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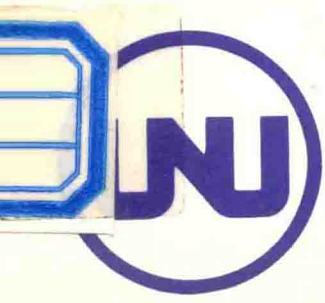
Social and Environmental Aspects of Desertification

International Geographical Union—
The United Nations University

Edited by J.A. Mabbutt and
Andrew W. Wilson



THE UNITED NATIONS UNIVERSITY

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SOCIAL AND ENVIRONMENTAL ASPECTS OF DESERTIFICATION

Proceedings of an Inter-Congress Meeting of the International Geographical Union Working Group on Desertification in and around Arid Lands, held in conjunction with the Arid Lands Sub-programme of the United Nations University Natural Resources Programme, and the UNESCO/MAB Programme. 3–8 January 1979.
Tuscon, Arizona, USA.

Edited by J.A. Mabbutt and Andrew W. Wilson

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To the University of Arizona for hosting the meeting, particularly to the President, Dr. John Schaefer, for opening the proceedings, and to the Dean of the College of Business and Public Administration, Dr. Rene Manes, and the Head of the Department of Geography and Regional Development, Dr. Richard W. Reeves, for their sponsorship.

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To the many faculty members of the University of Arizona who gave their time to participate in the meeting and its excursions. Several members of the university participated in the local panel discussions and in the reporting session on related MAB activities. We are particularly indebted to the guidance of Dr. Thomas W. Maddock Jr. on the post-meeting excursion, to Dr. Carl N. Hodges and his associates at the Environmental Research Laboratory, Tucson, and to many others who helped with local excursions and who are mentioned in the text.

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Financial grants towards the cost of the meeting and its excursions, and towards the fares and the expenses of participants, were received from UNESCO under the MAB Programme, from the International Geographical Union, and from the United Nations University. Without this assistance the meeting could not have been held and its essential international attendance would not have been achieved.

Funds have also been made available by UNESCO and the United Nations University towards the cost of editing and publishing these proceedings in the United Nations University Natural Resources Series.

With my co-editor, Andrew W. Wilson, I acknowledge warmly the support of the University of New South Wales in the compilation of the report, and in particular the assistance of Simon Berkowicz and Diana Bryers of the School of Geography at all stages in the preparation and editing of the materials.

J.A. Mabbutt
Chairman
IGU Working Group on Desertification
in and around Arid Lands
Project Co-ordinator, United Nations
University Arid Lands Sub-programme
December 1979

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INTRODUCTION

The Inter-Congress Meeting of the International Geographical Union Working Group on Desertification in and around Arid Lands, held at Tucson, Arizona, from 3 to 8 January 1979, was attended by 30 participants from 13 countries. It provided an occasion for reporting on research by members of the Working Group, and also for discussion on activities in connection with the forthcoming International Geographical Congress.

It was also a joint meeting with the Arid Lands Sub-programme of the United Nations University Natural Resources Programme, with its theme "Assessment of the Application of Knowledge to Arid Lands Problems," and provided an opportunity for introductory reporting by several investigators. It was felt that such reporting, even though brief, was useful because it would make others aware of what was being done, especially in regard to the socio-economic aspects of arid lands management. The role played by human factors is central to the work being done in the UNU Arid Lands Sub-programme, concerned as it is with the effective application of existing knowledge.

Related activities of Projects 3, 4 and 8 of the Man and Biosphere Programme were represented by reports by members of the relevant US MAB Committees.

The activities of the Working Group since 1972 have proved most relevant to United Nations activities in combating desertification, and it was appropriate that the Desertification Group of the United Nations Environmental Programme was represented.

At many points the participants were made aware of regional problems of land use and the management of natural resources in relation to the threat of desertification in the southwestern USA. This awareness was achieved through special sessions and panel discussions by local scientists, and was particularly the objective of excursions held during and after the meeting.

The international exchange of ideas, combined with the regional experience, proved most stimulating to all participants and should greatly benefit the continuing activities of the Working Group and its presentations to the 24th International Geographical Congress in Tokyo in August and September 1980.

1. TUCSON—THE CITY AND THE DESERT

At an introductory evening session, members of the Department of Geography of the University of Arizona described the physical setting of Tucson, the growth of the settlement and the changing attitudes of the inhabitants to their desert environment.

Development of Tucson: Andrew W. Wilson

The Spanish walled *presidio* of Tucson was founded in 1775 on the east bank of the Santa Cruz River near the site of several American Indian villages of the Sobaipuri tribe, which are now merged into the more numerous Papago. The name Tucson comes from the village San Cosme del Tucson and is derived from two native words: *schuk* or "black" and *son* or "talus," and refers to the black volcanic talus slopes of Sentinel Peak ("A" Mountain), at the foot of which the village was located.

Set in a structural basin at about 760 m elevation, Tucson is surrounded by mountains which attain 2800 m on three sides, but which are much lower on the west (Fig. 1). The higher mountains are granitic, but those west of the city contain many volcanic rocks. The coalesced alluvial fans that fill the down-faulted basin are derived largely from the high surrounding mountains, and the basin fill attains thicknesses of 900 or 1000 m.

The Tucson Basin is drained by the Santa Cruz River which enters at its southwest corner and exits to the northwest, passing close to the foot of pediments of the Tucson Mountains west of the city centre. Until a century ago the river was perennial and contained fish. It was used to run a water-powered grain mill south of the city from about 1860 to 1880. With the pumping of groundwater, the cutting of galeria forest south of Tucson and intensive grazing on the surrounding slopes, all around 1880, the watertable began to fall and the river became intermittent, as it is today.

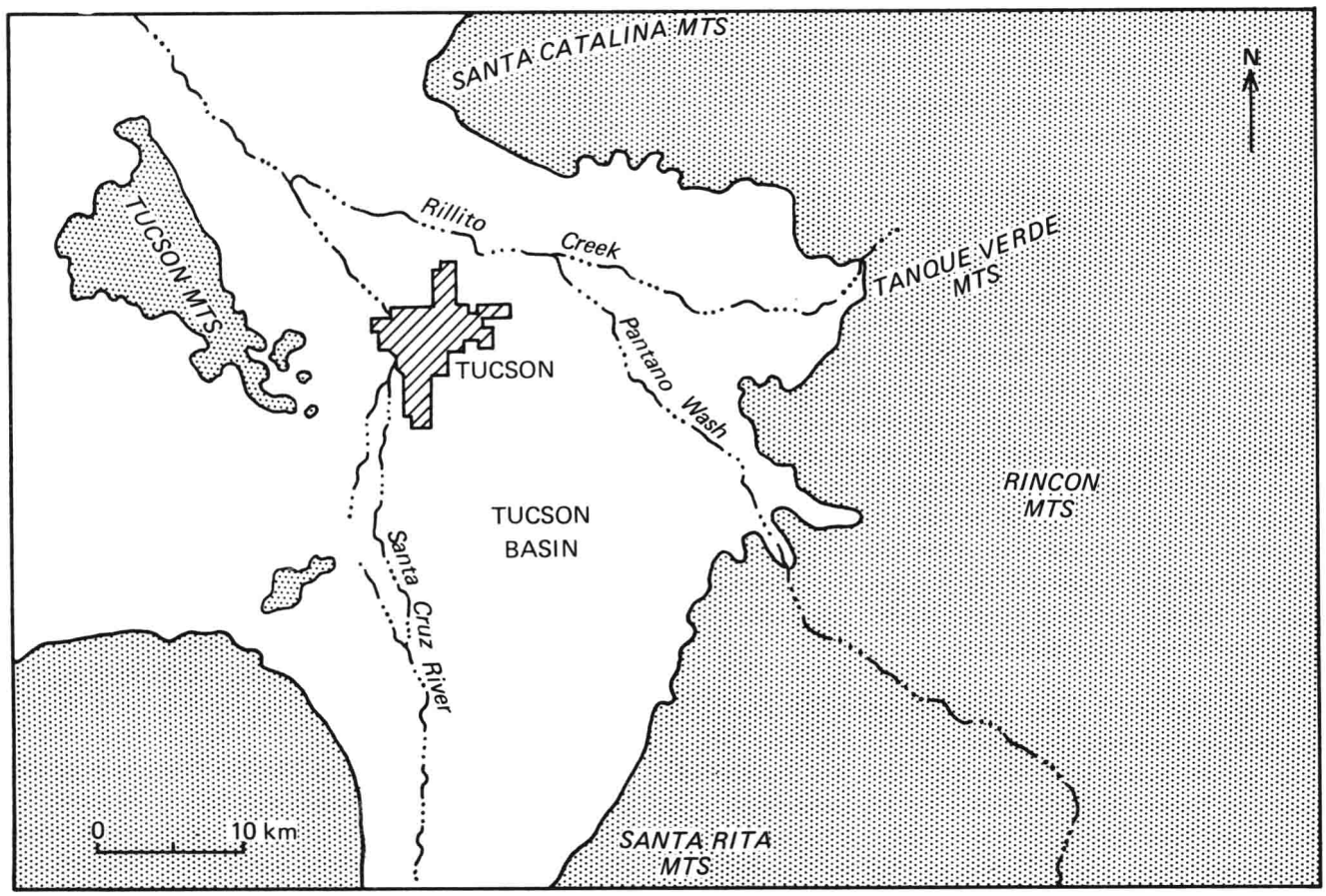

Fig. 1. Tucson and its physical setting (land above 900 m shaded)

More than 100 years of climatic records for Tucson show that extreme temperatures have ranged from −14°C to 45°C, that frosts occur every year, and that relative humidities are very low (less than 10 per cent) when temperatures are high. Precipitation comes in a winter and in a summer rainy season, and autumn and spring are dry. Mean annual precipitation is 292 mm, including 25 mm of snow, with 43 per cent falling in the cooler six months and 57 per cent in the warmer half of the year. As one goes west from Tucson, precipitation decreases and winter precipitation becomes relatively more important, whilst eastwards from Tucson the reverse is found.

Vegetation around Tucson is mostly desert shrubland, but as one ascends the mountain slopes one finds Pinon pine with more grassland, followed at higher and moister elevations by Ponderosa pine, Douglas fir and, finally, subarctic conifers. Vegetation on the slopes south of Tucson has changed in the last century, from desert bunch grassland to mesquite scrub. The cause is in dispute, but the change is in effect an example of desertification.

Groundwater is available at 5 m depth along stream channels with high rates of infiltration, but is regionally much deeper (usually below 100 m) and watertables are falling. Groundwater presently being used has been dated to several thousand years before the present. Large amounts of groundwater still remain to depths as great as 500 m, enough to supply the city for a century, but pumping leads to surface subsidence and damage to buildings and has been restricted in built-up areas.

In its early years Tucson was an agricultural community and a supply base for ranchers and miners. In the early nineteenth century the Mexican Revolution freed the area from Spanish control and in 1848 the United States annexed the area north of the Gila River. In 1853 the United States bought the southern part of Arizona in the Gadsden Purchase to provide a low-level rail route eastwards from southern California. The railroad from Los Angeles reached Tucson in 1880 and continued eastwards. This led to a great increase in cattle grazing, which was one cause of the change in vegetation mentioned earlier. Mining also became of considerable relative importance in the following years and Tucson served as a supply and shipping point for miners and ranchers. The population of Tucson in 1900 was 7,500, while Pima County totalled 14,700.

In the first half of this century the economy of Arizona was popularly characterized as consisting of the "four Cs": cattle, copper, cotton and climate (tourism), and this applied equally to Tucson. By 1940 Tucson had a population of 35,750, and Pima County, of which Tucson is the county seat of government, one of 72,838. In 1950 the population of Tucson had increased to 45,500 and Pima County had 141,200 residents, with manufacturing increasing and US governmental activities adding to the economy. In 1979 Tucson had about 325,000 citizens and the population of Pima County had reached half a million. Government at all levels is the major employer (26 per cent), trade follows (23 per cent), then services (21 per cent), manufacturing (9 per cent), construction (8 per cent), mining (5 per cent), agriculture (1 per cent), and others (10 per cent). This indicates a very diverse and changing economic base, with manufacturing now being the most active growth element and mining and agriculture of relatively low importance.

In adapting a modern, technologically advanced city to a desert landscape, adjustments have not come easily. Although the desert environment has been the essential attraction for many of the new residents, they have been slow to give up folkways brought from the humid midwest and northeast of the United States. The midwestern small town with its single-family houses set in green lawns has been a model for many, and it is only in recent years that desert landscaping has become popular. This has been encouraged by recent large increases in water rates. Summer cooling of homes and buildings is another high cost, and better insulation is being adopted for homes and other buildings. Most homes in Tucson are cooled by the relatively cheap evaporative coolers, but in July and August these are only marginally acceptable; accordingly, refrigerated cooling has been increasing in spite of its expense, and now many homes have both systems.

Public Perception of the Desert in Tucson: Thomas F. Saarinen

Dr. Saarinen pointed out that perception of the desert environment is a necessary preliminary to perception of desertification, whence the relevance of his topic to the meeting. He traced the changing perception of the desert by the inhabitants of Tucson with a review of historical evidence and from results of recent social surveys.

As shown by the history of the Great Plains, a critical factor in bringing changed perception of a semi-arid environment by settlers from more humid regions is the dependency of their livelihood on local rainfall patterns, through a drought-induced learning process. However, in Tucson, a predominance of urban settlement from the early years and the relative importance of livelihoods less dependent on rainfall, such as mining and ranching, hindered this learning process.

Early settlers adopted Hispano-Mexican forms, such as thick-walled, flat-roofed adobe houses with high ceilings and breezeways and shaded interior courts, partly out of necessity and partly through cultural assimilation. However, later-arriving Anglos brought with them their eastern image of what a city should be and, as opportunity allowed, imported

the trappings of their former lifestyles in humid environments. The desert was alien and ugly to them, since it differed from their ideal of the pastoral English landscape with ploughed fields and village skylines. The "frontier" was seen as a challenge to the creation of these ideal landscapes.

First attempts to attract tourists in the post-railroad period from 1870 to 1880 were based on the attraction of large resort hotels in the Eastern mould, and the visitors gained little appreciation of the land or people of the West.

A change in the attitude towards the desert began in the 1890s, as the pioneer phase receded into the past, but it was very slow to gain general acceptance. Among the innovators were anthropologists and prehistorians who tended to romanticize the Southwest Indian. Artists and writers were also attracted, and desert country motifs began to gain acceptance at the turn of the century as Indian crafts became appreciated and mission architecture became popular. The dude ranch movement in the 1920s was another expression of changing attitudes.

It was not until the 1950s, however, that the grass-lawn tradition was seriously challenged, as newcomers began to see the desert as a weekend playground rather than a hostile environment. Desert shrubs and stone began to be used in landscaping, and by the mid-1970s half the homes in Tucson had adopted this style. It had taken a century for a positive approval of the desert landscape to become apparent, although there was an earlier appreciation of the advantage of the sunny desert climate, as aridity came to be seen as an asset rather than a problem by the urban settler.

Surveys indicate a continuing high awareness of the climatic amenities through the 1970s and also a growing appreciation of the problem of falling watertables, perhaps the primary symptom of desertification in Tucson. A 1970 survey showed that the climate was the major advantage perceived by Tucson residents, while the desert appeared as an advantage in only 1 per cent of the sample interviews (Table 1). At that time less than half those interviewed perceived the problem of a falling watertable as serious, and there was even less awareness of other symptoms of desertification such as deteriorating rangelands, soil erosion and arroyo cutting.

A replication of the survey in 1977 revealed an increasing awareness of problems associated with desertification, for by then a majority of the sample considered a falling watertable as a very or somewhat serious problem, and there was a growing awareness of other related environmental problems as shown by the responses. The interesting thing is the recency of this development, perhaps part of the growing national awareness of environmental problems, aided by media attention, rather than an independent local development.

In conclusion, Dr. Saarinen stressed a growing awareness and appreciation of the desert environment, a shift towards desert landscaping and a growing public perception of the seriousness of problems associated with desertification, but noted that the most striking features of these developments are the slowness with which they took place and the strong influence of national norms on the inhabitants of this southwestern desert region.

Table 1: Perception by Tucson Residents in 1970 and 1977 of Problems Associated with Desertification

	Very and Somewhat Serious (%)			Not Serious (%)		Don't Know (%)	
Problem	1970	1977	1970-77 (% change)	1970	1977	1970	1977
Falling Watertable	46	58	+12	18	23	36	20
Deteriorating Grassland	30	41	+11	23	30	47	30
Soil Erosion	31	41	+10	31	36	38	23
Arroyo Cutting	26	35	+ 9	31	46	43	26

2. REGIONAL REPORTS ON DESERTIFICATION

Sahelian Zone

This was an area of critical interest for the United Nations Desertification Conference held in Nairobi in 1977. H. Mensching described studies of desertification in several parts of the region by geographers of Hamburg University. In Darfur Province, Sudan, Ibrahim has shown that 15 per cent of the north and central parts have been severely desertified, notably in the cultivated Goz belt and in the closely settled Dar Zaghawa area, whilst 30 per cent is moderately affected. The areas most vulnerable to desertification are the grazing lands with scattered millet cultivation in the north, and overgrazing is particularly marked in areas of Nubian sandstone, where permanent waters allow year-round stocking. In Upper Volta, Krings has demonstrated that desertification is associated with an increased agricultural use of the fixed dunes since 1955, at the expense of nomadic pasturing, in the zone of contact between sedentary and nomadic groups. A marked extension of cultivation followed the emancipation of the Iklan farmers from their former Tuareg masters and the rapid growth of population in the area, which has resulted in a shortening of fallow-cropping rotations. The seasonal use of pastures by pastoral nomads has also given place to permanent pasturing. In northern Niger, Taubert has studied the relationship between desertification and the growth of settlements and mobility of the population in Tahoua and Agadez provinces, particularly near the northern limit of millet cultivation, where cropping has also extended in defiance of regulation. Desertification here is linked with a growing seasonal emigration of the labour force, which acts as a safety factor in maintaining the economic balance of the region. These field studies have recently been completed and will shortly be published.

Monique Mainguet reported briefly on a wide range of Sahelian studies relevant to desertification by French physical geographers, including evidence of the chronology of pluvial and arid periods, the history of closed basins and their lakes, and the record of desert palaeosols.

A.T. Grove summarized English-language literature on desertification in the Sahel since 1976, much of it stimulated by the UN Conference on Desertification. Problems of long- and short-term climatic change have been covered in a number of publications, but one question which remains unresolved is whether the recent Sahelian drought was part of a continuing regime or whether it marks the onset of a significant climatic variation. Katz and Glantz have drawn attention to the tendency of decision-makers to underestimate the likelihood of recurrent drought in the Sahel and similar regions.

Grove cited a number of studies on population growth, increase in the numbers of cattle and its ecological effects, and resultant stresses between pastoralists and agriculturists. Overstocking, which has been linked with improved water supplies and veterinary services, now threatens the environmental balance and calls for solutions through social and economic changes: for example, the provision of alternative investment opportunities outside the pastoral sector and the reinforcement of the rights of individual groups to grazing in particular areas. A recent study of the Guidimaha region of Mauritania recommends that collective organizations should be encouraged amongst the villagers to make better use of water, to introduce new tools and varieties of crops and to produce fodder and improve livestock.

Southern Africa

P.D. Tyson reported on an extensive unpublished report on desertification in southern Africa by J.R.N. Wilcox in 1977. This dissertation shows that no factor has acted singly to cause desert encroachment. Periodic dry spells are the main natural cause, but anthropological factors are more important, notably overstocking into dry periods and the failure to allow impoverished veld vegetation to recover when rainfall increases before again restocking. The consequences have been an elimination of the climax vegetation, increased bare ground and run-off, and accelerated soil erosion, constituting progressive environmental deterioration.

Middle East

P.Beaumont gave an account of desertification in the Isfahan Basin of Iran, based on studies carried out in conjunction with staff of the Department of Geography at the University of Isfahan. The main water source is the snow-fed Zayandeh River, on which the Shah Abbas Dam was constructed in the mid-1960s. This has diminished flood damage and has provided hydroelectric power for regional industrial development, but has unfortunately resulted in an extension of secondary salinization in the lower part of the Basin, which depended on spring floods to leach the soils of accumulated salts.

The survey revealed several areas of rural depopulation, abandoned villages and loss of cultivated land. A major cause has been the attraction of relatively high urban wages, leading to the departure of younger men and a shortage of agricultural labour. An associated factor has been falling watertables and the drying out of several of the qanat systems serving the irrigation schemes. This is attributed to increasing cultivation and the sinking of wells in feeder upland basins over the past two decades, and also to increased pumping of shallow aquifers in the upper sector of the main alluvial fan.

I. Kobori presented a case study on Taibe village in the Palmyra Basin of Syria. This is part of a comparative study of oases dependent on foggara (qanat) supplies in the Old World, which will include investigations of Algerian oases. Extensive desertification around Taibe Oasis was not found, but some problems of falling watertables, accumulation of sands in nebkhas, sedentarization of nomads, and abandonment of ancient canals were reported.

North America

Andrew W. Wilson commented briefly on desertification in the arid southwestern United States, emphasizing that only a minority of the population is concerned with desertification because economic and social adjustment to the local environment is for the most part not dependent on the quality of the land. The cattle ranchers, and to a lesser degree the irrigation farmers, are dependent on rainfall, but the bulk of the population prefers drought as providing more pleasant living conditions. This attitude will persist at least until domestic water supplies are affected, some time in the next century or beyond.

Latin America

H.J. Schneider reported growing public concern over environmental deterioration in Latin America, including desertification, following the Nairobi Conference. Expressions of this include the preparation of a co-ordinated national plan to combat desertification in Mexico, supported by regional development projects in soil conservation and ecosystem management, an integrated research programme in semi-arid Chile, and the establishment of research priorities and regional developmental methodologies in several Latin American countries.

Australia

J.A. Mabbutt reported some stabilization of conditions in the extensive rangelands following initial degradation in many areas. This has notably followed governmental measures limiting stocking levels and assisting the creation of leases of adequate size for economic operation in the face of rising costs. His review stressed the lack of quantitative evidence of long-term trends in range condition but noted concern at the lack of regeneration of many perennial pasture communities in the south of the arid zone under the impact of the introduced rabbit.

In the dry-farming lands, physical and economic conditions have improved with the introduction of longer rotations in mixed farming systems and the retreat of cropping from some marginal areas. However, a recent survey indicates that 20,000 ha require urgent treatment to combat wind erosion and that about 450,000 ha need constant surveillance, since a combination of drought and deteriorating economic conditions could lead to a resurgence of erosion. A widespread, although localized, problem in many dry-farming areas is secondary salinization resulting from the clearing of deep-rooted perennial vegetation for cropping.

About 250,000 ha of irrigated lands, mainly in the Murray Valley, are adversely affected by waterlogging and secondary salinization. A major regional problem here is the disposal of saline drainage and pumping effluent and the associated control of salinity levels in the lower Murray River, which is also subject to influent seepage of saline groundwater. The interests of three states are involved, and the federal government has recently reconstituted and strengthened the Murray River Commission in the interests of co-ordinated river management.

Desertification arising from non-agricultural activities, such as mining and tourism and the associated settlements and constructions, differs in being localized. The fact that it is linked with capital-intensive enterprises makes mechanical remedial measures more feasible, whilst a growing concern for environmental conservation among the population outside the arid zone is enforcing action by mining companies and others in the interests of public relations. So far there has been little consideration of the social and economic impacts of these activities on existing communities such as aboriginal settlements or those of European pastoralists.

India

Mr. S.P. Malhotra of the Central Arid Zone Research Institute (CAZRI), Jodhpur, described studies on desertification and on measures to combat it in Rajasthan. Problems of increasing human and animal pressure on the land and concurrent declining productivity have increasingly engaged research at the Institute over the past years. The Institute was centrally involved in India's representation at the Nairobi Conference on Desertification, having authored the Indian Case Study on Desertification of the Luni Block, Rajasthan. Mr. Malhotra noted that Dr. M.S.

Swaminathan, Director-General of the Indian Council of Agriculture, was elected Chairman of the Committee of the Whole at Nairobi.

Emphasis is on a multidisciplinary approach, involving physical, biological and social scientists, with increasing stress on extension and training, particularly through Operational Research Projects. Significant progress has been achieved in projects on Arid Land Management and on Drip and Sprinkler Irrigation as Related to Desertification.

Reference was made to a research project on Social Aspects of Desertification in collaboration with the United Nations Research Institute for Social Development (UNRISD). Fieldwork on this project is almost complete and a report is expected late in 1979. Rajasthan was one of the field areas chosen by the Science Associations' Nairobi Seminar to test the application of indicators for monitoring desertification, again in the area of the Luni Block.

CAZRI was to have been involved in the Southwest Asian Transnational Project on Monitoring Desertification under the UNEP Plan of Action, in which India was to collaborate with Iran, Pakistan and Afghanistan, but this has not yet got under way and may be initiated only on a national basis.

Other activities noted by Mr. Malhotra were the holding at Jodhpur of the International Symposium on Arid Zone Research and Development in January 1978, and the Post-Plenary Session of the International Association of Archaeological and Ethnological Sciences, on Anthropology and Desertification, in December 1978.

3. REPORTS OF THEMATIC STUDY GROUPS

Study Group on Climate and Desertification

Leader: Professor P.D. Tyson

The members of this study group are:

Dr. T.G.J. Dyer	University of the Witwatersrand, Johannesburg, South Africa.
Dr. M.H. Glantz	National Center for Atmospheric Research, Boulder, Colorado, USA.
Mr. A.T. Grove	University of Cambridge, England.
Mr. D. Lee	Commonwealth Bureau of Meteorology, Melbourne, Australia.
Professor D. Sharon	Hebrew University of Jerusalem, Israel.
Professor H. Suzuki	University of Tokyo, Japan.
Professor P.D. Tyson	University of the Witwatersrand, Johannesburg, South Africa.

The study group was formed in 1976 following the Ashkhabad meeting of the Working Group. The intention was to encourage research of various kinds relating to the general theme of climate and desertification (including semi-arid areas). The meteorological and climatological framework into which the individual studies fall has been well developed by Hare in his background review on Climate and Desertification presented to the United Nations Conference on Desertification in Nairobi in 1977.

The work of the study group covers a wide field of interests including Quaternary lake-level fluctuations, coastal upwelling and deserts, the nature of desert rainfall, synchronization of desertification in the world, estimation of the likelihood of extended drought conditions in southern Africa, climate and crop yields in semi-arid regions and monitoring rainfall deficiencies in semi-arid regions.

The projects are as follows: -

Quaternary Lake Level Fluctuations: A.T. Grove
In a paper in 1976 on late Quaternary lake level fluctuations in Africa, Street and Grove showed how much of Africa has experienced quasi-synchronous changes in lake levels over the last 30,000 years. This work is being extended to include global lake levels in the Late Quaternary.

Coastal Deserts: M.H. Glantz
Research is being conducted on coastal upwelling of cold water and its influence on coastal deserts along with desertification.

Desert Rainfall Patterns: D. Sharon
Two main investigations have been conducted. The first is concerned with the analysis of daily rainfall in a desert area and the determination of localized rainfall distribution or spottiness. The second is concerned with the mesoscale structure and life history of Negev storms.

World Patterns of Desertification: H. Suzuki
The question of synchronization of desertification is being considered. The extent to which the less advanced northward extension of the Equatorial Westerlies during the 1968 to 1973 period has had world-wide repercussions is under examination.

The Likelihood of Extended Droughts in the 1980s in Southern Africa: P.D. Tyson
Maps to show the temporal and spatial variation of rainfall over the sub-continent from the mid-nineteenth century onwards have been prepared. The use of a simple model suggests that the decade from 1983 onwards may be one in which about seven to ten years will be drier than average.

Monitoring Rainfall Deficiencies: D. Lee
In this study the decile values of rainfall are used to provide the basis of quasi-forecasts of the probability that areas will be deficient in rainfall for specific periods.

Crop Yields and Climate: T.G.J. Dyer
Linear multiple regression models in which combinations of mid-season rainfall and temperature are taken as predictor variables are being formulated and used to predict end-season crop yields. Preliminary results suggest a surprisingly high proportion of crop-yield variance can be accounted for in this way.

The research findings of individuals in the study group have been presented at national and international conferences, and more than a dozen papers have been published in scientific journals.

Study Group on the Perception of Desertification

Leader: Dr. R.L. Heathcote

The members of this study group are:

Mr. M. Butler	Adelaide College of Advanced Education, Adelaide, South Australia.
Dr. R.L. Heathcote	Flinders University of South Australia, Adelaide, South Australia.
Mr. S.P. Malhotra	Central Arid Zone Research Institute, Jodhpur, India.
Professor T.F. Saarinen	Department of Geography, Regional Development & Urban Planning, University of Arizona, Tucson, USA.
Mr. M.U.A. Tennakoon	Central Bank of Sri Lanka, Colombo, Sri Lanka.

Since much of the work of this study group has been in the form of studies commissioned under the Natural Resources Programme of the United Nations University, and in view of the fact that work by other members is reported elsewhere in this publication, the main report of the study group is included in the United Nations University Session.

Study Group on Pastoralism and Desertification

Leader: Dr. Douglas L. Johnson

The members of this study group are:

Dr. E. Bernus	ORSTOM, Paris, France.
Dr. J.S. Birks	University of Durham, England.
Dr. D. Campbell	University of Nairobi, Kenya.
Dr. D. Chatty	University of Damascus, Syria.
Professor R.J Harrison Church	London School of Economics, England.
Dr. W. Fricke	Heidelberg University, Federal Republic of Germany
Dr. D.L. Johnson	Clark University, Worcester, USA.
Dr. M.M. Khogali	University of Khartoum, Sudan.
Dr. A. Schmueli	Tel Aviv University, Israel.
Professor B.W. Spooner	University of Pennsylvania, Philadelphia, USA.

Dr. Johnson reported that the focus of this study group was the response of traditional pastoral nomadic systems to change and the implications of this response for desertification processes. Several recent studies emphasized the ability of traditional pastoralists to assess the carrying capacity of grass and water at their disposal and maintain rotational grazing that avoids environmental deterioration. Whilst some of this balance may have been an inadvertent by-product of pastoral nomadic mobility, the result has been a dynamic equilibrium in most drylands until the early twentieth century. Even in terms of off-take rates from traditional rangelands, the record has been one of considerable productivity.

There seems little doubt that the picture of traditional rangeland users as rational and productive exploiters of dryland resources is well-founded. However, the systems that are adaptive under one set of socio-economic circumstances may be less successful when conditions change. Herein lies the current focus of the study group's investigation, which has concentrated on two types of adaptation to change:

(1) situations where livelihoods change and population concentration occurs, and
(2) instances where dispersed resource-use strategies are maintained.

In the first case, pastoral nomads are increasingly responding to change by opting out of the nomadic way of life through sedentarization or by introducing technology in ways that encourage local concentrations of people and flocks. In both instances the result is excessive pressure on local environments, leading to accelerated environmental degradation. Characteristically, the sedentarization of nomadic groups leads to rings of deteriorated vegetation close to the settlement, as fuelwood collection increases and grazing pressure is locally intensified. In other instances, introduction of concentrated inputs such as wells results in serious local disruption when land-use control mechanisms are not introduced simultaneously.

Two types of change affect pastoralists attempting to retain a dispersed and mobile pattern of land use. The expansion of dry-farm agriculturists, the conversion of dry-season pasture to alternative land uses, and the loss of control over open rangeland as a result of nationalization and the collapse of traditional tribal authority, have put traditional nomadic communities under significant stress. All of these processes have one common feature: they remove critical resources from traditional patterns of use and control. The amount of land alienated to alternative use is less important than its critical role within the traditional pastoral system. The alternative land-use systems and development projects may be productive in at least the short term, but the adverse social and environmental consequences are frequently experienced in pastoral areas and populations far removed from project boundaries.

The second type of change concentrates on using traditional pastoral systems as the basis for new rangeland development. Few examples of this type of concern have yet come to light, although Syrian pastoral co-operatives offer some indication of movement in this direction. By restoring local control over rangeland resources and retaining modified mobility patterns, some of the worst aspects of rangeland deterioration can be avoided and desertification potentially reversed.

The projects are as follows:-

Sedentarization and Desertification: A. Schmueli
Dr. Schmueli has studied Bedouin sedentarization in the Judaean Desert for the last 20 years and has more recently investigated the relationships between sedentarization and desertification in the Sinai and Negev deserts.

Migrant Studies: J.S. Birks
Previous investigations focused on migrants to Mecca in the Sahelian-Sudanic zone and socio-economic change among pastoralists in Oman. His current activity is participation in the International Migration Project which is examining labour migration in the Persian Gulf.

Pastoral Adaption to Modern Market Systems: D. Chatty
After initial studies in the Bika Valley, Lebanon, including transportation technology, Dr. Chatty has begun an investigation of pastoralism in northern Syria, as well as the development of pastoral co-operatives in the Homs-Hama area.

Resource Competition between Pastoralists and Sedentary Farmers: D. Campbell
Dr. Campbell is presently examining competition between the Masai and adjacent agriculturalists. Response of pastoral nomads to drought in Maradi, Niger, from 1968 to 1973 was the focus of an earlier study.

Pastoral Development and Drought in Northern Nigeria: W. Fricke
The final report of this investigation is about to be published.

Nomadic Pastoralism and Desertification: M.M. Khogali and E. Bernus
Dr. Khogali is involved with the Swansea-Khartoum Research Project which includes a pastoral component as well as a more general examination of this theme in the Sudan.

Dr. Bernus is carrying out a study in the Tuareg area of Niger.

Sahelian Drought Recovery: J. Sutter
Dr. Sutter has worked for three years on a pastoral development project in Niger concentrating particularly on nomadic recovery and also on changing terms of trade between nomadic and settled populations.

Well Development: R.J. Harrison Church
Dr. Harrison Church is examining well development policy in West Africa.

Study Group on Desertification in Extremely Arid Environments

Leader: Professor Wolfgang Meckelein

The members of this study group are:

Dr. W. Achtnich	University of Hohenheim, Federal Republic of Germany.
Dr. J.W. Allan	University of London, England.
Professor E. Ehlers	University of Marburg, Federal Republic of Germany.
Mr. O.A.H. Ghonaim	University of Alexandria, Egypt.
Professor I. Kobori	University of Tokyo, Japan.
Professor W. Meckelein	University of Stuttgart, Federal Republic of Germany.
Mr. C. Nesson	University of Bordeaux, France.
Professor W. Ritter	University of Regensburg, Austria.
Dr. E. Wehmeier	University of Stuttgart, Federal Republic of Germany.

Until recently, attention has been given almost exclusively to desertification problems in the marginal zones of arid lands, yet desertification has been increasingly reported from within the deserts proper; that is from the extremely arid areas. Deterioration or shrinkage and abandonment of the cultivated areas have been observed in isolated small and large oases and across oasis regions. The reasons for this are manifold and relate to the field of physical geography as well as that of social and economic geography.

To limit the scope of the work and objectives of the study group, it was recommended that research should mainly concentrate on relationships between desertification within oases and utilization of water resources. It was considered that, eventually, another item might be the threat caused by shifting sand. Problems of water supply may be connected for example with natural or artificial lowering of the groundwater table, but a surplus of water may also have

disastrous effects, causing a rise in the groundwater table and a salinity hazard in the soils.

Such phenomena of desertification are increasing and have contributed to a profound crisis of oases, most evident in the deserts of North Africa and the Middle East. A detailed analysis of causes and effects of desertification within oases is therefore extremely important. In North Africa alone, more than two million oasis dwellers are affected, not to speak of the 38 million Egyptians in the Nile Valley oasis and 500,000 nomads in the Sahara desert who are also dependent on oases. These figures underline the importance of the work in progress, which is significant because it has a direct bearing not only on the oases themselves but also on the utilization of resources in the surrounding extremely arid areas. A number of case-studies have been initiated to tackle the problems mentioned above. They have been carefully selected according to the following criteria:

- first, all the important countries affected should be represented;
- second, the case-studies should cover as many different aspects as possible. Both human and natural aspects of desertification have been examined.

The projects are as follows:

ALGERIA

Desertification in the Oasis Regions of Gourara and Touat, with Special Reference to Water Storage and to Water Salinization, and also to Problems of Moving Sand: Wolfgang Meckelein, in collaboration with Mrs. A. Kirchner
Field studies were carried out in the spring of 1978. Water samples were brought to Stuttgart and analyzed there. It appears that soil salinization is favoured not by water shortage but by bad irrigation and drainage techniques. In the area of Gourara, moving sands are also causing the abandonment of cultivated land. Here the formation of dunes close to the oases seems to be induced by man himself, in that artificial obstacles designed to protect against shifting sand lead to the formation of larger dunes which then endanger the oases.

Desertification In and Around the Aoulef Oases: Iwao Kobori
The paper deals with the Tidikelt area, one of the older oasis regions in the Western Sahara. Professor Kobori has worked there intensively and has also published some of his results.

Desertification in the Oued Righ, Northeastern Algeria: Claude Nesson
A publication will give examples of desertification from the oases of Oued Righ. Areas will probably be mapped to show where desertification has occurred already and those in which the process is presently active. Relationships will be documented between the phenomena of desertification and the withdrawal of groundwater, resulting in important lowering of the groundwater table and in harmful physical and cultural consequences. As a contribution towards remedial programmes, this case-study will offer a deeper insight into the dangers inherent in certain kinds of human interference, and demonstrate the possibilities of preventing and solving such problems in new reclamation projects.

TUNISIA

Desertification Phenomena in the Northern Oases of the Nefzaoua Region, South Tunisia: E. Wehmeier
A detailed description and explanation of the present water situation in the area is given. Two generations of aerial photographs (1949, 1969), as well as two field trips (1975, 1977) and data from the Tunisian Service de l'Eau, have helped to establish deeper understanding of the connections between groundwater extraction and fluctuations in the irrigated area.

LIBYA

Changes in the Oases of Southern Libya: J.A. Allan
Data have been established on relationships between the development of water resources and the desertification processes in the west and east of southern Libya.

EGYPT

Surplus of Water as a Main Cause of Desertification in the Siwa Oases: O.A.H. Ghonaim
Field studies were carried out in 1974, 1976 and 1977. The results so far show that increasing salinization is caused by rising groundwater. The high groundwater level itself results from a number of newly drilled wells, the water of which is only partly used or not at all. On the other hand, the abandonment of peripheral irrigated lands frees formerly-used spring water, and this also contributed to the water surplus.

Desertification Phenomena in a New Desert Reclamation Project: Wolfgang Meckelein
This study aims to find out why this new desert reclamation project, established with modern techniques, suffers from soil salinization and moving sand. One publication on this project appeared in 1977.

SAUDI ARABIA

Did Arabian Oases Run Dry?: W. Ritter
A number of important oases in central and eastern Saudi Arabia owe their existence to fossil (?Pleistocene) groundwater issuing from karst springs. Observations in Ghatghat, Aflaj, Wadi Miyah, Yabrin and Bahrain show that during historical times there existed either higher-located aquifers and springs, or even higher-yielding ones than today. In some of these areas irrigation is practised today only by flooding, and deep wells need to be drilled. These observations are backed by aerial photographs which show remnants of settlements and fields, tells, qanats, and groups of