Plan. It will cost \$5-6 million and will cover an area of 7.442 million ha, benefit a community of 350 000 people and generate an annual income of \$1 million for the local workers. 12 000 ha have been planted to-date.

Another 10-year (1980-1990) project is already underway in Syria. It is Fruit Tree Project over 65 000 ha which will benefit a community of 60 000 people and will generate a steady annual income for its workers. 20 000 ha have been planted so far.

**C. Establishment or Strengthening of Research Institutions in the Field of Desertification Control**

There are no research institutes or centres in the ECWA countries which are specifically established to deal with desertification problems. There have been research activities going on for many years, however, which have been undertaken by the university staff or other government employees in several countries of the region. These research activities covered various problems in crop production, rangelands, forestry, livestock, soil and water conditions, irrigation methods, plant water requirements, etc., which influence desertification in one way or another.

Since 1963 an Arid Zone Institute, attached to the University of Baghdad has been co-ordinating research work with the faculty of the College of Agriculture at Abu-Ghraib. The Institute carries on research mainly in the fields of soils and the ecology of natural vegetation. That institute, now much expanded and equipped and renamed as the Division of Agriculture and Water Resources functions as a major part of the Iraqi Scientific Research Council, and its activities cover various agricultural, natural resources and environmental issues, including those of desertification.

The Ministry of Agriculture and Agrarian Reform in Iraq has also established in late 1970's a well staffed Directorate-General of Applied Agricultural Research, which copes, as the name implies, with all problems related to agriculture, including those of natural resources and environment.

Several experimental stations and field plots in different climatic zones of the country are set aside for research activities of the above mentioned research bodies.

Similar research activities, which are related to desertification issue in one way or another, have been going on for many years in Egypt, Syria, Jordan, Saudi Arabia and Lebanon and are gradually strengthened as the technical staff and funds become available.

Lately, in Oman and the two Yemens a start has been made towards establishing research activities to cope with problems related to agriculture, animal wealth, natural vegetation, soil and water conditions, etc. The UNDP and the World Bank are supporting such research activities in the two Yemens.

#### D. Establishment or Strengthening of Teaching and Training Institutions in Desertification Control

An outstanding progress has been achieved in relation to the establishment and strengthening of teaching and training institutions in various fields of agriculture, natural sciences, veterinary and animal sciences, and farm machinery and irrigation in the ECWA countries within the past decade. There are now 26 universities in the region which grant degrees at the bachelors level in the fields described above. These are distributed as follows: 13 in Egypt, 4 in Iraq, 2 each in Syria and Jordan and one each in Lebanon, Oman, Kuwait, Saudi Arabia, and United Arab Emirates. Some of the Egyptian and Iraqi universities also grant degrees at the M.Sc. and Ph.D. levels in the above subjects.

Since the past 20 years, the College of Agriculture and Forestry of Mosul University at Hammam Al-Alil has been granting B.Sc. Degree in forestry and M.Sc. degree since mid 1970's.

The Arab League sponsored Forestry Institute at Booqa-Lataqiya, Syria has been providing instruction in forestry at junior college level for many years.

In addition to the above universities, there are now several technical agricultural institutes at junior college level and many vocational agricultural schools in Iraq, Egypt and Syria which have been specifically established to teach agricultural sciences.

There was established in 1979 a Technical Agricultural Institute and in 1981 an Agricultural High School in the Yemen Arab Republic with a total enrollment of about 300 students. In the Yemen Democratic Republic, a vocational Agriculture Extension and Training Centre was established at Tais in 1972. An Environmental Training Division was created lately in the King Abdel Aziz University, Saudi Arabia, to deal with problems related to the environment and desertification.

Whereas the primary goals behind expansion and strengthening of the agricultural colleges, institutes, schools and training centres in the ECWA countries are related to raising the levels of agricultural yields through improved methods and practices and better utilization of the available natural resources, their impact on desertification is definitely a positive one.

The following comparison of the number of college graduates in agricultural fields shows the remarkable progress in some of the ECWA countries in the past decade:

Countries	No. of Graduates	
	1970-71	1979-80
Egypt	3300	6544
Iraq	308	1488*
Jordan	-	436**
Lebanon	292	291**
Syria	118	1428
Saudi Arabia	16	120

\* Including Graduates in Veterinary Medicine.

\*\* Enrolled Students.

E. Establishment and Strengthening Information Centres and Mass-Media for Conscicus - Raising on Desertification

Creation of awareness on desertification causes and consequences in the ECWA countries is attained, indirectly, through the government's mass-media channels such as radio broadcasts and T.V. programmes whenever subjects concerning agricultural and natural resource problems are dealt with. Articles about similar issues also appear occasionally in local magazines and newspapers.

Agricultural extension offices, staffed with technical personnel, have long been established in several countries of the region. Expanded and strengthened steadily, these offices provide guidance and transmit information to the rural people as to the recent advances in various agricultural fields, including crop production, livestock, dairy, poultry, veterinary, range and forestry, soil and water conservation, irrigation methods, etc. When these matters are better understood by the rural communities and, therefore, improved utilization methods of the available natural resources are followed, there will be a significant achievement towards arresting of some of the desertification processes and reversing their trends in the long run.

F. Evaluation by Governments of Progress and constraints in Implementing Measures to Combat Desertification

The most significant progress achieved in regard to the Plan of Action to Combat Desertification (PACD) since it was initiated in 1977 has been the greater awareness by the respective governments of the real magnitude and consequences of this phenomenon. Some practical steps, though modest, have been taken since 1977. While quantitative assessment of various combative measures taken have been stated in previous paragraphs, some additional activities in this connexion as reported by the achieving countries are qualitatively mentioned below:

In Iraq, some of the nomadic bedouins have been settled under the supervision of the Administration of the Desert Uses Development and the agencies of the Ministry of Agriculture and Agrarian Reform. The Land Reclamation Organization of the Ministry of Irrigation has performed reclamation of saline soils over considerable areas.

The Jordanian Ministry of Agriculture has accomplished afforestation and planting of large tracts of forest areas and rangelands.

In Lebanon, the main achievements have been in the areas of terracing and afforestation.

The Saudi Arabian Environmental Protection Administration has made significant progress in afforestation and rural water supply.

In Syria, the Directorate of Steppe Rangeland and Sheep and the Directorate of Forests have made progress in rangeland development and afforestation.

The Yemen Arab Republic has achieved progress in terracing, erosion control and rangeland improvement.

Constraints confronting efforts aimed at combating desertification in the ECWA countries are numerous. While the types and magnitudes of constraints in one country may differ to a greater or a lesser extent from those in another, the relative importance of constraints in the region as a whole is summarized below:

Constraints	Estimated Relative Importance of Constraints
Organizational	13.0
Environmental	12.5
Lack of public awareness	12.5
Lack of trained manpower	12.0
Inadequacy of assessment	11.5
Financial limitations	11.0
Scientific and technical limitation	10.0
Inadequacy of monitoring	9.0
Inadequacy of project formulation	8.5

## IX. SUMMARY AND CONCLUSIONS

1. Desertification, being important phenomenon in all ECWA countries, covers an estimated 98% of the region's total area of 4.73 million Km<sup>2</sup>, with processes and severity varying from one country to another, depending upon physical factors and socio-economic activities followed in utilizing natural resources.

2. The most common forms of desertification in ECWA countries are represented by deterioration, crusting, and salinization of the soil, silting and salinization of surface water, wind and water erosion, increased dust storms and sand-dune formation, denudation of forests and rangelands, lowering of the ground water table and decreased land productivity.

3. Salinization, is important in Egypt and Iraq, while gypsum accumulation is typical of land in Iraq, Syria and Yemen DR. While water erosion is important in Jordan, Lebanon, Iraq and Yemen AR, wind erosion and deterioration of natural vegetative cover and soil structure are widespread in most countries of the region. Exhaustion of ground water aquifers are felt in most countries deficient in surface water, with sea water intrusion occurring in the Gulf and Peninsula countries.

4. A significant increase in the region's population has occurred in the last decade, partly due to a high annual growth rate, which stood at 3 per cent in 1980, and partly to the increasing number of immigrants seeking job opportunities in the region. The ensuing population pressure is likely to place additional burden on the limited natural resources, and unless a sound land use policy is applied, further degradation of these resources and the environment will occur.

5. Arable lands have increased in last decade by a small margin in the region as a whole. While this may be considered as an indication of a fight against desertification, it may have a reverse effect if it is achieved at the expense of lands occupied by natural vegetative cover.

6. The areas of permanent crops have increased appreciably in all countries of the region during the period 1970-1980. It is a positive sign in the fight against desertification.

7. The area of forests and woodlands remained unchanged in most countries of the region during the last decade. Iraq, however, reported an average annual decrease of 2.30 per cent, with a slight decrease in forest area in Lebanon and Saudi Arabia. Removal and degradation of forest cover lead to further desertification.

8. An annual increase in irrigated land of 0.85 per cent was realized for the region in the last decade. The largest annual increase of 1.72 per cent was gained in Iraq. Other, but lesser, increases were realized in the two Yemens, Saudi Arabia, Syria, Jordan and Lebanon. The increase in irrigated land area may be regarded as an indicator of fight against desertification.
9. The total cereal production in the ECWA region increased by 34 per cent in the last decade, with Syria alone contributing 71 per cent to that increase. Egypt, also, had a significant increase in cereal production, while Iraq, Jordan, Lebanon and Yemen AR had a slight decline. An increase in cereal production may be considered as an indicator of fight against desertification.
10. The region's livestock population increased by an annual rate of 1.80 per cent over the past decade. Most countries realized significant increases, especially Syria, Saudi Arabia and Yemen AR. The only two countries which recorded a slight decline in number of their livestock were Iraq and Lebanon.
11. The increased number of animal heads per unit area of grazing land will ultimately lead to further degradation of the rangelands in the region, if supplementary feed is not provided and a sound range management policy is not followed.
12. According to their order of importance, the processes of desertification in croplands of the ECWA region are wind erosion, declined soil fertility, water erosion and salinization, whereas the causes of these processes are climatic, erroneous cropping, unsuitable terrain and population pressure.
13. In rangelands, the important processes of desertification are deterioration of composition and lowering of density of vegetative cover, wind and water erosion and denudation of water points, caused by the increased number of livestock, restricted grazing lands, introduction of permanent water points, fuel gathering and insufficient man-made water points.
14. The main causes of forest degradation are clearing for cropping, fuel wood gathering and grazing. Charcoal production, forest fires and felling for timber are next in importance.
15. Several irrigation projects in Iraq and Egypt are suffering from salinization due to improper drainage. Others in Jordan, Lebanon, Oman, Qatar, Saudi Arabia and the two Yemens are affected by depletion of ground water.



16. Potential evaporation in ECWA countries being 2000-3000 mm annually, the loss from surface water bodies through evaporation is enormous.
17. Ground water, being accumulated over a very long period of time is being rapidly depleted in most countries of the region due to excessive exploitation.
18. Most of the ECWA countries, even though completely dry in at least 5 months each year, suffer periodically from abnormal dry spells even during the normal rainy season, with subsequent result of crop failure.
19. As part of measures to combat desertification, reclamation projects in Iraq, sand stabilization in Oman, afforestation, ground water survey and sand-dune fixation in Saudi Arabia, afforestation and range improvement in Syria, crop management and integrated rural development in the two Yemens are now going on.
20. Some projects aimed at creating additional jobs for rural communities have been undertaken in some countries of the region. Examples of these projects are, the establishment of meteorological research station and afforestation activities in Lebanon, date processing and banana ripening in Oman, development of steppe rangelands and afforestation in Syria.
21. Research institutions in agriculture and allied fields, steadily strengthened and expanded, in several countries of the region, will definitely have positive impact on desertification.
22. The steady increase in number of graduates from agricultural colleges, institutes, schools and training centres will have positive results in the fight against desertification.
23. The greater awareness by the governments of member countries of the real dimensions of desertification and the resultant threats facing their countries may be considered as a significant contribution towards the plan of action to combat desertification. Modest practical steps toward combat of desertification have been, also, taken in all countries of the region, as discussed in the text.
24. The outstanding constraints confronting efforts aimed at combating desertification for the region as a whole, in the order of prevalence are organizational, environmental, lack of public awareness, lack of trained manpower, etc.
25. Financial limitations, being important obstacle at present facing efforts towards the fight against desertification in some non-oil exporting countries, may be the major constraint in the future even in the oil rich countries of the region, due to the magnitude of the phenomenon.

26. Those categories of desertification such as gypsum and calcareous cementation, which have been caused by physical factors, most probably have reached their maximum extent. While being kept at a halt, not much can be done at present to minimize their effect.

27. Desertification, represented by wind and water erosion and sand movement, which is a product of climatic factors and man's misuse of his natural resources, is still going in a forward direction. It can be halted, and eventually reversed, if much effort is exerted and a sensible approach to utilizing natural resources is applied.

28. Other forms of desertification such as the removal or depletion of natural vegetative cover, salinization and deterioration of the soil, decreased land productivity and the exhaustion of the ground water are still advancing in the region. These, being caused mainly by man's actions, can be halted, even reversed, comparatively quickly and easily by following sound land-use policy, better irrigation and drainage systems, application of soil improvement techniques and the application of sustained yield principles in forests and rangelands.

29. Since the processes and causes of desertification vary from one country in the region to another, due to specific physical and socio-economic characteristics, fight against desertification can not be generalized and unified for the region as a whole. Taking the general methodology as a basis, a selection will have to be made of the measures suited to cope with the conditions prevailing in each country.