

MANAGEMENT, CONSERVATION AND DEVELOPMENT OF AGRICULTURAL RESOURCES IN THE UNITED ARAB EMIRATES*

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A. INTRODUCTORY

1. **Situation, Area and Population.** The United Arab Emirates, a federation of seven Emirates, which came into being in December, 1971, lies roughly between 22° 40' to 26° 10' N. latitudes and 51° 35' to 56° 25' E. longitudes. The Arabian Gulf lies to the northwest and the Gulf of Oman stretches along the east coast of the Emirates. The land surface of the mainland excluding the islands is about 77,700 square kilometres as given in the table below:

Table 1
Area of the United Arab Emirates

S.No.	Emirates	Area in sq. miles	Area in sq. kilometres
1.	Abu Dhabi	26,000	67,340
2.	Dubai	1,500	3,885
3.	Sharjah	1,000	2,590
4.	Ras Al Khaima	650	1,683.5
5.	Fujeira	450	1,165.5
6.	Umm Al Quwain	300	777
7.	Ajman	100	259
TOTAL		30,000	77,700

The population of Emirates including a large proportion of the expatriates is estimated to be a little over one million persons at present.

2. **Climate.** The overall climate of the Emirates may be described as sub-tropical, warm and arid. Air temperatures range between 35° to 50°C from May to October during the middle of the day and they may vary between 20° to 35°C at midday during the winter months. In the interior of the desert the

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highest temperatures on the ground during summer go up to 70°C and the lowest may fall below 0°C during winter months. The average annual rainfall of the Emirates which falls mostly during winter months is less than 100 mm. Some monsoonic showers are also received during summer months on the east coast and in the mountain belt which forms the watershed between the Arabian Gulf and the Gulf of Oman. The rainfall, however, is very erratic and varies externally both from year to year and place to place. Some moisture also condenses in the form of fog and dew, especially in the coastal belts. Strong winds and sand storms are also of common occurrence throughout the Emirates. They are especially more frequent and severe during summer months with the recorded maximum wind velocity going up to 31.8 kilometres per hour. The sand dunes are a dominant feature of the landscape over most of the Emirates.

3. **Soils.** The soils are generally coarse, sandy and undeveloped. They are deficient in organic matter, nitrogen, available phosphorus and trace elements such as zinc, iron and manganese. Non-calcareous soils may also be deficient in potassium. Soils in the 'Sabkha' coastal belt and low lying areas and depressions in the interior of the desert are highly saline.

4. **Only irrigated agriculture possible.** Most of the Emirates is an extremely arid area so that permanent and sustained agriculture is not possible without artificial irrigation. Some protection against high speed winds and high summer temperatures is also necessary in most places. Dry and droughty years are quite common. Next to the Empty Quarter of the Arabian Peninsula, the United Arab Emirates is perhaps the most difficult area for practising sustained agriculture successfully.

5. **Evidence of ancient agriculture.** It would be of interest to mention here that recent archaeological excavations by a French mission at Hili near Al Ain have provided evidence that agriculture was being practised in the Buraimi oasis about 3000 B.C. Seeds and stalks of wheat, barley, oats and sorghum, stones of dates and seeds of melon have been identified in the dug out material dating back to around 3000 B.C. However, evidence with regard to the use and methods of artificial irrigation employed to raise these crops in the ancient times is still to be found out.

B. CRITICAL AREAS OF RESOURCE PRESSURE AND ASSESSMENT OF RESOURCE LOSSES

1. **Destruction and degradation of natural vegetation and wildlife.** There is no doubt that naturally occurring arid zone vegetation both woody and non-woody found in the Emirates has either been completely destroyed from certain areas, or it has not been suitably managed and has degraded considerably over most areas. Along with the natural vegetation, wildlife which takes refuge in it had also suffered in the past. A brief account of the major vegetation types of the Emirates and wildlife that have suffered to varying extent is given below.



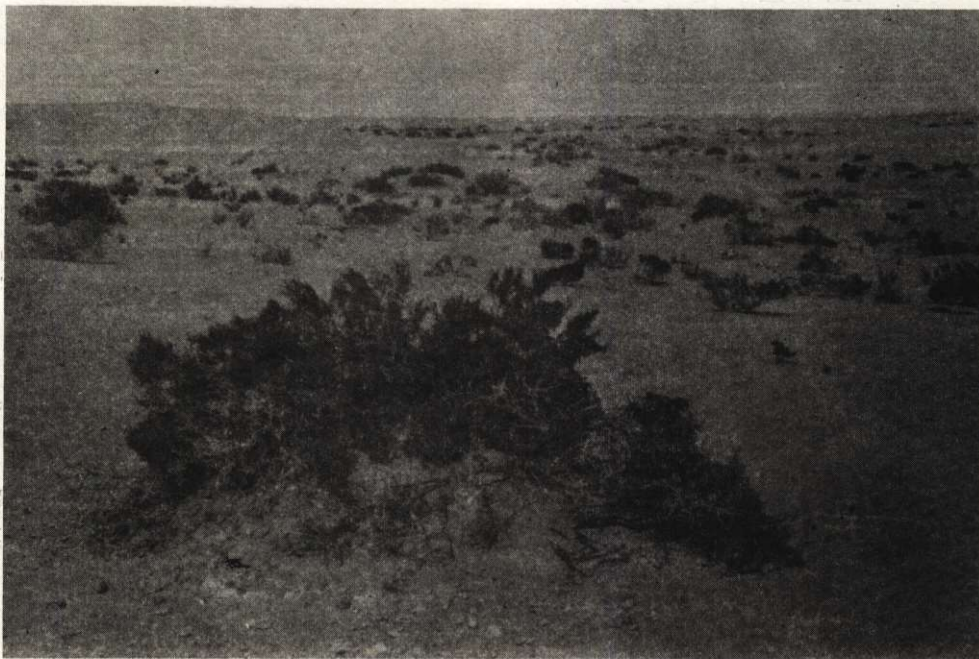
1. A *Encalyptus Camaladulensis* Shelterbelt along Habshan-Liwa Road,
Abu Dhabi Emirate

Photo: M.I.R. Khan



2. Plots of fodder crop in a date garden in Medina Zayed

Photo: M.I.R. Khan



3. 'Rims' (*Hammada elegans*) range land, in Saadia west, Western region of Abu Dhabi.

Photo: M.I.R. Khan



4 'Arta' (*Calligonum comosum*) range land along Beda Zayed-Liwa road

Photo: M.I.R. Khan

(a) *Mangrove forest*—It occupies an area of about 2,930 hectares as estimated by a UNDP mission in 1978. The dominant species of this forest 'Quoram' (*Avicennia marina*) has been severely over cut primarily as fodder for camels and livestock. Good stands of this type are to be seen only in a few sheltered and protected localities now.

(b) '*Haad*' (*Carnulaca spp*) range type—It is found beyond the 'Sabkha' salty flats on undulating sandy lands or on low sand dune terrain in the interior. The dominant browse species in this type are *Carnulaca spp*. The type has been over browsed and heavily grazed in the past. No reliable and precise statistics of the extent of this range type are available at present.

(c) '*Ghada*' (*Haloxylon persicum*) woody type—It also occurs adjoining the 'Sabkha' salty flats on medium sized grey sand dunes and has been over cut and excessively browsed. Area under this type and its distribution also needs to be precisely determined and mapped.

(d) '*Rims*' (*Hammada elegans*) range lands—They are the premier range lands of the United Arab Emirates and occupy sizeable areas. They have also been over browsed and over used in the past. Precise position with regard to their distribution and area requires to be surveyed, mapped and determined.

(e) '*Arta*' (*Calligonum comosum*) woody type—It occurs to a considerable extent in high red sand dune country and has been excessively browsed and cut in the past. Its precise area, distribution and condition need to be surveyed, demarcated and determined.

(f) '*Ghaf*' (*Prosopis spicigera*) and '*Samar*' (*Acacia tortilis*) forest—This most important forest type of the Emirates occurring mostly in the northern Emirates and the eastern region of Abu Dhabi in areas with better soil and rainfall conditions has been over exploited and not properly managed in the past. A good part of it has already been destroyed. The still surviving area of these forests needs to be demarcated, protected and properly managed on sustained yield basis.

(g) *Wildlife*—With the disappearance and degradation of natural vegetation the numbers of wildlife are also considerably reduced. The Gazelle which used to occur naturally in Abu Dhabi has disappeared altogether. It is now being reintroduced in the man made forest plantations. The Houbara bustard, a migrant bird, which used to come to the United Arab Emirates in large numbers from the central Asian steppes in old days, is a rare visitor now because of the disappearance of shelter and feed for it.

2. **Depletion and degradation of limited water resources.** Most agricultural development work including afforestation is totally dependent on artificial irrigation all over the Emirates. Most of the irrigation is done with the limited ground

water available in the Emirates. According to Halcrow consultants, as estimated by them in 1969, the total storage in the underground aquifers of the United Arab Emirates is of the order of 5.3 billion cubic metres with an average annual recharge of 105 million cubic metres. Subsequent studies have not lead to a revision of the total amount of underground water storage but a Sogreah consultants study of 1979 estimates a probable significantly higher annual recharge of about 240 million cubic metres. Taking the current annual use of water for agricultural crops, fruit trees, forest plantations and domestic use to be of the order of 640 million cubic metres, there is an annual overdraft of about 400 million cubic metres from the presently tapped aquifers. As a result there is a rapid and continuous decline of the water table in most aquifers of the United Arab Emirates. With the declining water table, the quality of water generally deteriorates. There is also a definite intrusion of sea water in the over exploited coastal aquifers of the east coast.

3. **Salinization of soil.** With artificial irrigation, depending on the quality of water used, salts tend to accumulate on the soil surface and in the root zone of agricultural crops and trees. This is occurring all over the Emirates whenever irrigation water is being applied. The rate of salinization varies not only with the quality of the water used but it is also affected by the method of irrigation used. The various methods of irrigation used in the Emirates are flood or basin irrigation, furrow irrigation, drip irrigation, sprinkler irrigation and bubbler irrigation.

The rate of salinization of soil is much faster in the case of the traditional flood irrigation or furrow irrigation methods as compared to the drip irrigation system. More water is needed for both irrigation and for reclamation of soil by leaching with the traditional methods of irrigation.

The quality of ground water varies a great deal in the Emirates. Water in the shallow aquifers derived from annual precipitation or its subsurface flow from the mountains contains less salts. The ground water derived from the deeper aquifers is generally more brackish. The water derived from the 'Sabkha' areas and from places nearer to the coast is generally more brackish than that obtained from the interior aquifers. The quality of the ground water gradually improves as one moves away from the coast into the interior. More brackish water used for irrigation purposes salinizes the soils much quicker. Larger quantities of more brackish water are, therefore, required to be used for the leaching of the soils salinized by it.

The salinized soils after their reclamation by leaching are again subject to secondary salinization. The irrigated soils thus would require to be reclaimed repeatedly after their recurrent secondary salinization.

4. **Encroachment by sand and sand dunes.** Roads, habitations, cultivated land and forest plantations are liable to be encroached upon by moving sand and

sand dunes in most places in the Emirates. This encroachment by sand is considerably much more where natural vegetation in the surrounding area had either been destroyed or depleted.

The sand has to be physically removed by using heavy earth moving machinery to clear the roads or to save habitations, farm lands or forest plantations. Physical impediments such as cement asbestos sheets, galvanized iron sheets or date fronds are erected across the main prevailing direction of the wind to check encroachment by sand. The sand accumulated against the physical barrier is also periodically removed. As a long-term measure live shelterbelts or wind breaks of arid zone species are raised to slow down the wind velocity and keep the sand away from openly invading the protected places. Both live shelterbelts or wind breaks and block plantations are being raised to lessen or check encroachment by sand.

A variety of sand dunes are found in various parts of the Emirates. They are continuously growing, moving and changing their shapes and forms. Recent observations, made on the comparatively stable and mobile sand dunes in the Western region of Abu Dhabi indicate that they may be moving at the rate of one to three metres annually in the main direction of the prevalent wind. A number of methods and techniques are being used to check their advance.

C. BASIC CAUSES OF DEGRADATION AND RESOURCE LOSSES

1. **Existence of delicate ecological equilibrium.** The environmental factors over most of the Emirates exist in a very delicate state of equilibrium. Their mishandling such as excessive use or some other form of mismanagement upsets the ecological balance and leads to serious losses of the natural resources. For example, by using the range lands beyond their carrying capacity either by intensive use or by grazing excessive number of livestock would lead to their gradual degradation and ultimate destruction. Under the harsh and variable climatic and environmental conditions prevailing in the Emirates, it is a delicate matter to maintain the ecological equilibrium. And it is this disturbance of the ecological equilibrium which generally lead to the degradation and losses of naturally renewable resources in the past.

2. **Increasing pressure of human and livestock populations.** Since the discovery and commercial exploitation of crude oil beginning in the early sixties, pressure on the local natural resources of the Emirates has increased tremendously. The human population which stood at about 180,000 in 1968, rose to about 320,000 persons in 1972. Then it jumped to about 870,000 persons in 1978, 900,000 in 1979 and is now estimated to be a little over one million.

Similarly, the livestock population is also increasing at a rapid rate as would be seen from the table given below:

Table 2

Livestock Population of the United Arab Emirates

S.No.	Kind of animals	Numbers during		
		1972	1978	1979
1.	Goats	225,000	250,000	310,500
2.	Sheeps	85,000	95,000	120,000
3.	Cattle	20,000	18,600	23,300
4.	Camels	35,400	48,000	56,400
TOTAL		365,400	411,600	510,200

In the Abu Dhabi Emirate an annual subsidy of 50 dirhams for every head of sheep or goat and 200 dirhams for every head of camel raised by the local inhabitants is paid by the government. The increasing numbers of livestock means greater pressure on the natural grazing lands which may be more than their carrying capacity in many cases.

3. **Excessive exploitation of the ground water resources.** As stated earlier, under critical areas of resource pressure, there is not enough recharge of the ground water aquifers which are being excessively exploited. There is an estimated overdraft of 400 million cubic metres of water annually at present which has resulted in the fall of water table in most aquifers. And the fall in the water level of the aquifers generally leads to the deterioration of the quality of irrigation water. The waters from the declining aquifers tend to contain more salts.

However, detailed meteorological and hydrological data for considerable lengths of time are needed to evaluate the situation both for national and regional aquifers more accurately and precisely.

4. **Lack of a clearly defined policy on resource management.** In the past a clearly defined policy for a wise resource management was neither available nor implemented. This resulted in an unscientific management of the natural resources leading to their degradation and losses. As a result of investigations and scientific studies of the natural resources started recently and which are being carried out now it should be possible to formulate and enunciate a suitable resource management policy according to our present state of knowledge and experience of the prevalent ecological conditions.

D. FORMULATION OF A POLICY ON RESOURCE MANAGEMENT

So far there has been no serious attempt for the formulation of a suitable

and well defined policy on natural resources management in the United Arab Emirates. However, the resources have been managed in the past under the directives and orders of the Rulers of the Emirates and in many cases very useful and valuable work has been done for the development of the agricultural resources. It will be more appropriate to say that a policy on resource management for the Emirates is being evolved at present.

In the context of the preparation of the economic and social five year plan (1981-85) for the United Arab Emirates, major policy issues have either been decided or they are being finalized at the moment. For the finalization of the five year plan for the agriculture sector, various policy issues with regard to proper management of the renewable agricultural resources are under the active consideration of the government. These issues are being decided in the light of a number of studies already carried out by the Consultants and on the basis of recent data collected, compiled and analysed by the Federal Ministry of Agriculture on climate, soils, water, hydrology, demography, cultural methods and marketing studies etc., for the proper management of the agricultural resources of the United Arab Emirates.

It is hoped that the policy being evolved will be clearly enunciated and effectively implemented by issuing needed legal enactments and by creating suitable infrastructure for their enforcement and implementation. Laws for setting up of an agricultural marketing corporation, a higher authority for the management of the country's water resources, a higher committee for environment have since been finalized recently. More enactments would be needed for the conservation and proper management of the natural resources such as forests, range lands and wildlife.

E. RESOURCE MANAGEMENT AND DESERTIFICATION CONTROL BEING INCORPORATED IN THE FIVE YEAR NATIONAL PLAN (1981-85)

As stated previously a scientific and proper management of the agricultural resources is being incorporated in the first national development plan in pursuance of the findings of the Consultants studies and the investigations carried out by the Federal Ministry of Agriculture. However, there appear to be some contradictions in the stand taken by the government previously and what should be the policy now in view of the latest studies and their results. Besides enhancing the productive capacity of the renewable natural resources, it is necessary that emphasis is also laid on their conservation. These resources are to be managed on a sustainable basis so that they are also available to the future generations for all times. The forests, including artificially raised forest plantations, and range lands require to be managed in a manner so that their yield and benefits will be available for ever on sustained basis.

The ground water resources also need to be conserved and wisely used. To achieve this, cultivated area may have to be limited, and more thrifty and economical irrigation practices which would reduce water needs and increase the productivity of cultivated lands would require to be employed. Already valuable work on the merits of various irrigation practices both traditional and new ones has been carried out at the Digdagga Agricultural Research Station of the Federal Ministry of Agriculture and its findings are available for field application. It is expected that any contradictions between the previous practices and what should be done would be resolved and necessary conservation and desertification control measures which should be followed now would be incorporated in the national development plan.

F. ORGANIZATIONS DEALING WITH INTEGRATED RESOURCE MANAGEMENT AND DESERTIFICATION CONTROL

The organization dealing with the integrated resource management and desertification control at the federal level in the United Arab Emirates is the Ministry of Agriculture and Fisheries Resources. The United Arab Emirates, for agricultural extension work is divided into four regions which are in the charge of four regional Directors of Agriculture. The Western Agricultural region covers the whole of Abu Dhabi Emirate. The central agricultural region covers Dubai, Sharjah, Ajman, Umm Al Quwain and Ras Al Khaima emirates. The eastern agricultural region deals with the areas of Fujairah, Ras Al Khaima and Sharjah emirates. The northern agricultural region includes most of Ras Al Khaima and parts of Fujairah emirate. Not much attention has so far been paid by the Federal Ministry of Agriculture for the proper management of forests, range lands and hilly catchment areas.

A good deal of work especially in the Abu Dhabi emirate is also being carried out by the Emirate's Agriculture and Forestry Departments in the field of integrated resource management. The agricultural development work is being dealt with independently in the eastern region of Abu Dhabi with headquarters at Al Ain and in the western region of Abu Dhabi with headquarters at Abu Dhabi. Similarly, the other six emirates are also doing agricultural development work at the emirate level as well. It would be desirable to develop suitable co-operation and co-ordination in the working of the Federal Ministry of Agriculture and the various emirates Agricultural Departments.

G. RECENT ACHIEVEMENTS IN THE MATTER OF DESERTIFICATION CONTROL

A lot of useful work has been done and is being done by the Federal Ministry of Agriculture and in the individual emirate Agriculture Departments for desertification control in recent years and since the convening of the United Nations Conference on Desertification in 1977.

1. **Collection of basic data.** The Federal Ministry of Agriculture through its Water and Soil Department has collected useful basic climatic and agrometeorological data from its nine climatological stations and a network of rainfall observing stations. Basic data on surface and ground water hydrology is being collected since 1975 from seven recording stations and various spot gauging sites. Sediment load studies of a number of hilly catchments have also been initiated. It is being arranged to upgrade six more spot gauging sites to full recording stations. Besides installing eleven water level recorders, data on water levels from a total of 239 bore holes has been collected. To monitor the quality of ground water, electrical conductivity and detailed chemical analysis of water samples have been carried out. Similarly, chemical analysis of soil samples from various parts of the Federation has also been undertaken at the Ministry's laboratories at the Digdagga Agricultural research station. All this useful information is being printed in the Water and Soil year book of the Ministry of Agriculture and is available for monitoring and devising desertification control.

2. **Afforestation.** A good deal of desert afforestation, raising of shelterbelts and raising of date gardens has been carried out by the Forestry and Agriculture Departments of the emirate of Abu Dhabi. Starting in 1975 more than 8,000 hectares have been afforested in the desert areas of the western region alone in the form of shelterbelts and block plantations using local ground water with the drip irrigation system. They carry more than 1,600,000 plants of arid zone trees species and forage plants such as 'Ghaf' (*Prosopis spicigera*), 'Samar' (*Acacia tortilis*), 'Sidr' (*Zizyphus spinachristi*), 'Arta' (*Calligonum comosum*), 'Markh' (*Leptadenia pyrotechnica*), *Atriplex* spp. etc.

3. **Shelterbelt planting.** A major road side tree shelterbelt project along Beda Zayed-Liwa asphalted road for a distance of 55 kilometres in Abu Dhabi emirate was started in the end of 1980. This project has been designed to protect from sand dune encroachment the recently completed road passing through high sand dune country from Beda Zayed town to Muzeria village in the Liwa oasis. The windbreak will be raised with arid zone tree species by using drip irrigation system in a width of 200 metres along the windward i.e., northwestern side of the Liwa road. The levelling work over a 225 metres wide strip all along the road involving cutting, transporting, filling and levelling of hundreds of millions of cubic metres of dune sand and earth with heavy earth moving machinery is in progress at present.

4. **Raising of date gardens.** Date gardens on an area of two hectares or one and a half hectares each are also raised by the Agriculture and Forestry Departments in the emirate of Abu Dhabi and after they are fully established, they are allotted to the local inhabitants for maintenance and for raising vegetable and fodder crops needed by them. These rectangular date gardens are provided with a shelterbelt of arid zone tree species on their outer boundary followed by two rows of date palms next to the tree shelterbelt. The unplanted area in

the middle of the date gardens is cultivated to raise fodder and agricultural crops. By now about 300 such date gardens have been completed and handed over to the local farmers in various places in the western region of Abu Dhabi. The irrigation of these date gardens is carried out by drip irrigation system for the trees and so far by flood irrigation in small basins for the raising of agricultural crops.

5. **Range management.** A project for range improvement over an area of about 25,000 hectares in the Bainuna area of the Western region of Abu Dhabi was started in 1979. The area has since been fenced and range conservation and development operations have just been started. Both drip irrigation and sprinkler irrigation systems will be used in this project to raise arid zone tree species and fodder bushes and grasses. It is a pioneering range improvement work being undertaken on a fairly large scale under extremely arid and desert condition.

H. HANDLING OF MAJOR ECOLOGICAL PROBLEMS BY THE RESEARCH AND PLANNING MACHINERY

Major ecological problems of a wide scale such as land degradation, encroachment by desert and range management have not been adequately tackled by the research and planning machinery in the United Arab Emirates so far. However, some useful work on land degradation has been carried out at Digdaga Agricultural Research Station of the Federal Ministry of Agriculture and the Al Ain Agriculture Research Station of Abu Dhabi emirate.

The Federal Ministry of Agriculture are at present putting up their new Agricultural Research Institute and Laboratories near Al Ain. They are expected to be provided with qualified research staff and equipment in the near future. This organization could be an appropriate body to undertake research among other things on major ecological problems facing the United Arab Emirates. This work could also be undertaken by the faculty of Biological Sciences and the newly established faculty of Agriculture at the Emirates University, Al Ain. Technical assistance from the UNESCO, the ECWA or the FAO for these wide ranging studies would be worthwhile and useful.

I. ACCOUNT OF SOME TRADITIONAL RESOURCE CONSERVATION STRUCTURES AND TECHNIQUES

1. **Seasonal grazing by nomadic graziers.** A variety of range lands exist in the Emirates. The vast range lands of Bainuna, Al Dhafra, Al Khatum and Al Hamrah cannot provide grazing and browsing for the livestock all the year round. And on account of the extensive variability of rainfall both in time and space, good grazing in the vast arid range lands may be available only at certain places. These range lands are, therefore, used according to the forage available in them

since times immemorial. The seasonal grazing of arid range lands can be practised more extensively now as the drinking water required for human beings and livestock can be easily transported by water tankers even to the far flung areas in the interior of the desert.

2. **Provision of supplemental feed.** Throughout the Emirates, supplemental feed has to be provided to the range fed livestock. Roughages in the form of dried and baled grass are imported from Oman and Iran and fed to the livestock. Similarly, concentrates like dates, dried fish, wheat bran etc., and manufactured cattle feeds are also used for supplemental feed.

Green fodder, raised in the farming lots consisting of 'Jat' (lucerne), 'shair' (barley), 'zahar' (sorghum), 'Saiblu' (millet) and fodder bushes like '*Artiplex nummularia*, *A. Canescens* and *A. halimus* is also fed to the livestock.

The provision of supplemental feed to the livestock practised since ancient times helps in reducing pressure on the range lands. The graziers can and do utilize the livestock subsidy given to them in the emirate of Abu Dhabi for the purchase of supplemental feed.

J. CONCLUDING REMARKS

As a result of the above given general survey and review of the present state of desertification control in the United Arab Emirates, it is suggested that action may be considered on the following proposals in order to combat desertification more effectively in the future. The proposals are briefly listed and discussed below:

1. **Survey, demarcation and mapping of natural resources.** This is necessary to know the precise situation and condition of the still surviving forests, and degraded range lands and any wildlife in them. This information is lacking at present. The use of satellite images, aerial photographs followed by ground surveys would be needed to accomplish this task.

All the existing natural resources should be surveyed, demarcated on the ground and mapped for their proper conservation, development and scientific management.

2. **Ecological studies and surveys.** These are necessary to devise and plan suitable conservation and management techniques for the natural resources of the United Arab Emirates. The Emirates University at Al Ain and the planned Agricultural Research Institute of the Federal Ministry of Agriculture could collaborate in these studies and surveys.

The Botany Department of the University may prepare and publish a

flora for the United Arab Emirates.

3. Detailed study of national and regional underground aquifers. Some useful work has already been done in this respect and more climatological and hydrological data are being collected for the whole of United Arab Emirates by the Federal Ministry of Agriculture. This data will be useful for the detailed studies of the national ground water aquifers. For the study of regional aquifers collaboration would be needed with Saudi Arabia and the Sultanate of Oman. The ECWA could probably help in organizing and conducting the regional studies.

4. Study and selection of suitable ecotypes and varieties of tree species and agricultural crops. For this both the indigenous flora and exotic foreign species and varieties would require to be studied. Already a large number of exotic plant species and varieties of crops have been introduced and are being cultivated at present. More attention needs to be given to the local plant material which has adjusted and adopted itself to the local environment through the ages.

It would also be worthwhile to import superior plant types and varieties from similar ecological areas in various parts of the world and try them under the United Arab Emirates conditions. This wealth of plant material could ultimately be utilized for future plant breeding work when it is undertaken in the United Arab Emirates.