



UNITED NATIONS ENVIRONMENT PROGRAMME

# DESERTIFICATION CONTROL

Number 6. April 1982





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## CONTENTS

Message from the Executive Director		3
For Every Child a Tree		4
Editorial	Gaafar Karrar	5
Revegetation of the Indian Desert	H.S. Mann	6
Combating Desertification around Iran's Salt Desert	Ellen Tavakoli	10
Desertification Monitoring and Assessment within GEMS		14
Additional Measures to Finance the Plan of Action to Combat Desertification		20
Population Expansion and Desertification in Tanzania	Michael B. Kwesi Darkoh	26
Review of the Implementation of the Plan of Action to Combat Desertification		34
News from UNEP		48
News from Governments		53
Book Reviews		55

ISSN 0379 2455

Cover: Landsat false-colour image of northern Kenya showing the area around the southern portion of Lake Turkana and Mount Kulal.

## DESERTIFICATION CONTROL

is an international bulletin published at six-monthly intervals by the United Nations Environment Programme (UNEP) to disseminate information and knowledge on desertification problems and to present news on the programmes, activities and achievements in the implementation of the Plan of Action to Combat Desertification around the world.

- Articles published in *Desertifi-*

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*Desertification Control* is published in English and can be obtained free of charge from UNEP. Inquiries should be addressed to:

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- The United Nations Conference on Desertification (UNCOD) was held in Nairobi from 29 August to 9 September 1977.
- This was the first worldwide effort ever initiated to consider the global problem and responsibilities posed by the spreading deserts.
- 95 States, 50 United Nations offices and bodies, 8 intergovernmental organizations and 65 non-governmental organizations participated.
- The United Nations Conference on Desertification prepared and adopted a worldwide Plan of Action to Combat Desertification (PACD) with 28 specific recommendations.
- The Plan of Action was approved by the United Nations General Assembly at its 27th session on 19 December 1977.
- Recommendation 23 of the Plan of Action invited all relevant United Nations bodies to support, in their respective fields, international action to combat desertification and to make appropriate provisions and allocations in their programmes.
- Recommendation 27 gave the responsibility for following up and co-ordinating the implementation of the Plan of Action to the United

Nations Environment Programme (UNEP) with its Governing Council (GC) and Administrative Committee on Co-ordination (ACC).

- Immediately after approval of the Plan of Action, the Desertification Branch was established within the UNEP Office of the Environment Programme to serve the Executive Director and ACC in carrying out their tasks in the implementation of the Plan of Action.
- One of the main functions required by the Plan of Action from the Desertification Branch was to prepare, compile, edit and publish at six-monthly intervals a newsletter giving information on programmes, results and problems related to the combat against desertification around the world.

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## MESSAGE FROM THE EXECUTIVE DIRECTOR

*Desertification Control* is issued biannually within the framework of the functions entrusted by the General Assembly to UNEP in implementing the Plan of Action to Combat Desertification. It is a vehicle through which information and experience on desertification and its control are disseminated.

At the time of the Stockholm Conference, desertification was not recognized as one of the global environmental issues. The Stockholm Action Plan for the Human Environment contained no recommendation directed towards desertification. However, recommendation 20 deals with soil capabilities and degradation, and recommendation 69 deals with marginal lands; and both are closely related to desertification.

Now that UNEP is commemorating the tenth anniversary of the Stockholm Conference, it is natural that the information organ for desertification, one of the most serious environmental threats of our present world, should come out with a special issue on the occasion.

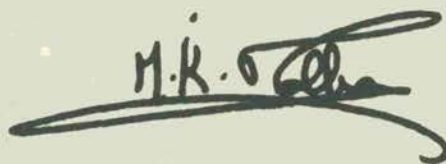
I am happy to note that this issue covers a variety of essential topics: scientific articles with a global geographical distribution, and full reporting on the implementation of the Plan of Action since the United Nations Conference on Desertification (1977), by UNEP, the rest of the United Nations system and intergovernmental and non-governmental organizations. In addition to the news of international activities during 1981, it brings news from several countries.

Stockholm (1972) focused global concern over the human environment in a declaration of principles and in an action plan to

guide national, regional and international action in order to save the environment for present and future generations through prudent conservation and rational use of resources, with a view towards sustained development. To what extent these goals relate to the cause of combating desertification is explicitly presented in the Plan of Action to Combat Desertification approved by UNCOD and endorsed by the General Assembly in 1977— five years after Stockholm.

We have learnt from experience that desertification— in short a substantive reduction of biological productivity— means less or no food supplies, depletion of the materials used for shelter, insecurity for the future, instability of society, with its traditions and values, and most seriously, it represents an imminent threat to the life-support systems of about 800 million people in some 65 countries.

The fight against desertification is to remedy these ailments and to protect and conserve the livelihood of people in the extensive territories in arid and semi-arid, and even sub-humid regions in the world. It is up to all of us, governments, international bodies and individuals to work together for this noble cause. This is our obligation towards present and future generations.



M. K. Tolba  
Executive Director  
United Nations Environment  
Programme



# For every child a tree

The United Nations Environment Programme has given priority to the problem of desertification in its commemoration activities which are marking the decennial anniversary of the birth of UNEP at the historic Stockholm conference in Sweden, in 1972. It has set as a specific goal the rekindling of public awareness of the need to protect the world's forests, to minimize the wanton destruction of trees and to catalyse reforestation projects world-wide.

While there are many ways to achieve this goal, one of the most satisfying is to involve children. Since it is the children of today who will shape and influence the world for future generations, UNEP has launched a youth-oriented project entitled "For Every Child a Tree".

One of the basic components of the project is designed to use children's libraries to expose the young to environmental issues and concerns. Nearly a dozen popular illustrators of children's books from around the world are creating posters on the

theme "For Every Child a Tree" which will be distributed to libraries world-wide. The libraries will display appropriate books, maps and exhibits and use the Librarians Guide to Ecology to encourage the circulation of books on nature, animals, conservation, and the environment.

Though the focus has been set on children, governments, non-governmental organizations, parents and social and civic groups are all being encouraged to become involved. The non-governmental organizations have circulated 25,000 folders to encourage funding of existing green belt movements.

A number of nations have pledged bilateral support during 1982 for the planting of trees in third world countries plagued with diminishing forests. Among these are Denmark, which has offered seedlings and technical assistance to Botswana

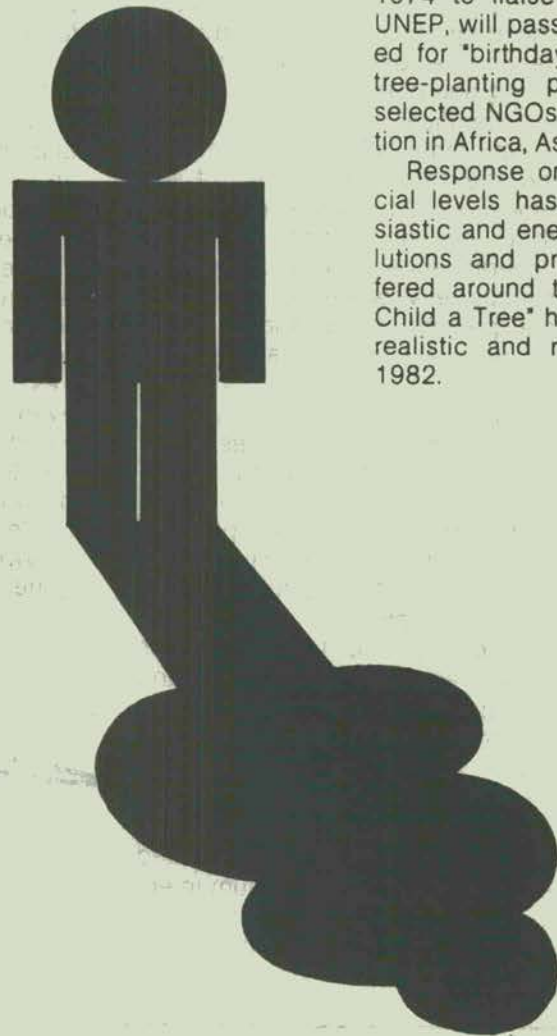
and Lesotho; Czechoslovakia will aid Ethiopia; India will aid Kenya; and Canada has offered to help Haiti.

National programmes thus far reported include a nation-wide tree-planting campaign in China under which every able-bodied Chinese citizen over the age of 11 will be required to plant five trees in 1982—a total of over three billion trees. The tiny island of Mauritius in the Indian Ocean has pledged support for the campaign by agreeing to plant 15,000 fruit trees in 1982 and in Japan every single child born in the year of Stockholm 1972 will be presented with a tree.

Parents have been invited to participate in the campaign by planting a "birthday tree" for every child born in 1982, or to plant a tree on a child's tenth birthday. Children are being encouraged to ask that their tree, or a matching one, be planted in an area of the world where trees have become scarce.

The Environment Liaison Centre (ELC), which was established in 1974 to liaise between NGOs and UNEP, will pass on all money collected for "birthday trees" or sponsored tree-planting projects to about 20 selected NGOs working on reforestation in Africa, Asia and Latin America.

Response on the public and official levels has, so far, been enthusiastic and energetic, with viable solutions and programmes being offered around the world. "For Every Child a Tree" has, indeed, become a realistic and recognizable goal for 1982.





## EDITORIAL

In 1977 representatives from around the world assembled at the United Nations Conference on Desertification (UNCOD) to gauge the extent and intensity of the world-wide problem of desertification, to give impetus to the international anti-desertification action and to develop a Plan of Action against what was rightly recognized as a most serious threat to the food-producing systems, to the human environment and to the quality of life in at least one third of the world: the uncontrolled spread of desert-like conditions and its associated loss of productive land. The urgency of the problem was heightened by the disastrous drought of 1968-1973 which affected millions of people dependent upon the resources of arid and semi-arid lands for their livelihood. Vast amounts of international relief were rushed to save the people. Today while the crisis has passed, the reality of the problem has not. According to a study prepared in 1980 for the General Assembly 3.3 billion hectares or 80 per cent of the world's total irrigated land, rangeland and rain-fed cropland in arid and semi-arid areas are affected by desertification. On a global level, the same study notes that the current annual loss of production due to desertification is in the order of \$26 billion. This is a cause of great concern at a time when more food is required for the ever-increasing world population.

The deliberations of the Conference in 1977 made it clear that success in the fight against desertification required (a) effective awareness, (b) the political will and (c) financial resources. The Plan of Action to Combat Desertification (PACD) approved by the Conference and the General Assembly, and the General Assembly resolutions that followed, have set up the appropriate mechanisms for action to combat desertification and for generating and maintain-

ing the political will that will ensure success. Unfortunately, while the mechanisms are now available, financing at the levels needed have not been forthcoming and there are signs that the political will has abated. Why is this so, and what must be done to reverse this trend? Much has been said about constraints on the implementation of the Plan of Action to Combat Desertification and on how national, regional and international efforts remain far short of those concerted efforts envisaged in the Plan and the decisions of the Conference. In short what is needed is the kind of drive and sense of purpose that brought about the Conference and made it a success.

The study of additional measures to finance the Plan of Action submitted to the General Assembly at its thirty-sixth session, which is summarized in this issue, explores means by which sources of funds for anti-desertification action may be obtained and sustained. But all measures require the combined political will of the world's nations for action to fend off the menace of desertification. Every effort must be made to generate that will and not to wait for catastrophic events that would drive the world community to make hasty and unproductive adjustments. It is a tribute to the foresight of the Conference that the approved Plan of Action called for a first general assessment of progress in its implementation seven years after the Conference. The occasion, which is only two years ahead, will provide a unique opportunity for national Governments and institutions and the international community now as they prepare for the occasion and later when they sit to review, discuss and learn from experience to plan what should be done in the future to ensure that the goal of implementing the Plan of Action by the year 2000 will be achieved.

Gaafar Karrar  
Acting Head, Desertification Branch



# REVEGETATION OF THE INDIAN DESERT

H. S. Mann, Director  
Central Arid Zone Research Institute,  
Jodhpur 342 003, India

India was one of the first countries to approach the problems of the desert and desertification soon after its Independence in 1947. When the 20 small administrative units were integrated into the present-day state of Rajasthan, it became possible to coordinate the activities of various agencies interested in the development of the desert area and to create a unified Master Plan for the direction, operation, and superintendence of all such activities. Attention was further focused on the deterioration referred to by a claim in the First Five Year Plan that the "Indian desert of Rajasthan has been spreading outwards in a great convex arc at the rate of about half a mile per year for the last 50 years". In recognition of this problem, the National Institute of Sciences (now the Indian National Science Academy) organized a Symposium on the Rajputana Desert in the year 1952. On its recommendations the Central Arid Zone Research Institute (CAZRI), initially named the Desert Afforestation Station, was established. This was perhaps the first major state-organized step among the Afro-Asian countries to contain the desert.

The arid and semi-arid zone in India is spread over eight states, but 90 per cent of the hot desert is located in north-west India, out of which 61 per cent is located in the State of Rajasthan. It is by far the most densely populated desert of the world, and the manifestations of environmental deterioration are particularly evident in this region. Continuing research by CAZRI and other organizations has made the Thar one of the "most studied" deserts in the world.

The Government of India and state governments in the arid and semi-arid zones, realized the alarming situation and reacted promptly. These governmental bodies provided funds for anti-desertification programmes, established an infrastructure to study the problems, evolved strategies to minimize the hazards of desertification and provided for the transfer of appropriate technology. They have also organized result-oriented extension programmes by creating appropriate agencies.

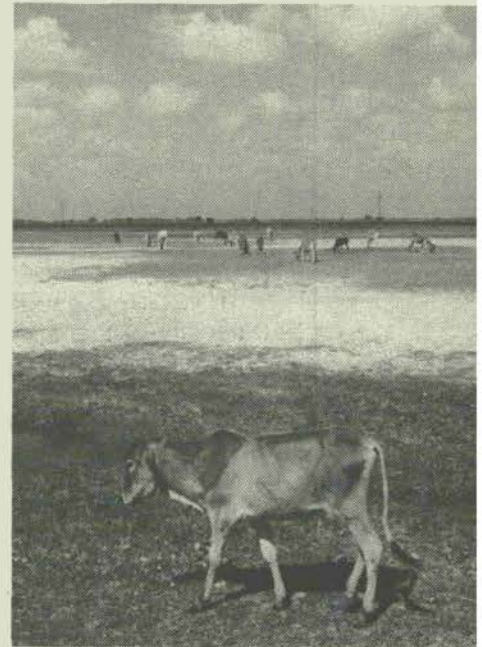
## REGENERATION NEEDS

Besides climatic fluctuations, erratic rains and extremes in diurnal temperatures, the principal problem of the Indian desert is the escalation of human and of livestock populations. Most of the other problems are in reality the consequences of these two major factors causing environmental degradation and desertification.

The human population has escalated from 3.56 million in 1901 to 13.94 million in 1981. The livestock population has also registered an increase from 9.4 million in 1961 to 19.8 million in 1977. The devegetation and degradation of the arid lands due to the presence of large human and livestock populations has necessitated the restoration and maintenance of vegetation cover both to stabilize and protect soils and to provide fuelwood to desert people and fodder to the livestock. Keeping these objectives in view, CAZRI has developed and standardized a number of cost-effective technologies for revegetating the Indian desert.

## REVEGETATION TECHNOLOGIES

*Sand dune stabilization:* Silvo-



*Overgrazing by livestock. The small marshy area seen will eventually dry up when the land is completely denuded if remedial action is not taken (Kanpur — Lucknow, India). H. Null/FAO*

pastoral technologies were developed and demonstrated at CAZRI to stabilize the bare sand dunes which threaten human habitations and cultivated fields in the arid areas. These consist of:

- fencing of shifting dunes as a protection from grazing;
- establishment of micro-wind-breaks on the windward side of dunes in lines at 5m intervals or 3m x 3m chess-boards, and
- sowing of grasses on the leeward side of the micro-wind-break and planting (with the onset of the rains) of adapted trees and shrubs raised in earthen bricks.

Economic analysis of this stabilization has indicated that the average cost of \$ 67 per ha will be repaid after the end of the thirteenth year. It has been found that about 50 to 70 mm of moisture initially present within the upper metre of unstabilized dunes helps in the process of seedling establishment. Moisture received from the monsoons rains is adequate for subsequent growth of the already established seedlings. Soil analysis after a few years of establishment indicated that the above technique influences the build up of organic matter in the dune soil.



**Afforestation:** Afforestation can serve several purposes. If the requirement is only for establishing green belts in the arid zones, such indigenous trees as *Prosopis cineraria*, *Azadirachta indica*, *Albizia lebbek*, *Salvadora persica*, *S. oleoides*, *Acacia nilotica arabica*, *A. nilotica leucophloea* and *A. jacquemontii*, which are of proven adaptability, though relatively slow growing, are suitable. However, if a fast turnover is planned for energy production, quick growing exotic trees like *Eucalyptus* sp., *Acacia tortilis* and *Prosopis juliflora* should be planted. A number of practical methods have been developed in the areas of (a) selection of species for different sites, (b) seedling production, (c) raising of selected trees and shrubs, (d) soil working techniques and cultural operations, and (e) protection against diseases and vertebrate pests.

In pursuit of the above objectives, 112 species of *Eucalyptus*, 65 species of *Acacia*, 8 species of *Cassia* and 63 species of 44 other genera were introduced in Jodhpur (mean annual rainfall 366 mm) and Pali (mean annual rainfall 411 mm) from Israel, Australia, the USA, the USSR, Zimbabwe, Chile, Peru, Sudan, etc. Research has shown that among the *Eucalyptus* species, *E. melanophloia* has greatest promise in Jodhpur, whereas in Pali, four species, namely *E. tessellaris*, *E. melanophloia*, *E. coolabah* and *E. camaldulensis* have shown good performances. Among the *Acacia* species *A. tortilis* (Israel),

*A. sieberiana* (Zimbabwe), *A. seyal* (Kenya), *A. aneura*, *A. salicina*, *A. ligulata* and *A. victoriae* (Australia) have performed well. Of these, *A. tortilis* has proved to be the most promising (100 per cent survival at Jodhpur and Pali) and has done extremely well on shifting sand dunes. In view of these results, *A. tortilis* has been introduced extensively in north-west India.

Among species of other genera, *Colophospermum mopane* (Zimbabwe) and *Dichrostachys glomerata* (Israel) are doing very well in the Indian arid zone. One important characteristic of these two species is their self-propagation. *Dichrostachys* naturally spreads through root suckers and *C. mopane* by seed dispersal. Care should also be taken while selecting plants to determine their suitability to local ecological conditions and soil profiles.

**Shelterbelt establishment:** A vegetative barrier placed in the path of the wind reduces its velocity near the ground by exerting a drag on the wind and deflecting the wind stream. This action constitutes one possible mechanism of wind erosion control. The effectiveness of shelterbelts in reducing wind velocity depends on many factors such as wind velocity itself, its constancy in direction, and the shape, width, tree height and tree density of the shelterbelt. The shelterbelts effectively protect crops, control sand drifting, and provide cover and food for wildlife. They are planted across the wind direction and on the

margins of agricultural fields. Successful shelterbelts of *Acacia nilotica* and *Dalbergia sissoo* over a length of 102 km were established at the Central Mechanised Farm, Suratgarh, in Bikaner District. Trees are planted in ditches of triangular cross-section 45 cm wide and 45 cm deep prepared with a mechanical ditcher.

**Arid horticulture:** Suitable cultivars of ber (*Zizyphus mauritania*), date palm and pomegranate have been identified. The selected ber cultivars yield as much as 45-50 kg fruit per tree even under the conditions of precarious rainfall, marginal soils and nominal inputs. Even in the absence of irrigation the desert farmer can have a source of income and nutrition from ber cultivation. A run-off collection technique has been developed to enable the farmer to have an assured and satisfactory source of water even in drought years. A major obstacle facing the quick cultivation of ber orchards was overcome by the development of a propagation technique. This technique raises budded plants in less than 5 months with outstanding success even in arid conditions. It can be used for raising other fruit plants in an arid climate. The technique has been used to propagate ber plants for distribution to various organizations and institutions in the country and for the Operational Research Programme of CAZRI, and has now been adopted by private nurserymen and extension agencies.

**Range management:** Studies on rangeland improvement, management and utilization have revealed that by simply fencing off an area, the forage yield from the rangeland could be doubled in about three years.

**Soil and moisture conservation measures:** Contour furrows on soils with rolling topography can dramatically increase forage yield. Contour furrows of about 150 cm<sup>2</sup> cross-section (60 cm wide and 25 cm deep) at a distance of 8-10 m across the slope increased the forage yield by 636 per cent. Contour furrows are inexpensively maintained and cost about \$13-18 per hectare. For water harvesting in pasture land, a tractor-drawn pitting disk has been designed and built. The use of the pitting disk in a cultivated pasture of *Cenchrus ciliaris*, *C. setigerus* and *Lasiurus sindicus* gave an average increase of over 30 per cent forage

Table 1. Area of the arid zone in India by state

	Area under the arid zone (km <sup>2</sup> )	Percentage of the total arid zone in India
Rajasthan	196,150	61.0
Gujarat	62,180	19.6
Punjab	14,510	5.0
Haryana	12,840	4.0
Maharashtra	1,290	0.4
Karnataka	8,570	3.0
Andhra Pradesh	21,550	7.0
Total area	317,090	100.0
Jammu and Kashmir (cold arid zone)	70,300	

Source: A. Krishnan in Desertification and Its Control



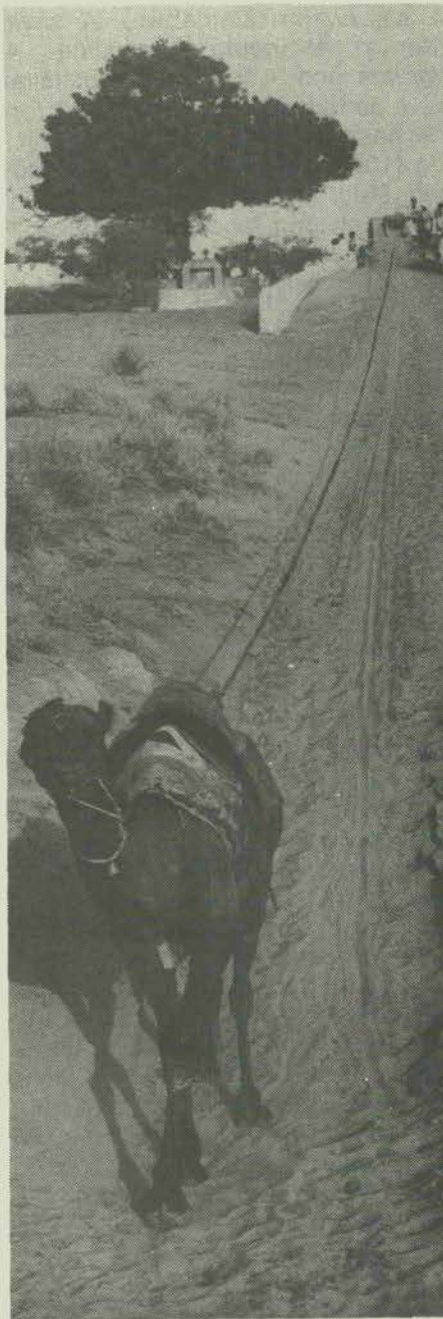
# INDIAN DESERT

yield. The fabrication cost of disker comes to below \$35 if discarded discs are used and \$84 if new discs are used. The pasture land under management should be protected through barbed-wire fencing against indiscriminate grazing.

**Reseeding:** Owing to erratic rainfall conditions and the poor germination of seeds of *Lasiurus indicus* and *Dichanthium annulatum*, the sowing of a mixture of seeds of *Cenchrus* species and *Lasiurus indicus* for low rainfall tracts and of *Cenchrus* species and *Dichanthium annulatum* for high-rainfall tracts is recommended. The seeding rate of different mixtures is 5 to 7 kg per hectare. The required quantity of unhusked seeds of grasses, appropriate for the tract, should be mixed with moist sandy soil at three to four times the volume of seeds and drilled uniformly in lines 75 cm apart, immediately after the first effective showers, in 8 to 10 cm furrows and at a depth of not more than 1-3 cm in the soil. Such reseeded rangelands need at least two weedings during the first year of their establishment.

**Introduction of legumes:** As the availability of fertilizers is a problem and their cost is quite high, the role of legumes in grassland production is under study. In limited trials, legumes planted in combination with cultivated pastures have resulted in a higher content of nutrients and particularly of crude protein in the composite forage material. Studies of the compatibility and performance of promising legumes, e.g. *Dolichos lablab*, *Phaseolus atropurpureus*, *Clitoria ternatea*, *Rhynchosia minima*, *Atylosia scarabaeoides*, *Cyamopsis tetragonoloba*, *Phaseolus aureus*, *P. aconitifolius* and *Vigna sinensis*, on grasslands under different climatic subregions are in progress. In some areas such as the Bikanar District in pure stands of *Lasiurus indicus*, legumes such as *Phaseolus aconitifolius* are used as interspace crops. This improves production and increases yield.

**Silvo-pastoral approach:** Considering that livestock husbandry occupies the most important place in the economy of the arid regions and



Wells may have to be dug hundreds of metres deep to reach the water table. It then requires the strength of a camel or a pair of bullocks to draw water to the surface (Searo, India). A.S. Kochar/WHO

that frequent droughts result in a loss of cattle wealth owing to the shortage of fodder resources, it is necessary for range improvement to be complemented by the raising of fodder tree and shrub species which not only give much-needed forage during the periods of scarcity but which also provide shade and shelter to the grazing animals, thereby helping them to utilize forage uniformly on the range. In addition, fodder trees and shrubs will support micro-climatic conditions conducive to the natural regeneration

of grasses which fall higher in the succession. Studies have shown that a density of 14 per cent of *Zizyphus nummularia* is optimum for increased forage production. *Prosopis cineraria* is an important forage-tree species which grows in cultivated fields (sometimes more than 60-80 trees per hectare) without any detriment to the crops grown in association with it. The tree is lopped for its protein-rich (17.5 per cent) leaves. Studies have shown that complete lopping (lopping of the entire tree) gives a significantly higher fodder yield (58-72 kg per tree) than the lopping of the lower two-thirds (28-48 kg per tree); or the lower one-third (19.73 kg per tree) of the crown.

## REVEGETATION PROGRAMMES

In 1970-1971 the Government of India sponsored a Rural Works Programme for organizing labour-intensive and production-oriented works in the drought-prone districts of the country, in addition to the normal developmental efforts implemented in these districts under the State Development Plans. Priorities prescribed in the Rural Works Programme were:

- major, medium and minor irrigation projects, including land levelling and other infrastructure facilities;
- soil conservation and afforestation works;
- increase of agricultural production;
- establishment of marketing complexes;
- village and district roads necessary to open up the area.

The scope of the programme was subsequently enlarged to form an integrated area development scheme to seek a permanent solution of the problems of drought in these districts. Accordingly the emphasis shifted from labour-oriented to problem-oriented schemes. This programme was designated as the "Drought Prone Areas" Programme (DPAP) in 1972-1973. The various components of the programme are:

- Development and management of water resources;
- Soil and moisture conservation measures;
- Afforestation with special emphasis on Social and Farm Forestry;
- Development of pasture lands and



range management in conjunction with development of sheep husbandry;

- Livestock and dairy development;
- Restructuring of cropping patterns and changes in agronomic practices;
- Development of subsidiary occupations;
- Development of infrastructure;
  - drinking water supply scheme,
  - rural electrification,
  - rural roads,
  - milk routes.

The strategy of DPAP is to maximize production in good rainfall years and minimize losses when the monsoon fails. Since the development of agriculture has obvious limitations in these areas, the farmers are encouraged to take up subsidiary occupations like animal husbandry, poultry, sericulture and horticulture. Development of a comprehensive package of facilities including processing and marketing has been attempted for such subsidiary activities to enable farmers to derive remunerative prices for their produce. Infrastructure for dairying and sheep breeding has been developed to support cattle and sheep rearing avocations. Afforestation is being carried out on a relatively extensive scale to improve the environment and to meet the requirements of the local population, both

cattle and human. Earlier emphasis was on the development of forest rangelands and restoration of the neglected forests. Rural electrification has been promoted with a view toward assisting the exploitation of ground water.

The Government of India launched another programme in 1977-1978 designated as the "Desert Development Programme" for integrated development of the desert areas to increase productivity, income levels and employment opportunities for the inhabitants through optimal utilization of physical, human, livestock and other biological resources. The schemes covered under the programme included Pasture Development, Cattle Development, Dairy Development, Sheep Development, Camel Development and Forestry. For infrastructural development only rural electrification was permitted on a limited scale. Later the element of individual beneficiary schemes was also introduced.

The Government of Rajasthan revitalized the Desert Development Board and established a Department of Afforestation and Pasture Development which is functioning in an efficient manner. The major components of this revegetation programme and the physical achievements up to 1980-1981 are:

- Farm forestry (1.22 million ha)
- Silvo-pastoral plantations (4,750 ha)
- Village fuelwood and fodder plantations (2,800 ha)
- Sand dune stabilization (13,850 ha)
- Shelterbelt-cum-roadside plantation (4,301 row km)
- Pasture development (19,500 ha)
- Fodder banks (10,600 quintal capacity)
- Canal side plantations (3,600 ha)

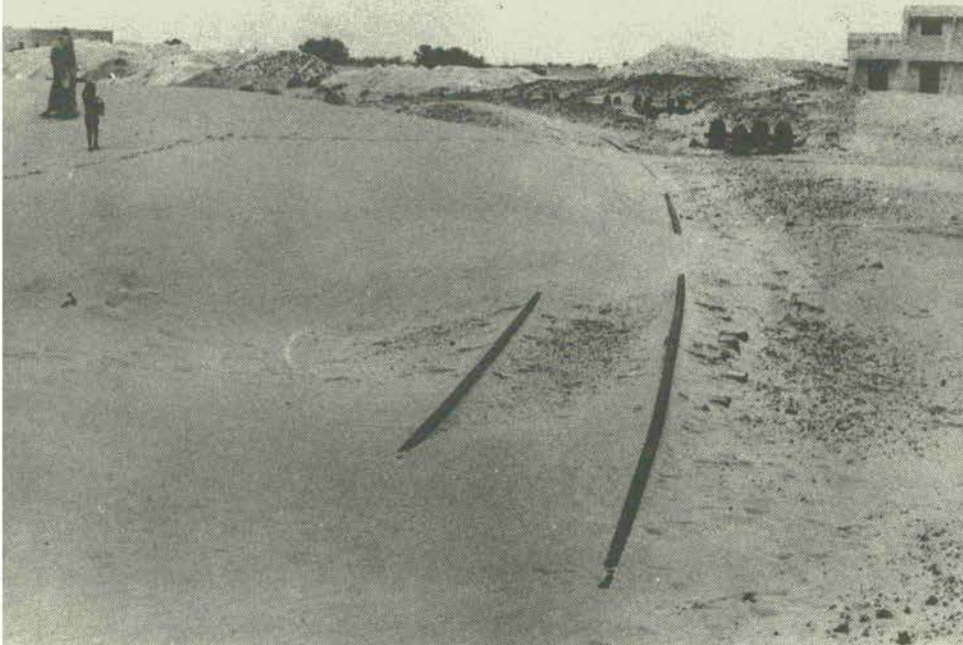
The proposed financial outlay under the Desert Development Programme for various forestry schemes mentioned above for the plan period has been kept at about \$200,000.

The afforestation programme in the Rajasthan Canal Project area, which envisages protection of canals, roads and farmlands from shifting sand dunes and the supply of fuel wood, timber and fodder, is being implemented with the assistance of the World Bank within the project area of 200,000 hectares (Phase I of Stage I). For the remaining 246,000 hectares (Phase II of Stage I), preliminary action has been initiated. The various works being implemented include shelterbelt plantations along canals and roads, fuelwood plantations near villages, sand dune stabilization, and pasture development. The progress of the past years is likely to bring about revegetation of at least part of the desert region. Allocations available for these works during the VI planning period amount to about \$85,000. Similar large-scale programmes are in the pipeline in the states of Haryana and Gujarat.

## PUBLIC PARTICIPATION

Lack of resources and education compel the desert dwellers to cut vegetation for fuel, shelter construction and fences to protect the crops from grazing animals. To reduce the pressure of fuel demand on the vegetation, research at CAZRI has culminated in the development and construction of inexpensive solar cookers. However, they will take some time to reach rural inhabitants. In the meantime, serious efforts to educate the desert people are currently being made. The villagers are being associated with afforestation at the village level and are becoming deeply involved in the revegetation programmes for the desert regions.

*The railway line in Kolayat (India) has been buried under shifting sand dunes. A.S. Kochar/WHO*





# COMBATING DESERTIFICATION AROUND IRAN'S SALT DESERT

*Ellen Tavakoli  
Alamdeh, Mazandaran  
Iran*

Most of Iran, with the exception of the Caspian coastal areas, consists of arid or semi-arid lands, of which three fourths is officially classified as rangelands and one fourth as desert. The deserts include an estimated 20 million hectares of sand dunes, most of them in the Central Plateau around the Salt Desert, subdivided by mountain ranges into two deserts, the northern Dashte Kavir and the more famous Dashte Lut. Physical conditions vary greatly due to the irregular topography, and daily temperatures may vary as much as 30 °C to 40 °C.

Before the beginning of the Iranian desertification control programme, the region had about 5 million hectares of active sand dunes which became the principal focus of the Iranian Government's extensive programmes to control and reclaim the desert. These projects, which were at

the centre of Iran's conservation efforts over the last decade, included all aspects of soil erosion and desertification control. The most successful aspect, however, was the sand dune stabilization programme which reportedly led some officials to declare that "desertification is now behind us; we are now concerned with land degradation."

Conservation of marginal lands continues to be an important priority in Iran where 30 per cent of all cultivated land is in marginal areas. More than half of the population live in some 65,000 small villages of which two thirds have less than 250 inhabitants.<sup>1</sup> Such small communities are common in the desert areas. Pastoral nomads are also still numerous in Iran. They have maintained the tradition of seasonal utilization of marginal land and the socio-economic struc-

ture of a viable desert culture.

## SOIL EROSION IN THE CENTRAL PLATEAU

The wide variety of terrain in various stages of erosion, the wealth of vegetation types and plant species (up to 10,000 identified), along with the prevalent desert culture and revolutionary conditions, make it possible to illustrate almost any aspect of desertification in Iran. There is evidence to indicate human activity in the Central Plateau for at least 10,000 years. Plants and animals were domesticated on both sides of the Zagros Range from 6,000 to 7,000 years ago<sup>2</sup> and throughout the Plateau there are indications of the exploitation of land and natural resources for at least 4,000 years.<sup>3</sup>

*Artiplex and Panicum between palisades on a shifting sand dune.  
Bureau of Soil Conservation and Watershed Management of Iran.*





Historically, the human land-use systems of the Plateau have extended to and been closely related to the ecologies of the high mountain ranges of the Alborz and Zagros. The mountain valleys were favoured locations for early settlements, and the forests on the mountain slopes were destroyed during ancient times leaving the hillsides vulnerable to erosion. The light alluvial soils washed down from the mountains were then—as now—easily blown away by the winds that sweep the Plateau, and formed into sand dunes. Such dunes have been known to reach several hundred metres in height and to have buried the sites of ancient civilizations.

East of the Zagros near the old city of Kashan, the archaeological mound of Sialk shows long-abandoned civilizations spanning 3,000 years (7,000-4,000B.P.) in several superimposed layers, the latest having been an urban settlement with buildings of wood. Such communities around the northern rim of the Salt Desert also built dams and developed the complex subterranean canal system of irrigation called the qanat system, to make the best use of the limited water resources.

The now arid and almost barren lands at the edge of the Salt Desert have been cultivated since the dawn of history. The degradation of these originally fertile soils, which were a sea-bottom during the Devonian period, has been a long, fluctuating and still-continuing process.

During the past two to three millennia, the land-use patterns in Iran's desert regions remained rather stable. Competitive technologies and economic or administrative restrictions had not led to the introduction of ecologically destructive practices. The early pastoralists and other inhabitants soon learned that land would only remain fertile for a limited period and that rangelands could support only so much livestock. With abundant land to move to, they left the exhausted soils to recuperate.



*Transplanting seedlings into plastic bags: the well, pump and water reservoir in the background are major components of a sand dune fixation nursery. Bureau of Soil Conservation and Watershed Management of Iran.*

The water resources available from rivers, springs and aquifers have remained relatively constant for centuries, except for variations between wet and dry years and the shifts in water use based on the qanats, which permitted the extension of agricultural communities deeper into the desert. A few centuries past in the Central Plateau there were reportedly some 270,000 km of qanats forming the basis of irrigation and agriculture. By the 1960s the annual discharge of qanat waters was estimated at 20 billion cubic metres and the length of existing qanats at some 180,000 km.

The 1960s brought the new technologies of the dam, the water-pump and the tractor, along with the land reform programmes and business-oriented investment in agriculture. The new technologies opened up huge areas to irrigation farming. Their use also led, however, to increased land degradation and desertification. The large-scale introduction of motorized water pumps changed the socio-economic structures of the villages and made it possible to increase the cultivated areas and support larger herds of livestock - for a time. In the long run, however, it led to

overgrazing, soil exhaustion, erosion and desertification.

Sand storms had long been a problem in the region and sand dune encroachment had forced the abandonment of villages long before the drought of the early 1960s. Suddenly, however, the situation became critical, as hundreds of villages had to be evacuated due to encroaching sands. Even cities such as Yazd and Kerman on the edge of the Desert were threatened. Communication links—roads, railways, and airports—were blocked by sand dunes. Crops were lost to sand dunes and fields left unplanted because of the threat of moving sands.

Sand dune encroachment and wind erosion were recognized as major problems in the comprehensive national plans of the last decade drawn up to combat erosion and desertification of all kinds. The aim of these programmes has been primarily to control the processes that lead to desertification and eventually to identify and eliminate the causes. One of the most successful programmes has been sand dune fixation, both by biological and combined mechanical and biological means.

1. 1975 Census.
2. Contemporaneously with similar accomplishments in Mesopotamia.
3. Pierre Amiet and Maurizio Tosi, "Report on Phase 10 at Shahri- Sokhta", East West Vol.18, No.1-4, 1978.



# IRAN'S SALT DESERT

## THE SAND DUNE STABILIZATION PROGRAMME

The problems of desertification and sand dune encroachment started to become a matter of serious public concern in Iran at a time when the country was technically and financially able to effect desertification control programmes. Two pilot sand dune fixation projects were begun in 1958 and successfully completed in the following five years. In 1965 the Iranian Government began its first large-scale sand dune fixation projects. At Sabsevar in the north-east corner of the Dashte Kavir, the village of Haresabad was being engulfed by sand dunes up to six metres high. Here sand dunes were stabilized with an indigenous species of white saxaul, "tagh" or *Haloxylon persicum*, planted between palisades of *Ferula galvaniferas* and *Aristida pinnata*, also native species. Within three years, the white saxaul bushes formed forests up to three metres high, stabilizing the dunes and allowing the villagers to return to their homes. Today the saxaul is the mainstay of the Iranian sand dune fixation programme, particularly in the highly arid and saline areas.

*Six-seven-year-old Saxaul (Haloxylon persicum) plantation in Sabsevar. White saxaul is the mainstay of the Iranian Sand Dune Fixation Programme. Bureau of Soil Conservation and Watershed Management of Iran.*



The 100ha demonstration project in Sabsevar has grown to 300,000 hectares of planted sand dunes. Part of the ambitious green belt project, approved in 1974, this is now in the final stages of fixation with almost one million hectares of sand dune plantations surrounding the salt flats known as "the kavirs". Another green belt in the south, of which some 72,000 hectares have been planted, aims at stabilizing all the active sand dunes in Khuzestan and the coastal dunes of the Gulf area.

While the methods of planting barren dunes have been found suitable for sand dune stabilization in most areas around the Kavir and around Isfahan, the help of mechanical mulching has been sought in the south, east and south-east, where high wind velocities make any other method inapplicable or less effective. Mulching is also used for expediency to stabilize the environs of airports, railroads and other public installations.

In principle, mulching is a very effective technique for pre-stabilization of sand, and in Iran, the availability of petroleum mulch makes it relatively economical. The petroleum film, usu-

ally applied after seeding or planting, not only binds the soil particles for a considerable period (12-18 months), but also conserves moisture and absorbs solar heat creating a hot-house effect which speeds up germination and the growth of seedlings. For instance, the dunes covered with petroleum mulch in Khuzestan, Sistan, Baluchistan, Sarax and Khorassan have shown spectacularly rapid vegetation growth within periods of one to three years. However, mulching tends to increase the cost of planting sand dunes by three to five times, depending on the terrain. Therefore it is used only where immediate or quick protection is required. Alternatively, palisades may be used where initial protection from high winds is required for the seeded or planted areas. However, palisade construction is an expensive and laborious undertaking, though it does provide desired employment for the villagers in the winter months.

## SPECIES USED FOR SAND DUNE FIXATION

For planting the sand dunes, woody species are propagated from seeds or from cuttings in nurseries at the sand dune stabilization project substations (60 in 10 provinces). From the nurseries they are distributed as six-month-old seedlings to the plantation sites.

In the Iranian sand dune fixation programmes, the most commonly used plants are the various species of saxaul including *Haloxylon persicum*, *H. aphylla*, *H. amodendron*, *H. salicornicum*; the tamarisk (*Tamarix stricta* and *T. pallissii*); some acacias (*Acacia farnesiana*, *A. arabica*), the mesquite bushes (*Prosopis juliflora* and *P. spicigera*); shrubs such as "scambil" (*Calligonum comosum*); the halophytes *Atriplex canescens* and *A. halimus*; the grasses *Panicum*, *Aristida* and *Sedlitsia* spp.

After testing about 70 exotic species, the indigenous species were found to be more successful. The species chosen were not only capable of surviving drought and binding the soil but had many other useful characteristics as well. The saxaul is an excellent example of this. It provides a high quality charcoal for fuel. Its roots may descend as deep as 40 metres



to find water and its foliage serves as valuable fodder for sheep and camels.

The scambil is also an excellent sand binder and source of fodder, while the poplar *Populus euphratica* is a source for fuel and construction. The "kahur" or mesquite bushes, *Prosopis spicigera* and *P. juliflora*, are also good sources of fuel and fodder.

In the first year after planting, watering is vital to all species and some require up to three years of attention. Usually the watering is done by local villagers, either by hand or by using hoses feeding from tanks pulled by trucks. The more the villagers can participate in the work of sand dune stabilization the better they appreciate its value and the more they benefit through earned income.

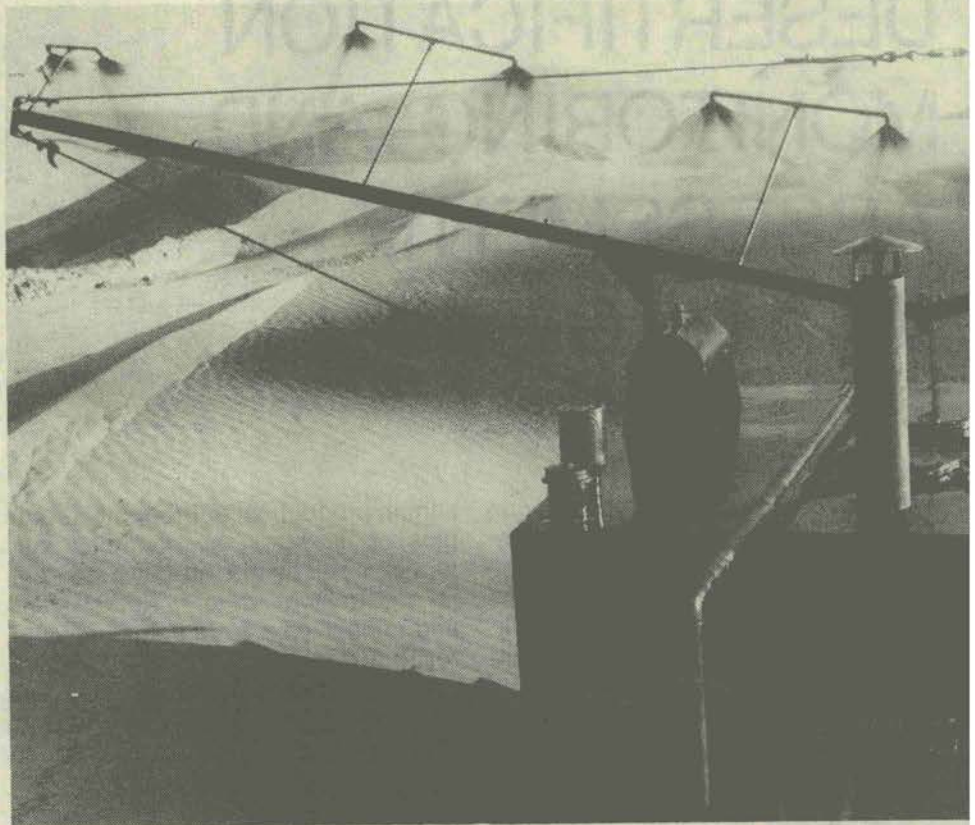
The total area of sand dunes and sandy desert lands planted and protected since the beginning of the programme, including the more recent areas under treatment, amounts to some 7 million hectares. This, in effect, covers the entire area of active sand dunes existing at the beginning of the programme. The sand dune stabilization programme has cost a total of \$30 million just to bring the problem of sand dune encroachment under control.

While the problem may now be under control, the threat still exists. As long as soil erosion continues, the possibility of the formation of new sand dunes remains, and programmes will be required to combat this and other problems of land degradation.

The objectives of future projects in sand dune stabilization and afforestation have been defined along the following lines:

- Protection of agricultural areas, industry, roads, railways, airports, townships, oil installations, etc.;
- Production of wood;
- Production of aesthetic surroundings - recreational facilities, encouragement of wildlife development;
- Soil and water conservation, to control flooding, erosion and sedimentation;
- Improvement of grazing lands;
- Creation of public works to combat unemployment.

The officials in charge of the Iranian sand dune stabilization programme stress that sand dune encroachment should not be taken in isolation, but



Spraying of sand dunes by petroleum mulch in Khuzestan. The sprayer shown is Iranian made. Bureau of Soil Conservation and Watershed Management of Iran.

should be considered as an integral part of land use planning and development.

To prevent or control desertification, land use practices should be correlated with specific ecological conditions at any given site through systematic soil conservation surveys designed to determine optimum land use. In such critical areas as Yazd, the driest inhabited area in the Kavir (annual rainfall 40-60 mm) geomorphological soil studies have shown the urgency of encouraging the population to turn their efforts from agriculture to other means of livelihood, as the population of some 250,000 has long surpassed the capacity of the local water resources. The water table is falling so swiftly that even subsistence farming has ceased to be economically feasible.

#### POST-STABILIZATION LAND USE STRATEGIES

The sand dune stabilization programme aims not only at controlling sand dune encroachment, but at permitting rational exploitation of the stabilized sand dunes. The post-stabilization land use strategies include production of wood and fodder,

and in some cases the growing of fruits or other appropriate crops such as castor beans (*Vicinus communis*). The land use strategies for the reclaimed lands stress the importance of environmental protection. Land reclaimed from sand dunes may be allocated for cultivation, grazing, or total protection, according to such factors as water supply, degree of vegetation growth, and characteristics of the users.

The Iranian desertification control policies stress the need both for reclamation of sand dunes and other degraded lands and for prevention of further degradation. In this regard, grazing policies are particularly important in view of the country's large numbers of livestock, a very large proportion of which are bred by nomads on marginal lands. While there is recognition of the need for regulation of grazing, there are many difficulties involved. Where the land has been traditionally used for grazing and seasonal farming by pastoral nomads such as the large desert tribes of Bakhtiaris, Qashgais and Baluchis, the policies must take account of their particular life-styles and social organization.



# DESERTIFICATION MONITORING AND ASSESSMENT WITHIN GEMS

The Global Environment Monitoring System (GEMS), established in response to the mandate given at the United Nations Conference on the Human Environment held in Stockholm in 1972 to co-ordinate environmental monitoring activities within the UN system, is an activity of the United Nations Environment Programme.

This article describes the methodologies that have been developed by the GEMS for the purpose of ecological monitoring as a tool for development planners and managers alike. As desertification represents one of the most pernicious and widespread cases of ecological deterioration, this methodology has tremendous potential and actual application for the assessment and monitoring of desertification. GEMS has collaborated with the Desertification Branch in the development of desertification assessment and monitoring projects in South America. As UNEP looks forward to its 1984 stock-taking exercise to review and analyse achievements under the Plan of Action to Combat Desertification (PACD) since the Desertification Conference in 1977, considerable attention to monitoring and assessment activities in the combat of desertification and continued co-operation with GEMS is planned.

## INTRODUCTION: THE FUNCTIONS OF RANGELAND MONITORING DATA

Arid and semi-arid rangelands throughout the world have a number of characteristics in common: extensive grassland cover; high rates of nutrient turnover; large variations in

annual production; appropriate strategies of utilization by nomadic pastoralist populations; and environmental controlling factors, notably soil and rainfall, which are notoriously unreliable and discontinuous in space and time. Traditionally these areas and the pastoral people who inhabit them have not received attention in development plans, because of administrative remoteness and relatively "low potential" for intensive agriculture or livestock raising.

Increased attention is now being focused on rangelands. The reasons are complex: the spread of agriculturalists and the attendant government interest and infrastructure; the need to bring outlying border regions under central control; a global protein deficit; and, more recently, a series of dry years which have resulted in considerable loss of human life and domestic livestock.

There is a need to design and perfect land-use systems in order to produce food on a sustainable basis without destroying the stability of ecosystems. The objective of Governments responsible for these rangelands is to plan the development of production systems which optimize the long-term welfare of people.

Although activities associated with land use planning and day-to-day management have the same ultimate objective, operationally, they deal with different time-scales. Planning activities investigate the various options for land use in an area, i.e. what is currently going on, and what is possible over the long term. Management is concerned with relatively short-term campaign strategies to deal with changes in production (primary and secondary) for a given set

of environmental circumstances in order to maximize secondary production.

Land use planning and management require proper understanding of existing systems. Such understanding is derived from data collected and analysed in ways which elucidate the dynamics of the ecological, economic and sociological processes which characterize the areas in question.

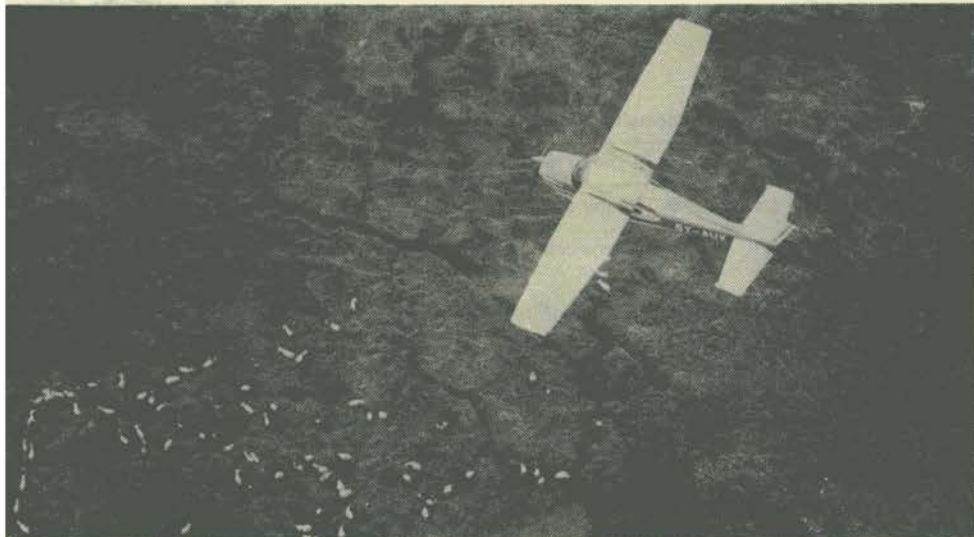
It is necessary to have simple, quick and readily available methods to determine present demands on the land, the land's capacity for supporting human life, and its future, in terms of productivity and sustainability, under different forms of management. In order to reduce costs, operational agencies must seek methodologies which, with a minimum of modification, are useful to both planners and managers. It is believed that recently developed ecological monitoring strategies are able to serve both masters. As the term implies, monitoring is the systematic and periodic collection of information over time. It is mainly concerned with the elements of the basic dryland food chain: vegetation, livestock, people.

## MONITORING METHODOLOGY: COMBINATIONS AND CORRELATIONS

The "monitoring methodology" is not a rigid procedure but is often rather an *ad hoc* combination of intensive and extensive techniques to provide useful data for planning and management of large tracts of rangelands. Through correlations between intensive and extensive data bases (ground to air to satellite), useful and cost-effective statements can be made about actual and potential production. It is recognized, however, that in the process of correlation some precision will be sacrificed. The manager must carefully design his sampling to minimize loss of information without becoming too detailed. (The manager who knows everything about 1000 km<sup>2</sup> will not be of much use to the planner who must deal with 1,000,000 km<sup>2</sup>, unless the former has some basis for extrapolating his results.)

A primary management consideration in ecological monitoring is to effectively balance the low cost of extensive data collection methods with the need for high-quality information





A light aircraft flies over a flock of sheep on a systematic reconnaissance flight (SRF). This is the most cost-effective "first look" at evaluating livestock population in a survey area. GEMS (UNEP)

from intensive data collection techniques. To take extremes: a Landsat image produces, in the first instance, low-information data at a cost of approximately \$0.01 per square kilometre. On the other hand, a vegetation survey carried out by a ground team produces detailed data at a cost of the order of \$100.00 per square kilometre. Clearly the information quality of the extensive approach must be improved to be of much use, while the cost of the intensive approach must be lowered to be practical. Some optimal combination of the two techniques provide, the most cost effective data.

The ecological monitoring methodology advocates the simultaneous application of data collection from three levels: the ground, taking samples over time, the air, in Systematic Reconnaissance Flights (SRF) from light aircraft, and space, from LANDSAT visual or digital data.

The most cost-effective "first look" at a rangeland area on which to base subsequent data collection strategies is SRF. If SRF is repeated over time, the quality of the data, such as population estimates of animals or patterns of seasonal change in primary production, become more precise. The precision is enhanced if the SRF programme is run concurrently with collection of information on the ecological state on the ground. Time series ground data also improve in quality as patterns of production change are related to controlling factors (rainfall and soil type) and modifying factors (animal use, fire, influence of man).

If the third tier of data acquisition, satellite imagery, is added to the scheme, it becomes possible to relate both micro-events in production recorded on the ground, as well as meso-events in animal distribution from SRF to the micro-scale produced by a set of Landsat spectral reflectance signatures over hundreds of square kilometres.

The combinations of methods allow correlations between them, which eventually should result in the phasing out of the more expensive intensive techniques. Management and planning decisions may then be made as a matter of course using the cheapest data collection techniques, backed up and checked at a manageable frequency by quality control air and ground samples. Figure 1 illustrates the application and progression of methodologies schematically.

Up to the present, however, no area has yet arrived at this happy state in which a time-series of satellite-generated data provides policy-makers with the necessary information on which to plan and manage. We are still at the stage of tentatively combining the methodologies and extracting the correlations.

The reason for this retarded state of the art lies largely in an inherent reluctance among ground- or aerial-orientated researchers to expand beyond their predisposed data-collection platform. Another, more practical reason, is the lack of easily accessible, easily usable data analysis facilities. The advent of the interac-

tive, user-orientated mini-computer is largely overcoming this practical constraint.

In the meantime, therefore, while this correlative data base is being built up, planning and management agencies are receiving usable information from the monitoring system. This occurs largely because of the flexibility of the monitoring strategy. With a basic understanding of the nature of the problems, useful information may be obtained from any particular one or nearly any combination of the three tiers of data collection. Brief tabloids of results obtainable from SRF and from visual analysis of Landsat data are given in tables 1 and 2 respectively.

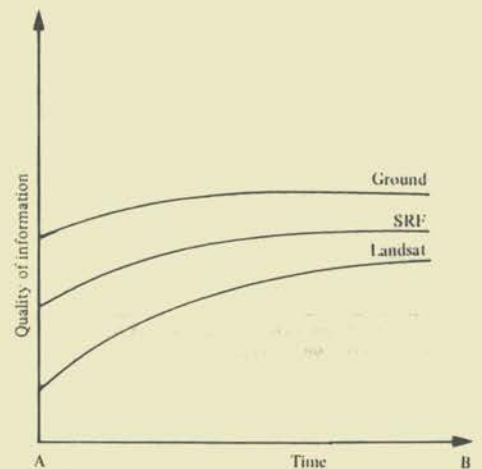


Figure 1. Information quality from three levels of ecological monitoring

A. At the onset of the monitoring programme, ground work produces high quality information but is too expensive and too detailed to supply management data for very large areas. The quality of remotely obtained data from systematic reconnaissance Flights (SRF) or from satellite imagery is relatively low, but extremely useful for first approximations.

A-B. Simultaneous data collection and synthesis from three levels allows correlations between the results of extensive and intensive methods. If the correlations are satisfactory, then the extensive method begins to replace the intensive.

B. At this point, the quality of the information from the extensive methods is such that the more intensive (and expensive) methods are phased out and repeated only as occasional checks. High-quality information may then be obtained at relatively low cost for very large areas.



Table 1. Some results obtainable from systematic reconnaissance flights

Type of flight	Intensity*	Periodicity	Type of result
Inventory	5-10 km	Once only, or once every few years	Estimation of size of domestic or wild animal population
			Permanent data base from which to draft maps of soils, vegetation or topography
			Distribution of infrastructure (roads, village water points)
			Verification of eco-zone boundaries determined from aerial photos or Landsat imagery
			Determination of stock routes
Specific objective	20-50 km	Annual beginning of rains	Advanced information on beginning of green wave
		At peak of rains	Estimation of annual production
		End of dry season	Distribution and type of burns
Monitoring	5-30 km	Seasonal	Estimation of animal population, sizes of increasing precision
			Distribution and phenology of vegetation cover
			Seasonal animal distribution
			Distribution of biomass of primary and secondary production
			Correlations between biotic and abiotic factors
			Establishment of boundaries of ecological management units
			Correlations between animal distribution and spectral signatures from Landsat imagery

**Note:** The above operations are not mutually exclusive; for example, an SRF for a specific objective could produce results to serve monitoring needs  
 \* Distance between flight lines

Table 2: Some results obtainable from visual Landsat data

Type of image	Results
1:1,000,000 mosaic of colour composites	Preliminary definitions of ecological zones
1:1,000,000 colour composite transparencies (in a seasonal series)	Identification of ephemerally green areas
	Identification of zones with a high production potential
	Estimation of occupancy by pastoral people, domestic stock and wildlife (given correlations with a data base of distribution from SRFs)
	Soil humidity (given correlations with a data base from ground studies)
1:500,000 and 1:250,000 colour composites, paper positives or transparencies	Preliminary topography, soils or vegetation maps



## COST OF MONITORING: VALUE FOR MONEY

Although SRF rests somewhere between ground work and satellite imagery analysis in terms of information quality, particularly at the outset of the investigations, its cost effectiveness is considerably higher. This is a difficult point to quantify directly. The flying and data acquisition part of an SRF programme is relatively inexpensive. For example, it would cost roughly \$20,000 to cover an area of 100,000 km<sup>2</sup>, roughly three times the size of the Sahelian zone in Upper Volta. For this outlay, data are obtained on the attributes listed in table 3. Comparable information collected from the ground, or from aerial photography with ground checks would take many man hours of collection while, obviously, only the crudest of relationships could be derived from the first set of uncorrelated Landsat images.

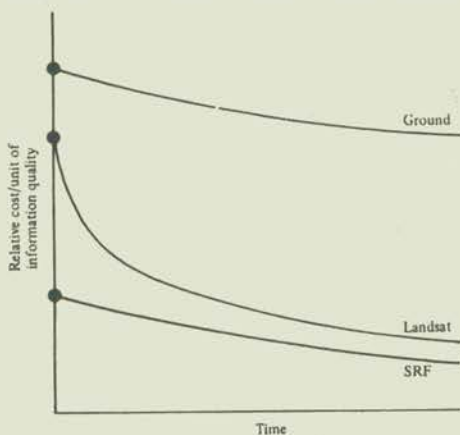


Figure 2. The relative changes in cost per unit of information collected from the ground, from Landsat imagery and from SRF.

As the monitoring programme progresses and the correlations between the various levels of data acquisition increase, the relative cost relationships between the three levels of data acquisition change. Figure 2 is an attempt to express these changes. It can be seen that the costs per unit of information from SRF are consistently lower. Those of ground work are high and improve only slightly with time. The initial high cost and subsequent dramatic improvement of the cost rate for Landsat information occurs because after rela-

Table 3. Habitat attributes which may be monitored by an ecological monitoring unit at the three levels of data acquisition (ground air space)

Permanent	Semi-permanent	Ephemeral or seasonal
Topography	Plant physiognomy (cover, vegetation type, etc.)	Rainfall
Soils	Plant community composition	Insolation
Drainage		Soil moisture
Water holes	Zoogenic features (wallows, sajt licks, etc.)	Evapotranspiration
		Plant phenology (greenness)
Static animal features such as termite mounds	Distribution of non-migratory large mammal species	Plant productivity (biomass, part composition, chemical composition, energy content, etc.)
		Distribution of migratory large mammal species
	Human settlement (villages, roads, farms, ranches)	Large mammal productivity (biomass, reproductive state, condition, food off-take, etc.)
		Large mammal population structure
		Fire
		Surface water

tively expensive initial ground correlation a remarkable level of detail is eventually possible for very large areas of land. It never quite reaches the effectiveness of SRF, largely because it is unable to cope with the difficulty of accounting for the erratic distribution of secondary production (i.e. domestic livestock and wildlife).

## INFORMATION FLOW: DEVELOPMENT OF A WORK PLAN

Managers and planners require results, and it is appropriate to consider the organization of the information flow to attain the results. Figure 3, adapted from a GEMS Rangeland Monitoring Project document, shows a typical work-plan strategy designed to organise data collection and disseminate analysed information to managers and planners.

The steps are logical and simple: plan the approach, execute the initial stratification from a low-intensity survey flight, fix preliminary operational boundaries over the study area, initiate data collection from the three levels (ground, air and space), analyse the data, produce preliminary results, review the depths and scope of the information obtained (revise data collection, if necessary), prepare reports for operational units (management and planning), and initiate follow-up programmes.

Given careful organization in the initial planning phase and a degree of bureaucratic autonomy (to minimize time-consuming delays such as inter-

ministerial squabbles over territorial rights), there is no reason why the review state ("are the data adequate") cannot be attained within 18 months from the inception of the monitoring project. This suggests that managers and planners can have relevant reports in hand less than two years after the starting date. Moreover, due to the flexibility of the strategy, the full programme can be short-circuited in cases of urgent need for rapid policy decisions, and bear fruit after the first half year (see the Rukwa, Tanzania, case study, below).

Once monitoring has been set up, data analysed and management plans implemented, it is the task of an ecological monitoring unit to carry on work and measure the effects resulting from the implementation of the plans themselves. The agency responsible for initiating the work must insure that there exists the institutional establishment which will respond to, and take action on, the monitoring information. In nearly every government such establishments exist; it is vital to identify them and bring them fully into the picture as early as possible in the programme.

## CASE STUDIES: MONITORING FOR PLANNERS

*Southern Tanzania:* A single SRF coverage of 30,000 km<sup>2</sup> in the Rukwa region of Tanzania determined the current distribution of infrastructure, domestic livestock and wildlife which allowed a preliminary land use plan for the area to be prepared in



less than a half a year from the time of data acquisition.

**Kenya:** As part of the International Bank for Reconstruction and Development (IBRD) tourism loan to the Government of Kenya (IBRD 1975) SRF data was used to identify the ranges of very large herbivore (elephant, rhinoceros, buffalo, hippopotamus and giraffe) populations vis à vis current land use patterns in order to produce a set of land use options which make the best use of this particular sector of the wildlife community.

SRF monitoring data has identified concentration and dispersal areas for wildlife and domestic livestock allowing planners to decide where to develop the two types of enterprise.

A combination of ground and SRF monitoring data identified areas of differential utilization of primary production and seasonal dispersal of livestock and wildlife. The data were used in delineation of land use zones and in deployment of watering points to increase available forage for pastoralists herds.

**Saudi Arabia:** Water development for livestock production in the Arabian Shield South is using SRF data on aerial photographs to outline the seasonal ranges of livestock as an aid to effective deployment of a water scheme network.

**CASE STUDIES: MONITORING FOR MANAGERS**

**Saudi Arabia:** An ecological monitoring unit is planned as a basis for nomadic ecosystem management in the north-central part of the Kingdom.

**Senegal:** A UNEP/FAO project is supplying unique data on the Sahelian pastoral ecosystems of the country to a wide range of users, for example: the Government Livestock Authority, the University and the World Bank.

**Kenya:** Analysis of SRF monitoring data has produced figures which identify potentially dangerous rates of decline in those wildlife species which are important as attractors of foreign exchange from tourist revenue. Grevy's zebra and elephants have declined by 60 per cent since 1972.

A combination of ground and SRF data allowed a very large area of state land in south-west Kenya to be allocated for ranching, agricultural settlement, forest reserves and conser-

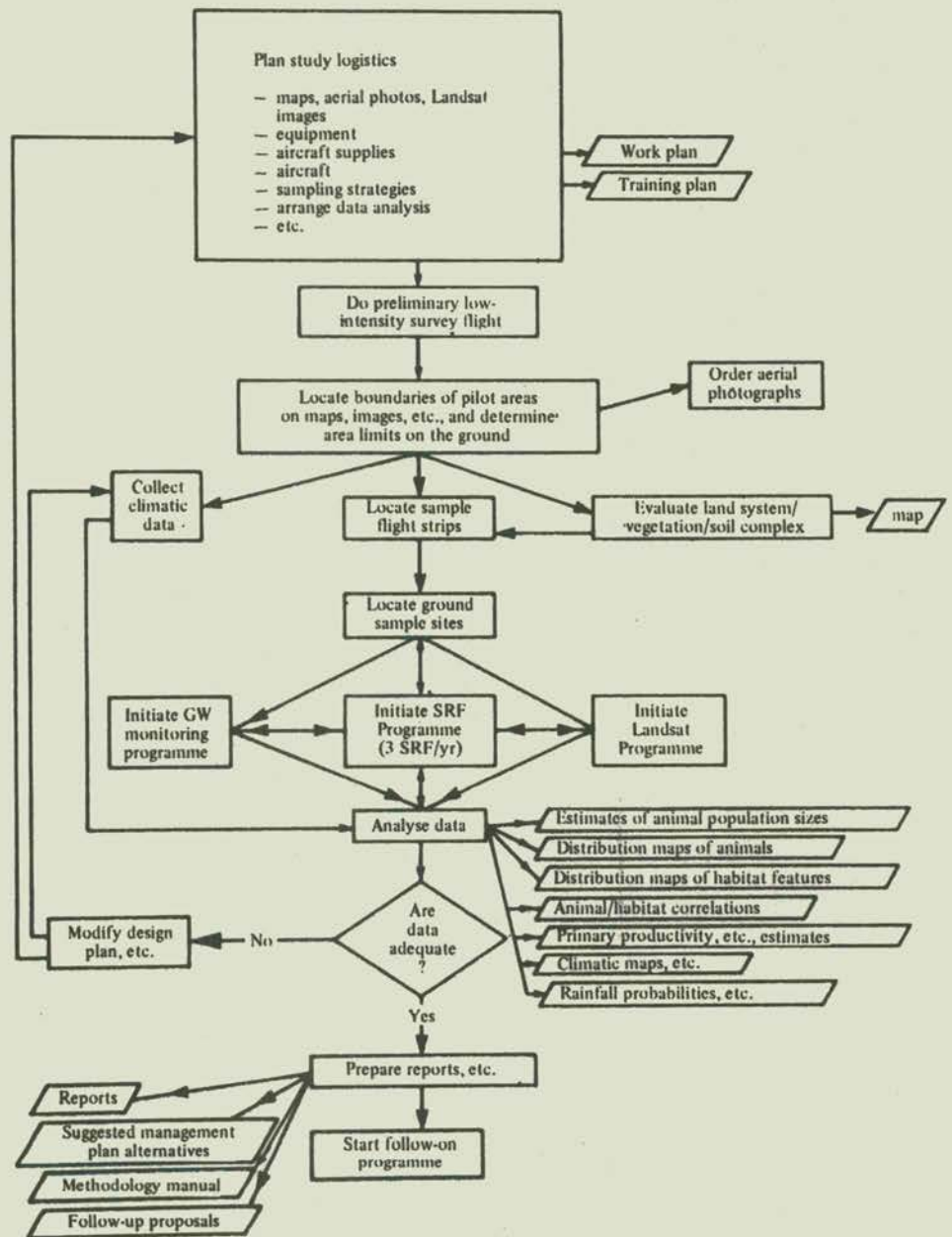


Figure 3. The flow of information through an ecological monitoring unit (EMU), together with the organization of the EMU work plan and some of the results that an EMU can be expected to produce.

vation areas. No less than five new game or forest reserves were established in the area on the basis of these surveys.

Based on distribution data from SRF, compensation for potential domestic stock grazing foregone to wildlife has been calculated for three key wildlife/pastoral areas.

Using inexpensive visual analysis of Landsat false colour images and average herbivore occupancy data from SRF, it has been found that Landsat spectral reflectance categories are better predictors of animal

(domestic livestock and wildlife) occupancy than conventional rainfall and evapo-transpiration indices.

Studies of community dynamics of wild herbivores from SRF distribution and numbers data related to ground production data have provided baselines for assessing effects of various park management strategies.

**DESERTIFICATION: A SPECIAL CASE OF "DEPRODUCTION"**

In arid and semi-arid rangelands, several forms of "deproduction" com-



monly occur. Deproduction is a downward trend in ecosystem production. Within each year, primary production falls off as the seasons change from wet to dry. The ecological integrity of the system is kept intact by the fly-wheel effects of secondary producers—people and livestock stay alive, fortunately, long after the grass has withered. Only sensitive indicators, like milk production or body condition, track closely the annual ebb and flow of protein. Such indicators, have long been monitored by the nomads, whose life-style is particularly well adapted to cope with and avoid the often inevitable consequences of seasonal deproduction in arid regions.

Over several years, production may drop with a decrease in rainfall. Here again, a measure of ecological inertia is maintained by the secondary producers. Only after prolonged dryness does the biomass of the secondary producers drop, either through death or migration. Such longer term deproduction often appears as though it will eventually reach a point of no return in which there is zero nutrient turnover. When the process seems particularly well advanced, it is called "desertification", whether the cause is drought or poor land use practices.

**DESERTIFICATION ASSESSMENT: WHAT ECOLOGICAL MONITORING CAN PROVIDE**

**Critical data**

A wide range of data types pertinent to the process of desertification has now been identified and catalogued. All of these data types are obtainable and quantifiable through one or more levels of ecological monitoring.

The problem is that the relative importance of the controlling factors of all forms of desertification cannot yet be ascertained. It is, therefore, not possible at this stage to say precisely which factors are the most important to monitor, although there are fairly strong indications. It is clear that a major function of ecological monitoring is to collect a bank of extensive time-series data in order to understand the dynamics of production systems. A major function of the analysis of monitoring data is to give insights into the causation of production trends, such as that of desertification.

It must be emphasized that the relative dearth of knowledge need not retard action. Indeed, both management and land use decisions have been made after the very first data collection foray in an ecological monitoring programme.

**Components of desertification assessment**

The correct analysis of monitoring

data should yield a set of results which form the components of an assessment of desertification. These components could, at least in part, also form the basis for map legends for display. A list of the components would include:

- a) *Process*: What type of desertification is occurring
- b) *Rate*: How fast it is occurring.
- c) *Extent*: How widely it is occurring.

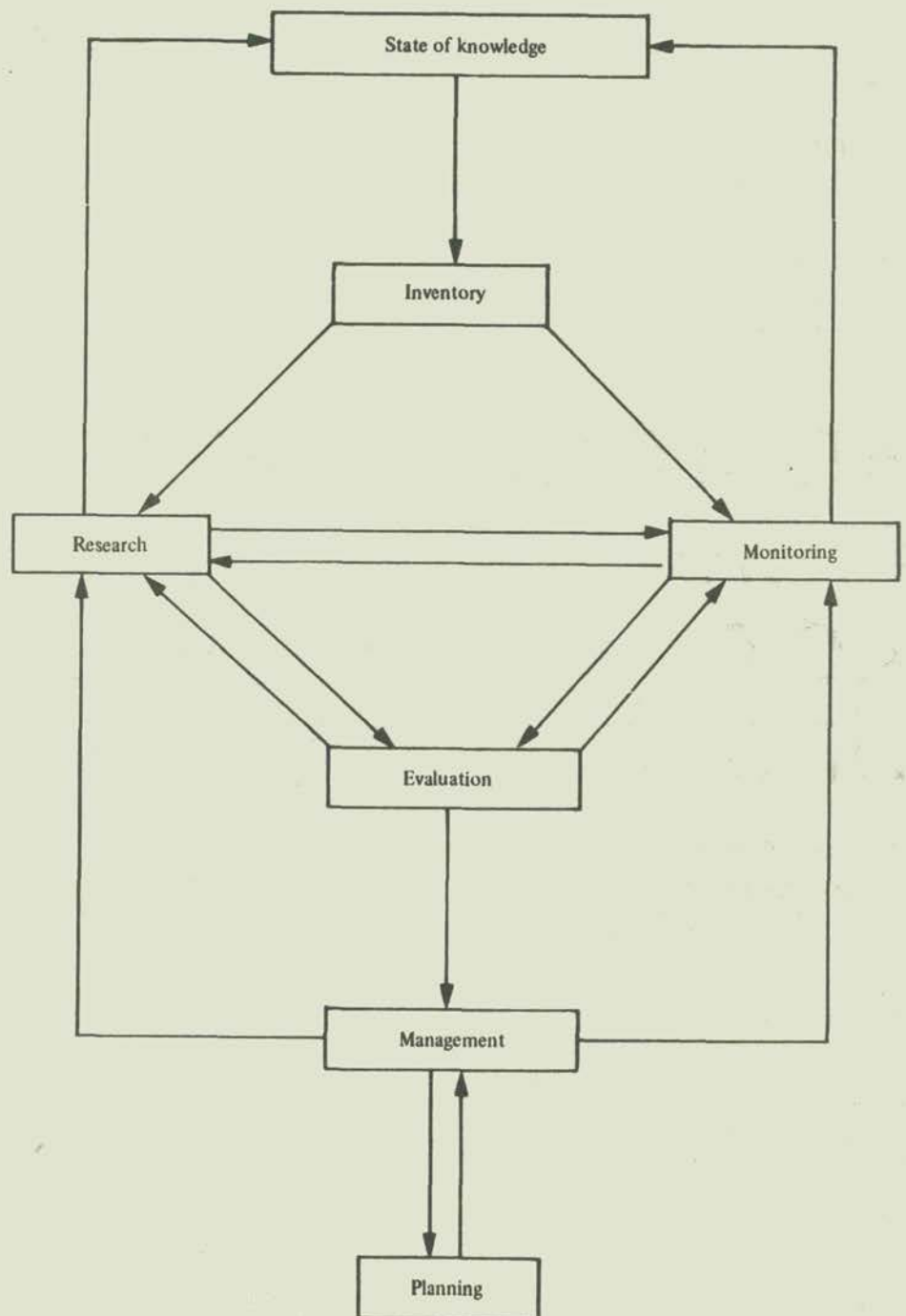


Figure 4. The relationship between inventory, monitoring and management.



- d) *Effect on productivity:* How the process is effecting both primary (plants) and secondary productivity (animals) in the short and long term.
- e) *Role of social structure:* What are the negative as well as many positive effects of traditional (pastoral) forms of land use.
- f) *Hazard:* What is the risk of the occurrence of desertification in the area.

Data collected from the now-standard ecological monitoring methodology are able to provide the analytical basis for desertification assessment.

#### **Comprehensive resource assessment programme**

The flow of information, beginning at determination of the existing state of knowledge of an area, through the acquisition of further data and its evaluation, to management and planning, is

shown in figure 4, which is essentially the framework within which UNEP's Earthwatch programme works. Information moves from the particular in the initial stages to the general in the latter part, and is structured by the evaluation process into forms suitable for short term operation by managers and for long-term land-use allocation by the planners. It must be emphasized that data are drawn throughout from a number of disciplines—agriculture, ecology, sociology and economics – and that management and planning cannot take place without information from all of them.

The diagram also makes clear the close relationship between monitoring, research and evaluation and indicates the need for a single body to be responsible for the collection, processing and dissemination of information for this activity cluster. At the national level this can be done through a national government

ecological monitoring unit such as those currently being established within the GEMS renewable natural resource monitoring network.

#### **CONCLUSION**

Since ecological monitoring methodology is geared to measure all stages of deproduction, it can monitor the process of desertification. The combination and correlation of data collected from three levels (ground, light aircraft, satellite) allows the attainment of a progressively more detailed picture of ecological processes occurring over very large areas.

A small-scale detailed picture, systematically compiled from ecological monitoring, enables the actual and potential areas of desertification to be pinpointed, their nature assessed, and their extent estimated, as a basis for planning and management decisions on appropriate land use.

# ADDITIONAL MEASURES TO FINANCE THE PLAN OF ACTION TO COMBAT DESERTIFICATION

A summary of the report presented by the Secretary-General to the thirty-sixth session of the General Assembly

Proposals for additional predictable and adequate sources of funding for the Plan of Action to Combat Desertification originated during United Nations Conference on Desertification (UNCOD) in 1977. Since then these proposals have been discussed, on the basis of studies prepared by high-level experts, by the General Assembly at every subsequent session. A group of high-level specialists in international finance considered the recommendations of the General Assembly at its thirty-fifth session and prepared for the next session feasibility studies and concrete recommenda-

tions for the implementation of these proposed additional means. The General Assembly at its thirty-sixth session (resolution 36/191) requested that the views of the Member States on the study be obtained and summarized in a report by the Secretary General for submission to the General Assembly at its thirty-seventh session. The full study is in three sections:

- a) Additional means of financing desertification control projects.
- b) Detailed modalities of obtaining resources on a concessionary

basis.

- c) A full feasibility study and working plan for the establishment of an independent operational financial corporation for financing of desertification projects.

#### **ADDITIONAL MEANS OF FINANCING DESERTIFICATION CONTROL PROJECTS**

A world-wide co-ordinated effort to arrest the spread of desert-like conditions requires, according to the Report, a large and predictable



supply of funds. Estimates put the number of hectares lost to desertification at 20 million each year. The total cost of anti-desertification projects in developing countries for the 20-year period to the year 2000 has been estimated at a medium range of \$48 billion. This represents an average annual funding requirement of 2.4 billion. The national governments of developing countries whose resources each year are depleted by the loss of arable land under the pressure of ever increasing-population and which are subject to the fluctuations of climate and the threat of drought cannot meet these requirements without outside help.

The report in the first section considers six measures which hold some promise of contributing substantial and predictable flows of resources to a World Development Fund. They are:

- 1) Generalized trade taxes
- 2) International Monetary Fund gold sales and Trust Fund reflows
- 3) Link between Special Drawing Rights and development finance
- 4) International revenues from seabed mining
- 5) Taxes or "parking fees" from geostationary communications satellites
- 6) The Common Fund for Commodities

tax, levied on specific categories of goods and services. It concludes that, for the purposes of discussion, it is wise to consider a tax on the trade flows of merchandise alone. This decision was made in view of the administrative difficulties of a tax on service transactions and their relatively small volume (one fifth) compared to the \$2,000 billion global value of the merchandise trade. Some portion of service transactions are ancillary costs passed on to the final purchaser and would be captured in a tax only on merchandise. By using the c.i.f. (cost, insurance and freight) price of merchandise, the taxable revenues from insurance and freight services are also captured. The report recognizes that a tax on merchandise alone, if proved feasible, could at some point be extended to include service transactions provided that such were properly structured for equity and ease of administration.

A simple "shadow-tax" or surcharge added to taxes already levied within each country would be difficult to enforce and essentially unenforceable. An international treaty for a trade tax administered by a special body would be required to form a more binding agreement between nations. This assures greater predictability and promises to be more politically acceptable to national legislatures which would prefer that the international community not pre-empt their traditional sources of domestic revenue. With world trade likely to grow from \$2,000 billion to \$2,500 billion by 1984 and with the advantages of a large tax base, a rate as low as 0.1 per cent would yield \$2.0 billion a year currently and perhaps \$3.0 billion by 1987. Assuming 10 per cent for desertification control, the tax would yield over \$250 million a year through the eighties. At the same time 0.1 per cent is too small to be considered threatening to the volume of trade.

The availability of a network of national customs authorities greatly expedites the administration of the tax. A tax on merchandise would be in essence a surtax on dutiable and non-dutiable goods. Since customs officials generally value even non-dutiable goods for statistical purposes, their capture for taxation would not pose any great difficulty. The legal foundation for taxation of

Table 1: Alternative estimates of total costs of a 20-year programme of basic corrective measures for the rehabilitation of desertified lands in developing countries requiring external financial assistance

Type of land	Area covered (in millions of hectares)	Total cost of corrective measures <sup>a)</sup> (millions of US dollars)		
		Low	Medium	High
(1)	(2)	(3)	(4)	(5)
Irrigated land	16.35	8,175.00	12,262.50	19,620.00
Rangeland	722.62	7,226.20	18,065.50	29,904.80
Rainfed cropland	68.03	13,606.00	17,007.50	30,613.50
Sand dune stabilization	2.04	449.00	449.00	449.00
<b>Total</b>	<b>809.04</b>	<b>29,456.20</b>	<b>47,784.50</b>	<b>79,587.30</b>

a) Estimates are based on extent of desertified areas and average low, medium and high unit costs of their rehabilitation. Costings are based on the assumption that the affected areas in column 2 are moderately desertified.

Past experience demonstrates developing countries inability to mobilize the vast sums required for desertification control on their own. Of the \$586 million of total funds provided in 1978 for desertification control only \$59 million or 10 per cent came from national governments. The remaining \$527 million was made available through external assistance. Furthermore, this amount of external assistance has not as yet approached the required level. In 1980, the estimated net external assistance requirement was \$1.8 billion. Recalling the long-term total requirement of \$2.4 billion annual expenditure, it becomes clear that the current programme of \$586 million falls nearly 2 billion dollars short.

The Group makes the conservative assumption that 10 per cent of all additional resources would be made available for desertification control.

#### International taxation of trade flows

The study of the high-level financial specialists examines the various forms of international taxation along the following criteria:

- revenue potential
- ease of administration
- fairness
- economic effects

The report considers both a gross sales tax on the broadest possible mix of goods and services including tourism, transportation and financial services, and a more narrowly based



Table 2: Expenditure on desertification control (calendar year 1978)

	(dollars)
Member States of the Organization for Economic Co-operation and Development (OECD) plus international and regional financing agencies	443 million
Bilateral and multilateral flows from the Organization of the Petroleum Exporting Countries (OPEC)	23 million
United Nations system other than World Bank and IFAD	61 million
<b>Total</b>	<b>527 million</b>
National expenditures	59 million
<b>Grand Total</b>	<b>586 million</b>

world trade would require a basic treaty or convention to be negotiated and ratified by an agreed minimum number of states to permit it to enter into force.

The report considers major disadvantages to an international trade tax. The tax like all broad-gauged consumption taxes is unavoidably repressive. They weigh most heavily on low income, especially smaller countries that have a relatively greater dependence on imports. A number of schemes are advanced to remedy the inequities through rate differentials and rebate formulae. The feasibility of any international tax schemes remains essentially a political question. The decisions for its implementation involve judgements that remain controversial. The report calls for those countries who can afford to make sacrifices, the developed and oil-rich countries, to do so as a demonstration of their political will to marshal genuine additional resources for the purposes of long-term world development.

### IMF gold sales and Trust Fund reflows

The report reiterated the necessity to promote the common objective of phasing out gold and national currencies as the preferred international reserve medium. In lieu of these forms of international currency it seeks to establish Special Drawing Rights (SDRs) as the means of exchange in international transactions. To this end and as part of its programme of divesting itself of one third of its existing gold stock, the IMF auc-

tioned off one half of that amount — roughly 25 million ounces between 1976 and 1980. This resulted in \$4.6 billion profit of which \$1.3 billion was distributed directly to 104 developing countries. This left a balance of \$3.35 billion which, together with accumulated income, permitted the creation of a total of SDR 2.9 billion to be transferred to a trust fund established for the purposes of concessional lending to certain low-income developing countries suffering from payments imbalances.

Some part of the repayment of Trust Fund loans can become available for anti-desertification purposes. The Fund's Executive Board has already preempted a total of 2.25 million of these reflows for certain other purposes. However, a residual amount of 650 million due under Trust Fund repayment procedures is as yet unpreempted by any Fund Board decision. This is represented by the difference between the SDR 2.9 billion lent under the Trust Fund and the SDR 2.25 billion of reflows already earmarked for "essentially IMF purposes". With additional interest income accruing over the period 1986-89 when payments begin on the last instalments of Trust Fund loans, this amount could increase to SDR 1 billion, or 250 million in each of these four years.

This amount can be used towards balance of payments assistance on special terms to developing members in "different circumstances". The Group of Experts believes that the Fund's executive board is free, under the existing articles of agreement, to

allot this money for anti-desertification purposes. Under the circumstances and given the time element involved, the prospect of such a decision does not allow any statement to be made regarding the relative predictability of such reflows becoming available.

### Link between SDRs and development finance

Special Drawing Rights (SDRs), as explained above, are the new reserve medium used by the IMF to create international liquidity. SDRs are currently allocated in proportion to the quotas of Fund members: roughly 26 per cent of any allocation accrue to the non-oil-developing countries. The basic notion behind a "link" between SDRs and development finance is that, as stated by the Pearson Commission in 1969, "The developed countries relinquish a part of their quotas of the new reserve medium (SDRs) in favour of the less developed countries". This is what is known as the "indirect link" as opposed to a "direct link" which would result from a change in the quota system. Such an indirect link would provide a source of development finance entirely free of the Fund's requirements of either conditionality or else ultimate repayment.

The link would operate through the following mechanism:

- 1) A participant receives an allocation of SDRs according to the quota and must pay charges equivalent to market rates of interest to IMF.
- 2) If the participant holds SDRs it will receive interest on these holdings.
- 3) Since the rates at which the charges and interest accrue are equal there is no net cost upon participants until a net transfer of SDRs occurs.
- 4) When the participant reduces his holdings by transferring them to a development institution or by settling its own payments deficits, only then will it incur a net interest charge. It forfeits the interest income on SDRs it once held while continuing to pay charges attached to their allocation.

The Group determined that an "indirect" link was optimal in terms of providing an interest-subsidy element to an anti-desertification programme and in terms of its speedy implemen-



tation. The indirect link maintains SDR allocations proportionate to Fund quotas, but is accompanied by an agreement among donor countries to transfer a predetermined portion of their SDR allocations or their equivalent in currency to development financing institutions (DFI). Donor countries continue to bear the obligation to pay charges attached to their original allocation. This is similar to a contributing country having borrowed money which is transferred without interest or charges to DFI, in this case the anti-desertification institution. The institution can hold the funds and earn a return or use SDRs without incurring an interest cost.

The effect of a link in any form is to extend a continuing line of credit to developing countries. This enhanced line of credit will facilitate the access of developing countries to normal capital markets and thereby increase their capacity to finance balance of payments. At the same time the market rates of interest will permit confidence to be maintained in the asset so that developed countries who will be foregoing some of their normal SDR allocations as a result of the link will continue to have an inducement to earn and accept SDRs.

Assuming that the IMF obtain support for the proposal of an allocation for the fourth basic period 1982-1986, the Group estimates conservatively a 5 billion SDR per annum allocation. If 25 per cent of SDR allocations are transferred through the indirect link by countries having per capita income of at least \$3,000, the amount involved would reach 800 million SDR.

Supposing 10 per cent was released for desertification control, 80 million SDRs would then be made available for interest subsidies for such programmes. However, for reasons similar to those stated in the preceding section, it is impossible to predict accurately the extent of any potential revenue stream from these sources.

#### **International revenues from sea-bed mining**

The high seas have long been recognized as an "international commons", the resources of which should be available to the international community. Under this rationale the resources of the high seas might be exploited to provide funds for world

development in general and desertification control programmes in particular. By international law national governments have economic jurisdiction of coastal waters up to 200 metres in depth and "deeper waters adjacent to the coast". According to the present Draft Convention of the Law of the Sea Conference exclusive national zones may be extended to 200 nautical miles offshore. Beyond these limits the responsibility of the development of living and non-living resources would fall to an International Sea-bed Authority. The Authority would be composed of UN Member States and would govern operations related to sea-bed mining. As the sole body authorized to levy taxes, fees, royalties, or other charges on such operations, it represents the only channel available for tapping the large amounts of potential funds for development purposes.

The available technology does not as yet permit the deep sea exploitation of oil and gas reserves beyond the 200-mile limit. Until such activity is made possible attention is centred on the mining of manganese nodules as a source of international revenue. These potato-sized nodules gain their value from the other metals contained in them; nickel, copper and cobalt in addition to a 30 per cent manganese content. At present no full-fledged pilot project has been established for the production of these metals. The techniques required however have been proven in the laboratory. The combination of official demands for expensive prototype demonstration units and fluctuations in metal prices and production costs has resulted in a downgrading of the commercial priority accorded to sea-bed mining. The current outlook points to a scheduled start-up in 1992.

Past analyses of the economics of sea-bed mining have indicated that the supplies of cobalt and nickel could exert significant adverse effects on existing producers of the nodule metals. To meet this difficulty the Convention tries through the use of production limitations to forge a compromise between the interests of existing producers and the international community. Some producers feel the balance is not adequate. There is some question as to whether losses to independent producers would assume

major dimensions relative to prospective economic rents from sea-bed mining, this effectively negating the Convention's revenue-raising objectives. As long as this uncertainty exists it is difficult to project the potential revenues flowing from the Authority's operations.

Studies that attempted the prediction of the magnitude of international revenues have produced widely diverging results. Estimates of the internal rates of return vary from 5 to 100 per cent. The uncertainty about the geological, technological, economic and legal factors involved make accurate predictions impossible. Much depends on the agreement to the Law of the Sea Treaty, ratification of which has been delayed, pending possible new negotiations in 1982. The mining consortia may be unprepared to proceed with investments without an international treaty. They cannot risk the large investment required in the face of uncertainty and possible international reversal.

However even in the event of a breakdown in negotiations, the possibility of international revenue from deep-sea mining must be pursued. Otherwise the funds may be preempted by enterprises operating under the authority of national legislation.

#### **"Parking fees" for stationary communications satellites**

The technological constraints of the modern telecommunications industry indicate that the number of locations available for geostationary communication satellites may at some point in the relatively near future become scarce. A geostationary earth satellite rotates in a unique orbital zone around the equator at a distance of approximately 22,000 miles from the earth. It travels west to east, thereby remaining approximately in the same position relative to a certain point on the earth. Based on current technology there is a limit to the number of such satellites that the geostationary orbit zone can accommodate. At the same time, the demand for communication services is increasing dramatically. The determining factor in whether or not "parking spaces" will in fact become scarce is the degree to which technological advances in telecommunications, which would allow more signals to be accommodated by each



orbital zone, can keep up with the increasing demand for telecommunication services.

Techniques have been developed for use in the most "crowded" spots (over North America, the Indian Ocean and the Atlantic Ocean) for increasing traffic volume. Frequency reuse through polarization, whereby some signals are sent vertically and others horizontally, or the use of directional antennas permitting two satellites in the same orbital position to serve different areas, along with new "beam splitting" techniques have already more than doubled satellite capacity. In the medium-term future the advance of technology is expected to develop additional means to increase the possible number of signals sent from each orbital station.

However, demand may grow at the same or greater pace than technology. Intelsat, which operates 12 of the approximately 100 active geostationary satellites in orbit, has had growth in the number of telephone circuits from 1.8 thousand in 1969-1970 to 14.4 thousand in 1978-1979, an annual average growth rate of 26 per cent. Technological advances that multiply capacity tenfold a decade would, therefore, just keep pace with the demand through 1990. According to a recent analysis the best estimate is that foreseeable technological advances will make it possible to meet demand for "at least the next two decades without encountering a generalized problem of overcrowding".

The Group of Experts concluded that, for the near term and very likely much of the next decade or two, international taxation of geostationary satellite parking slots holds little promise as a substantial source of international revenue. It nonetheless recommends early establishment of the principle of international taxation of this resource, along with a system of regulation for the use of orbital positions, in order to prevent any future overcrowding. The Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space, to be held in 1982, may provide an opportunity for considering action on both suggestions.

### Common Fund for Commodities

The Common Fund for Commodities is intended to serve as a means to stabilize the prices of participating

commodities by selling from stock a commodity when its price is rising and buying up a commodity when its price is falling. The Fund is divided into two accounts. The First Account helps finance the buffer stocks for those commodities for which International Commodity Agreements (ICA) have been established. The pooling of resources due to the association of various ICAs would achieve economies in financing. The purchase of one commodity could be financed through the sale of another. Current estimates suggest that if suitable agreements were reached on the major commodities under discussion (rubber, tin, wood, sugar, coffee, tea, cotton, copper, jute and hard fibre), the total resources of the First Account would be between \$6 and \$8 billion. The First Account however is not intended as a source of international revenue.

The Second Account finances programmes for research, marketing, development of commodity processing and productivity for commodities with ICAs. It will have resources of \$350 million, \$70 million allocated from the capital of the Fund and \$280 million from separate voluntary contributions. It would appear then that the annual flows of concessional lending through the Second Account would be approximately \$100 million in the first three years. Subsequent flows would depend upon the volume and frequency of replenishment as decided by the Governing Council of the Fund.

Each commodity that comes under an ICA will have an International Commodity Body (ICB) designated by the Common Fund (CF) Executive Board. ICB will be an intergovernmental body, open to all Member States of the United Nations or any of its agencies or the International Atomic Energy Agency, and will be concerned with the trade, production and consumption aspects of the commodity in question. It shall be in a position to adopt a suitable method for ensuring the proper discharge of any technical or other responsibilities arising from its association with the activities of the Second Account. Therefore any decision to include desertification control measures among those receiving Second Account support must be sponsored by the relevant ICB.

The Group concludes, however,

that even over the long term when the Common Fund is likely to be ratified and operational, it seems that it is unlikely to be a major source of incremental revenue for general development. The annual concessional flow of \$100 million amounts to only 3 per cent of global annual concessional assistance, although this amount could grow. Even this modest flow may not be "additional" in the sense that donor countries may adjust the composition of their normal foreign assistance programme to make funds available for the Common Fund without increasing total aid.

The Common Fund for Commodities can make a significant contribution to world economic growth and stability through commodity stabilization. It can be however only a minimal source for international development in the sense of extra tax revenue or concessional funds for international purposes, including desertification control.

### Detailed modalities of obtaining resources on a concessionary basis

Section B of the report describes three means of raising resources from Governments other than outright grants. The first of these consists of Governments extending interest-free loans, to be repaid over periods of up-to 20 years out of the interest received from borrowing countries, assuming interest rates of 2.5 to 3 per cent. The second means involves raising funds from Governments on commercial terms, using a combination of budgetary grants and extra-budgetary sources to subsidize commercial interest rates. Finally the report considers in greater detail the third possibility, that of obtaining financial resources from private capital markets, to be re-lent on concessionary terms with the support of both interest-rate subsidies and guarantees and/or collateral. These subsidies would be made available for desertification purposes subject to approval by the IMFs Executive Board on the use of Trust Fund reflows and/or the implementation of a link between SDRs and development finance as described above.

The Group of Experts concluded that a combination of these devices would allow developing countries the possibility of borrowing money from



normal capital markets on an average of as much as \$300 million a year in 1982-1986 and up to \$400 million between 1987 and 1990.

This amounts to roughly \$2.8 to 3.0 billion over these eight years. Such recourse would need to be backed up by the guarantees of interested donor Governments and/or institutions. The report discusses different forms of joint and several guarantees, with special reference to a limited joint and several guarantee, which limits each guarantor's obligation by reference to a callable capital component.

The strength and credibility of the assurances provided lenders in the form of guarantees or collateral will determine whether borrowing is feasible on the order indicated and on what terms. In turn, these terms would then determine the size of the interest rate subsidies required to achieve a desired degree of concessionality, either within or without the framework of the independent financing institution discussed in the final part of the study.

less of the project's social desirability and economic merits. About one fifth of projected desertification expenditure— or around \$500 million out of a total (gross) \$2.4 billion a year— falls into this category of long-term anti-desertification programmes located at the margin of the project feasibility scale. The projects to be funded by the corporation would have to be financed primarily with the funds provided by Governments on an interest-free basis. The willingness of the international community to supply such interest-free funds is critical to the latter's viability.

Both borrower and donor countries (including international institutions) are expected to become stockholders by contributing to the corporation's equity in equal shares of \$1 million, all equal with respect to voting rights, dividends and repayment of capital. A conservative estimate puts the equity base under this system at \$100 million. No part of this equity capital would be used to extend loans. Instead, the corporation would be ex-

institutions. The corporation expects to meet this loan demand of some \$500 million through interest-free loans provided annually by donor countries. Half of the total, or \$250 million will be shared by developed countries according to a scale determined by their ability to contribute and the other half will be raised through negotiations with the centrally planned economies, the petroleum-exporting countries and the remainder of the developing country members of the United Nations (except the least developed).

The terms of loans for all approved projects will be somewhat less concessionary than those attached to IDA and IFAD credits, but are more favourable than the World Bank "third window" terms. This is only logical since countries should be encouraged to seek assistance for anti-desertification projects from IDA and IFAD whenever possible. On the other hand, the nature of the projects involved calls for a higher degree of concessionality than that envisaged in the World Bank "third window" operation.

## Conclusion

Anti-desertification programmes are necessarily long-term. They require a long period of gestation in order to bring them to fruition. This breeds uncertainty regarding the economic returns associated with such programmes. Traditional sources of financing are therefore in most cases unavailable for anti-desertification purposes. The new additional means to finance the combat against desertification presented in the above report represent a major step towards providing the necessary sums of money with the required element of predictability.

The report concludes that "all countries of the globe, whether or not they are directly threatened by the advance of the deserts should consider themselves involved in the fight against desertification". The extent to which this hope becomes a reality, the extent to which the world's nations co-operate in the implementation of some or all of the suggested measures, will determine whether or not an impending world-wide crisis can be averted.

Table 3: Prospective yields from additional measures of financing PACD, 1982-1990

(millions of US dollars)

	1982	1983	1984	1985	1986	1987	1988	1989	1990
Trade tax at 0.1 per cent	2.25	2.38	2.52	2.67	2.84	3.00	3.18	3.37	3.57
Trust Fund from IMF gold sales	-	-	-	-	0.29	0.29	0.29	0.29	-
SDR link	-	0.92	0.92	0.92	0.92	0.92	0.92 <sup>a)</sup>	0.92 <sup>a)</sup>	0.92 <sup>a)</sup>
Satellite parking fees	-	-	-	0.03 <sup>a)</sup>	0.04 <sup>a)</sup>	0.05 <sup>a)</sup>	0.07 <sup>a)</sup>	0.08 <sup>a)</sup>	0.10 <sup>a)</sup>

a) Indicates figures that are more speculative than others.

## Independent operational corporation for the financing of desertification projects

The purpose of an independent operational corporation for the financing of desertification projects is to provide funds for projects for which the future returns cannot be quantified beforehand and which could not attract funds from existing multinational and regional development banks and similar financial institutions regard-

pected to cover its current operating expenses out of four fifths (80 per cent) of the interest income earned on this equity base. The remaining 20 per cent will be transferred to a fund for anti-desertification research and experimentation. Donor countries would be encouraged to make further voluntary contributions to that fund.

Loans would only be extended for the high-risk part of desertification projects leaving those parts suitable for financing by existing bodies such as the World Bank or IFAD to these



# POPULATION EXPANSION AND DESERTIFICATION IN TANZANIA

Tanzania, with an area of 884,000 km<sup>2</sup> and a population in 1978 of 17.5 million lying between latitudes 1°S. and 12°S, provides a good example of a tropical country where population pressure—human and animal, domestic and wild—is rapidly giving rise to moderate-to-high levels of land degradation. Some 45 per cent of the country is believed to be already affected, and another 35 per cent is being threatened. Unless appropriate measures are taken to arrest the situation, desertification will accelerate and spread to the remainder of the territory which exhibits all the symptoms of incipient environmental degradation.

The principal areas undergoing desertification in Tanzania at present are the arid and semi-arid central region including the area around the new capital of Dodoma. parts of the Lake Victoria basin, especially Sukumaland, and the Maasai territory stretching northward to the Kenya border (fig. 1). On a United Nations "Desertification Map of the World" (UNEP/FAO/UNESCO/WMO, 1977) the central belt including the Dodoma region and the north-western segment including parts of Arusha, Kilimanjaro and Pare are marked as areas of "alluvial or residual surfaces subject to stripping of top soil and accelerated run-off, gully erosion on slopes and/or sheet erosion or deposition on flat lands". Western Mara, southern Mwanza (Kwimba District), Shinyanga, Singida and northern Tabora appear on the same map as areas of "stony or rocky surfaces subject to areal stripping by deflation or sheetwash".

The most intensively degraded area extends from Mpwapwa in Dodoma region to Babati in Mbulu District. In particular in the Kondoa-

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Irangi District, some 160 km north of Dodoma, soil erosion has reduced the land to completely unproductive status with incipient "badland" development. The hills have been denuded of trees and grass, the pediment slopes subjected to gulying and sheet erosion, and there are sand-choked rivers criss-crossing and mantling cultivated fields. The two

small lakes in the area, Lakes Bicha and Haubi, are gradually silting up with sediments transported from the surrounding catchments by ephemeral streams such as the Mkuku, a tributary of the Bubu River. The Dodoma-Arusha road which passes through Kondoa District, runs through severely eroded country while the Dar es Salaam railway is threatened by washouts.

## Population growth, migration and desertification

Many factors have combined to make soil erosion and desertification a

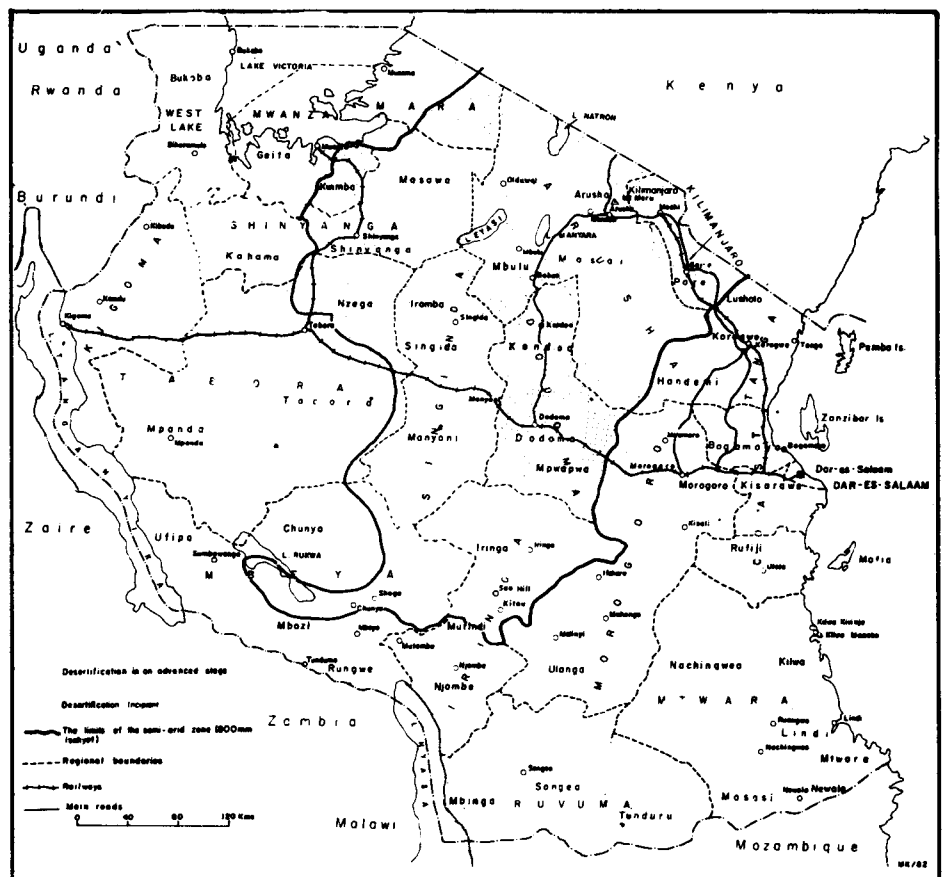


Figure 1: The semi-arid zone of Tanzania



Table 1: Semi-arid Tanzania: Population Increase, 1948-1978 (in thousands)

Regional District	1948	1957	1967	1978	48/78 (%)	48/78 (ann.%)
<b>Dodoma:</b>						
Dodoma (rural)	210	226	297	262	24.8	0.8
Kondoa	146	151	213	275	88.4	2.9
Mpwapwa	102	116	175	262	156.9	5.2
<b>Total</b>	<b>458</b>	<b>493</b>	<b>685</b>	<b>799</b>	<b>74.5</b>	<b>2.5</b>
<b>Singida:</b>						
Iramba	133	151	182	242	81.9	2.7
Manyona	53	59	80	104	96.2	3.2
Singida	169	163	192	213	26.0	0.9
<b>Total</b>	<b>355</b>	<b>373</b>	<b>454</b>	<b>559</b>	<b>57.5</b>	<b>1.9</b>
<b>Shinyanga:</b>						
Maswa	245	292	404	304	24.1	0.8
Shinyanga	214	256	321	431	101.4	3.4
<b>Mwanza:</b>						
Malya/Kwimba	238	242	306	325	36.5	1.2
<b>Total</b>	<b>697</b>	<b>790</b>	<b>1,031</b>	<b>1,060</b>	<b>52.1</b>	<b>1.7</b>
<b>Steppeland Total</b>	<b>1,510</b>	<b>1,650</b>	<b>2,170</b>	<b>2,458</b>	<b>62.8</b>	<b>2.1</b>
<b>Kilimanjaro:</b>						
Kilimanjaro rural	268	351	474	631	135.5	4.5
Same/Pare	86	109	150	208	141.9	4.7
<b>Total</b>	<b>354</b>	<b>460</b>	<b>624</b>	<b>839</b>	<b>137.0</b>	<b>4.6</b>
<b>Arusha:</b>						
Arusha (rural)	106	139	176	299	182.0	6.1
Mbulu	151	188	289	194	28.5	0.9
<b>Total</b>	<b>257</b>	<b>327</b>	<b>465</b>	<b>493</b>	<b>91.8</b>	<b>3.1</b>
<b>Iringa:</b>						
Iringa (rural)	126	171	232	290	130.0	4.3
<b>Highland Total</b>	<b>737</b>	<b>958</b>	<b>1,321</b>	<b>1,622</b>	<b>120.1</b>	<b>4.0</b>
<b>Grand Total</b>	<b>2,247</b>	<b>2,614</b>	<b>3,491</b>	<b>4,080</b>	<b>81.6</b>	<b>2.7</b>

Source: 1948-1967 based on census figures and extracted from United Republic of Tanzania (1977) *The Threat of Desertification*, Dar es Salaam, p.20. 1978 based on 1978 census figures (provisional) extracted from Daily News of 17 January 1979, p.3.

major problem in the semi-arid areas of Tanzania. The most important is the pressure of population upon land use and management. Table 1 shows the population growth and distribution in the semi-arid areas of Tanzania. The total population in 1948 was 2,247,000 and in 1978, 4,080,000, revealing an increase of 81.6 per cent over the 30-year period, or an annual growth rate of 2.7 per cent. There is a marked difference between the rates of increase from district to district and

region to region, with 9 out of a total of 14 districts growing at the national rate, which has been estimated to be anywhere from 2.7 per cent to 3.0 per cent per annum (UN Fund for Population Activities, 1979). Whereas population in the "steppelands" increased by 62.8 per cent (from 1.5 million in 1948 to 2.4 million in 1978), that of the surrounding "highlands" more than doubled (120 per cent), from 737,000 in 1948 to 1.6 million in 1978.

Figure 2, showing the average

densities of the rural population in mainland Tanzania brings out the contrast between the central areas of low agricultural potential and moderate high population density, and the surrounding peripheral areas of high agricultural potential and high population density. Figure 3 shows changes in density by districts between 1948 and 1967 (Moore, 1973). Changes have been expressed as percentages of the 1948 densities. Only one district, Ngara, recorded a decrease in



# TANZANIA

density; all other districts recorded increases with a maximum relative increase in Geita District where density has increased by 166.4 per cent (Moore, 1973). In general, the greatest absolute increase occurred in those areas which already carried high densities. Most notable of these were Arusha, Kilimanjaro, Mzizima, Newala and Rungwe districts and most of the Mwanza region. All these areas have high agricultural potential due to fertile soils, well-established cash crops or proximity to a major urban market. The semi-arid plains witnessed moderately high relative increases, especially in the districts bordering the high potential agricultural areas. The overall picture of the demographic situation is one of rapidly increasing population. Taking into account the effect that natural increase and urban migration must have had on population increase in the country as a whole, there is ample evidence to show that desertification in the semi-arid areas of Tanzania has been caused by increased human and animal pressure on the fragile low-potential agricultural areas due to migration of agricultural groups from the densely populated peripheral high-potential agricultural areas. This is indicated not only by the steadily high increases noticeable in the population of both the semi-arid plains and the surrounding highlands from one census period to another, but also by migration trends as revealed by the 1967 population census data.

Tables 2 and 3 and Figure 4 give the general picture of interregional population movements in Tanzania. The tables and map emphasize two types of movement: long distance such as those from the interior toward the coast and short-distance such as those between the Lake-cluster districts. It is largely movement of the latter kind involving expansion or overspilling of population into new and nearby agricultural areas that is rapidly giving rise to land degradation in several parts of the semi-arid zone. During the last half century or so, the pressure of rapid population growth has led to migration into the semi-arid areas of Tanzania. Migration and land degradation in the area south of Lake Victoria provide examples of this.

## Migration and Land Degradation in the Lake Cluster Districts

The area bordering Lake Victoria

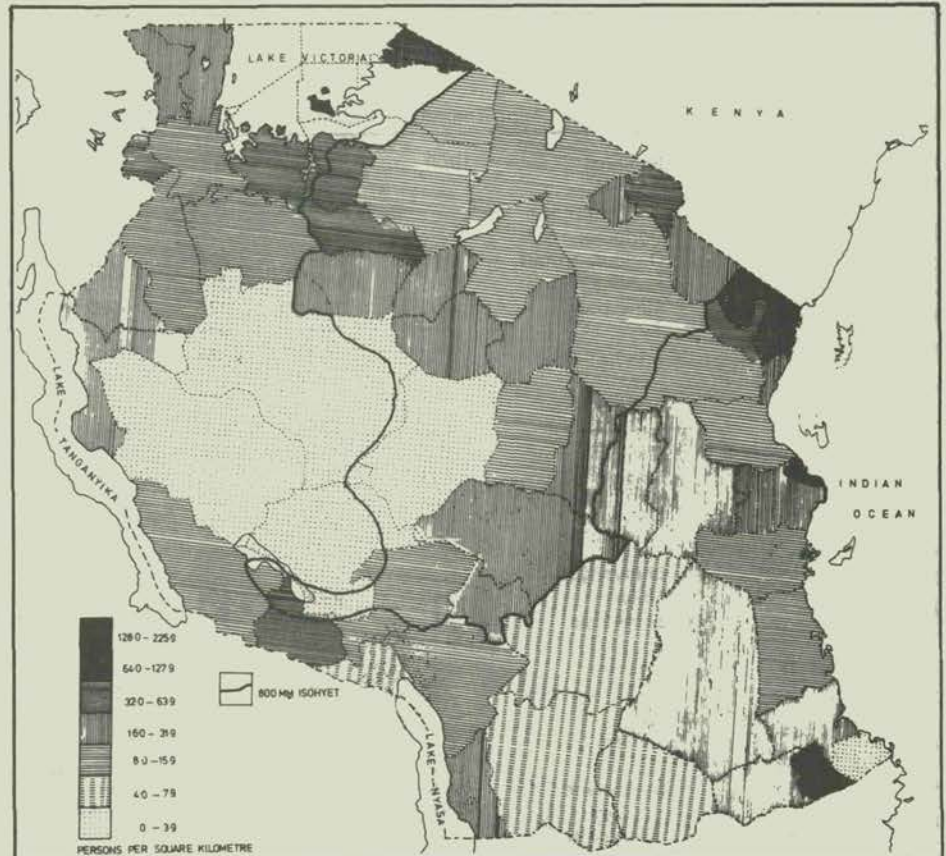


Figure 2: Mainland Tanzania: rural population density, 1978

Source: Based on 1978 census statistics, *Daily News* 17 January 1979.

comprises five regions: Mara, Mwanza, Shinyanga, Tabora and West Lake. Together they cover more than a quarter of the mainland area of Tanzania. Their recorded population in 1978 is: Mara 723,000, Mwanza 1.4 million, Shinyanga 1.3 million, Tabora 821,000, and West Lake 1 million. Their annual population growth rates range from 1.9 per cent to 3.5 per cent.

The northern part of the region experiences sub-humid conditions and has average rainfall above 800 mm. The southern part of the region from Kwimba District in Mwanza region to Tabora has a semi-arid climate with annual average precipitation generally below 800 mm. The greater part of the rain falls between November and May (unimodal) although rains in January are often low and unreliable. This is a manifestation of two distinct rainy seasons (bimodal), a pattern which asserts itself further north. Total rainfall is uncertain and the wide variation of both the amount and incidence within the monthly totals is of critical importance to farming.

South of Lake Victoria as far as

Shinyanga, the region is inhabited mainly by the Sukuma, a farming and herding people. Cotton is their principal cash crop. Profits from cotton are invested in livestock as a safeguard against crop failure and fluctuations in world demand for the crop. Their staple food crops are maize, sweet potatoes, sorghum, legumes and cassava. According to Collinson (1972), in a typical cultivated area of some 6.5 acres, cotton takes up 45 per cent of land, followed by maize/cassava/legumes and roots 25 per cent, rice 12 per cent, sweet potatoes 9 per cent, and maize/sorghum 4 per cent.

Further to the south where the land is inhabited by the Nyamwezi, ecological conditions are different. While in the north cattle-keeping is widespread, the existence of the tsetse fly in much of the south has made this almost impossible.

Historical events are responsible in part for differences between the north and the south. The Nyamwezi in the south have a history of travelling which made them prime targets for European recruiters in need of labour



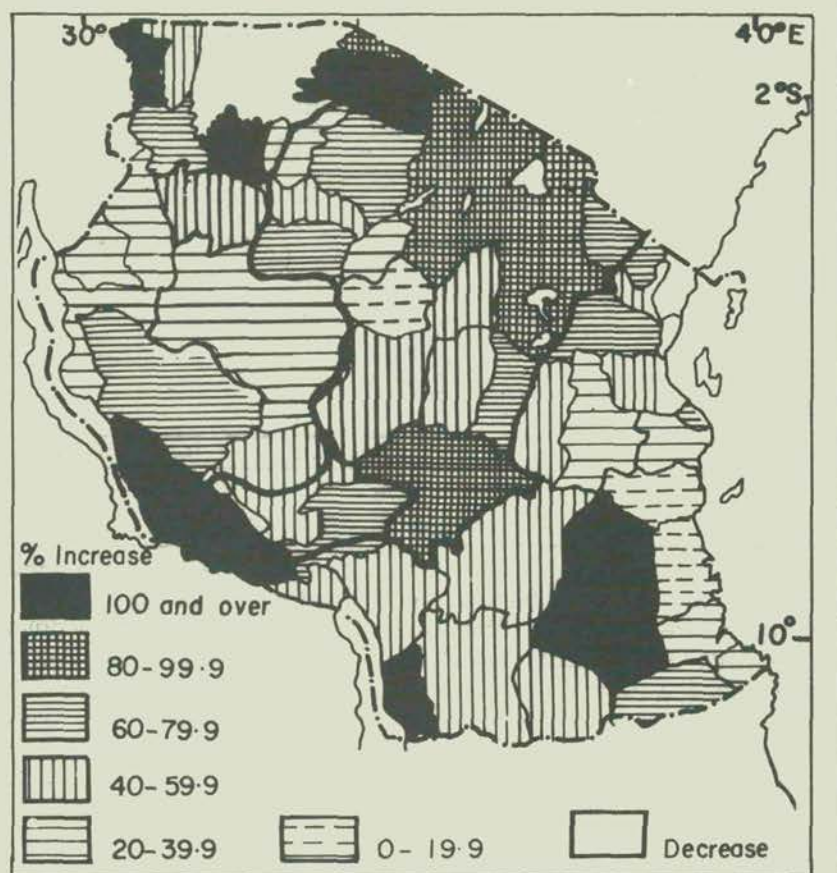


Figure 3: Tanzania mainland; percentage change in rural population density by district 1948-1967  
Source: J.E. Moore, (1974).

for work on plantations and on the railways (Egero, 1974). In the north, cattle-keeping provided the Sukuma with a safeguard and a means of avoiding conscription. In the south the lack of cattle and the initial participation in trade and portage of the Nyamwezi led to labour migration and loss of manpower which resulted in complete stagnation of the local economy (Egero, 1974). Large areas in the south experienced a direct decline in their population owing to the drain of labourers. This had particularly disastrous effects because of the delicate man-land balance in these areas. The conscription of males removed the labour required to clear the bush against the ever-menacing advance of the tsetse. Potentially fertile land was lost to the tsetse and sleeping sickness and other epidemics spread as a result of the deteriorating economic situation. (Egero, 1974; Kjekshus, 1977.)

In the North, cotton was introduced around the turn of the century and by 1910 had grown into the dominant cash crop for a steadily expanding area of cultivation. After the British

take-over of Tanganyika, the need to increase the revenue from the central railway and expanding cultivation of cotton in the Lake region led to the construction of a branch line to Mwanza. This line, completed in 1928, facilitated a southward expansion of the cotton area. The increase in the acreage from none in the beginning of the century to 142,000 acres in 1945 and 582,000 in 1960 therefore implies a corresponding increase in the proportion of land used for cotton (Egero, 1974). McLoughlin in a recent study (1971) described the cotton-growing areas as extending 220 miles from north to south and 210 miles from east to west.

#### Cotton Cultivation, Migration and Land Deterioration in Sukumaland

Colonial demands on Sukumaland and the response arising from local conditions led to expansion into new areas bounded by the ultimate lack of suitable land at the edges of the expansion field (Egero, 1974). The major influences within this area have been increasing population and the expansion of cotton-growing as a

basis of the cash economy. In the relatively densely populated areas of Sukumaland, there is no actual physical shortage of land and the better soil types are fully utilized. However, traditional means of fertility maintenance are beginning to break down. Originally, according to Collinson (1972) once the surrounding land showed signs of exhaustion the farmer moved to a new location. In the settled areas this apparently evolved into a movement of the farmer from one cultivated area to another within the potentially arable areas controlled by the family. As population pressure built up and there were no new holdings to be opened up locally by new families, the area of fallow on the family holding was reduced either in order to provide land to sons who married or the total area held by the family was divided between inheritors. Thus the traditional methods of leaving land fallow to maintain fertility broke down as the density of population increased. Although land was still available, the potential of uncultivated arable land became poorer and poorer.

One of the methods used to adapt to these new circumstances described above by Collinson has been migration to the periphery areas where land is plentiful but where soil and climatic conditions are less favourable. As Sukumaland agricultural practices of land extension appear to have been emphasized rather than intensification of cultivation through, for example, crop rotation, these practices combined with the population explosion, land clearance, livestock pressure on land and rapidly depleted soil fertility have led to what McLoughlin (1971) calls a "leap frogging" process. Farmers move at certain intervals to the new areas beyond the frontiers created by others in the period since they came to open new land. The gradual push of cotton cultivation and herding southwards and eastwards into climatically more vulnerable sandy areas is subjecting these areas to soil depletion and degradation. McLoughlin (1971) notes that from the more densely settled areas of Kwimba and Mwanza the cattle owners have been sending their herds to Shinyanga and Maswa plains. This was more recently followed by moves into the Serengeti National Park or the Wembere Plain







Table 3. Regional in-migration and net migration

	Immigration			Outmigration			Net Migration		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Arusha	52,231	30,804	83,035	13,443	11,876	25,319	38,788	18,928	57,716
Coast*	93,278	62,350	155,628	23,792	18,010	41,802	69,486	44,340	113,826
Dodoma	21,645	17,156	3,8801	29,197	21,876	51,072	-7,552	-4,720	-12,272
Iringa	12,352	9,917	22,269	37,704	22,290	59,994	-25,352	-12,373	-37,725
Kigoma	5,454	5,150	10,604	34,676	16,870	51,546	-29,222	-11,720	-40,942
Kilimanjaro	26,868	14,163	41,031	33,726	18,313	52,039	-6,858	-4,150	-11,008
Mara	19,661	20,015	39,676	18,350	13,468	31,818	1,311	6,547	7,858
Mbeya	22,943	18,152	41,095	40,886	24,246	65,132	-17,943	-6,094	-24,037
Morogoro	44,067	24,913	68,980	37,839	27,858	65,697	6,228	-2,945	3,283
Mtwara	11,060	9,082	20,142	35,257	2,2716	57,973	-24,197	-13,634	-37,831
Mwanza	57,265	45,217	102,482	78,627	74,441	153,068	-21,362	-29,224	-50,586
Ruvuma	8,283	7,680	15,963	31,850	18,850	50,700	-23,567	-11,170	-34,737
Shinyanga	61,341	59,925	121,266	54,532	53,176	107,708	6,809	6,749	13,558
Singida	15,059	13,693	28,752	42,635	31,156	73,791	-27,576	-17,463	-45,039
Tabora	70,516	65,873	136,389	45,954	38,238	84,192	24,562	27,635	52,197
Tanga	60,574	27,583	88,157	31,272	22,754	54,026	29,302	4,829	34,131
WestLake	23,375	21,328	44,703	19,457	16,075	35,532	3,918	5,253	9,171
Zanzibar	11,465	5,115	16,580	8,240	5,903	14,143	3,225	-788	2,437
All	617,437	458,116	1,075,552	617,437	458,116	1,075,552	0	0	0

\* Including Dar es Salaam

Source: Claeson and Egero (1973) p.261

seems to be increasing, especially as traditional methods of agriculture and animal husbandry have shown little change for the better.

#### Population Expansion and Desertification in Gogoland

The Gogo country around Dodoma, Tanzania's new capital, provides another example of the impact of population pressure, both human and animal, giving rise to desertification.

The Dodoma region in central Tanzania is a semi-arid plain with scattered hills of granites and gneisses known as inselbergs. The soils are reddish brown to greyish sandy loams on the gently sloping pediment plains, and black cracking clays in the floodplains. A "hardpan" layer frequently occurs in the former in which the sand is bound by alkaline clay particles to form a hard horizon (Cook, 1975). The average annual rainfall is less than 600 mm and shows large interannual and inter-monthly variability. The dry season is 7-8 months long lasting from May until December. The main tribe throughout the area is the Gogo, described as cultivating pastoralists (Rigby, 1969). Cattle plays the dominant role in their culture but their main food supply is from the cultivation of crops, especially sorghum, millet and groundnut. In this respect the live-

stock only have a supportive function, which nevertheless is an important one especially in times of drought—a frequent occurrence in the semi-arid environment. Other tribes occurring in smaller numbers are the Bena, Hehe, Maasai, Sagara and Nguu (Conyers, 1971).

Early accounts indicate that the area of the Gogo country was formerly much smaller with its peripheral districts being utilized by neighbouring nomadic pastoralists. Population increase among the Gogo people has led to an influx of cattle-keeping cultivators, thereby bringing under pressure areas previously used only for nomadic grazing. Nomadism by its very nature is transitory and does not necessarily result in overgrazing. But because modern science has enabled population, both human and bovine, to increase rapidly in the area, this previously satisfactory system of indigenous animal husbandry has broken down. The traditional shifting cultivation which ensured a sustained yield has had to give way to a quasi-static agriculture for which sustained-yield farming systems have not yet evolved (Tanzania, 1977). In parts of southern Dodoma, the situation is alarming. Previously uninhabited areas of bush have disappeared and given way to human habitation and

cultivation. The rapid increase in cattle population has led to problems of inadequate grazing (especially during the dry season), unmitigated browsing, and trampling. Driven from the exhausted flat lands, the peasants are now cultivating on the rocky hillsides and upper pediments. Insufficient fallow time between cultivation periods has led to the impoverishment of land while cattle grazing has removed the last vestiges of vegetation cover. There are no accurate stock counts for the district since the Gogo do not willingly divulge information concerning their cattle (Rigby, 1969). However, the number of cattle is estimated at one million. The cattle population density averages 1.9 hectares/stock unit. A UNDP/SF livestock project in Dodoma uses an average of 2.5 hectares/stock unit as a minimum safe density (Berry and Townshend, 1973). It is evident by this measure that Gogo territory is overstocked.

As in Mwanza, a new factor has crept into the pattern of land use in the semi-arid area around Dodoma. With the creation of large new villages established in the area during operation Dodoma in 1971-1972 and the rapid growth of Dodoma town which is planned to become the new capital, population growth and settlement are leading to increased pressure on the



# TANZANIA

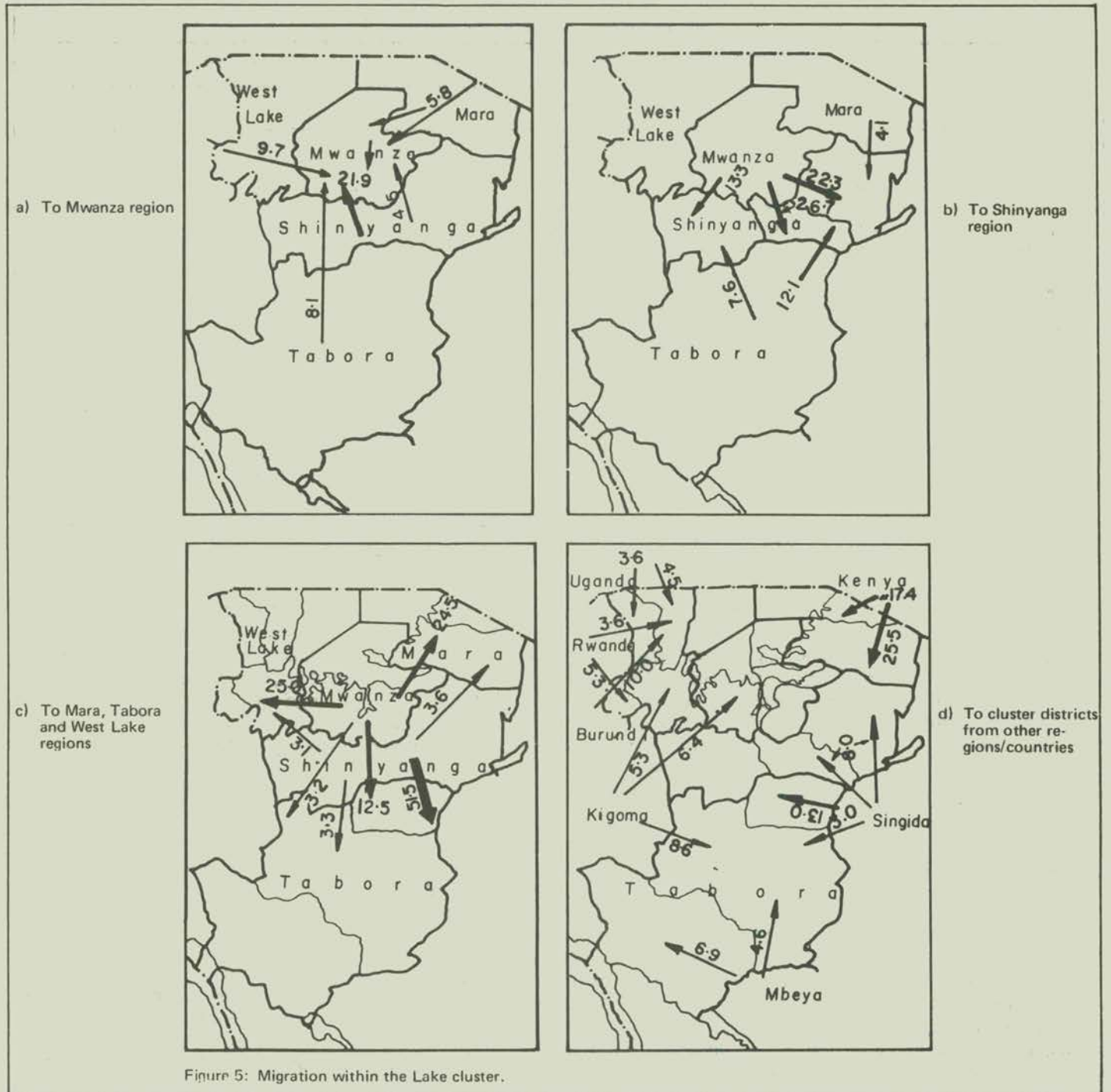


Figure 5: Migration within the Lake cluster.

soil, firewood and water resources.

## Conclusion

The degradation of the ecosystem of the semi-arid areas of Tanzania is a function, not merely of the semi-arid zone's inherent vulnerability but more important, of the human and animal pressures stemming from the rapid growth and expansion of population. Over the last half century, the unpre-

cedented population growth and increased human pressure on land in the high-potential and high-density areas have caused migration into the adjacent low-potential semi-arid steppelands and plains. As the case studies on the Lake-cluster districts and Gogoland have shown, agriculture-based, animal-based and urban-based livelihood systems are posing a serious threat to the fragile ecosystems of the semi-arid lands. Already in Gogoland, the consequences

of desertification are beginning to manifest themselves not only in decreases in the productivity of the resource base, but in recurrent famines, chronic food and water shortages and loss of animal and human life due to starvation (Tanzania 1977, pp. 9-10). The solution to the problem is not simply a matter of encouraging afforestation as is being done at present. It calls for a comprehensive, systematic and integrated approach. An action plan at the na-



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tional level is badly needed based upon the formulation of a comprehensive national human settlements and land policy. The traditional land-use system of "exploit and move" should give way to a new concept of "stay and maintain" land fertility (Rapp, 1976). Population growth prohibits a return to the ecologically sustainable fallow or rotation systems once used with success. The only alternative is to adopt new cropping systems that minimize erosion and that employ crop rotation, water conserving tech-

niques, animal manure, green manure, and, where moisture permits, perhaps chemical fertilizers (Eckholm and Brown, 1977). Villagization should mean a new situation, one of planned intensive land-use for long sustained yields. Follow-up studies on the state of the environment, monitoring the environmental impact of the large new villages established under the villagization programme, should be given high-priority as a basis for improved land-use planning. Every effort must be made to

strengthen local research capacity at the national level for that is where policies are formulated and where decisions are ultimately made. Whatever the mistakes or inadequacies of research in the arid zone of Tanzania in the past, and whatever the frustrations felt about research at present (especially on the part of politicians) there is a lack of basic scientific knowledge of arid zone resources of Tanzania. It is essential that scientific work continue and be adequately supported in terms of funding and training.

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# REVIEW OF THE IMPLEMENTATION OF THE PLAN OF ACTION TO COMBAT DESERTIFICATION

## MAJOR INSTITUTIONAL ARRANGEMENTS

### The basic framework

The United Nations Conference on Desertification (UNCOD) was held in Nairobi, Kenya, between 29 August and 9 September 1977. The Conference adopted a Plan of Action to Combat Desertification (PACD) which was subsequently endorsed by the thirty-second session of the United Nations General Assembly as a world-wide effective, comprehensive and co-ordinated programme of concerted international, regional and national action to combat desertification.

As the Implementation of the Plan of Action to Combat Desertification is expected to be carried out by Governments through their national institutions with the support whenever necessary of international or bilateral programmes, close co-ordination of national, regional and international efforts in a campaign against desertification was required. The follow-up and co-ordination of the implementation was entrusted to UNEP with its Governing Council and the Administrative Committee on Co-ordination.

Three bodies were established to assist in the implementation of the PACD:

- 1) A Desertification Unit (now the Desertification Branch) in UNEP,
- 2) A Consultative Group for Desertification Control (DESCON), and
- 3) An Interagency Working Group on Desertification (IAWGD).

These are the three main institutional mechanisms which evolved out of the Conference. Their activities since UNCOD will be discussed individually although they necessarily and continually interact with each other in the implementation of PACD.

In addition to the world-wide catalytic and co-ordinating role of the

above-mentioned institutions, the General Assembly at its thirty-third session designated the United Nations Sudano Sahelian Office (UNSO) as the arm of the United Nations to be responsible for assisting, on behalf of UNEP, the efforts of the 15 countries of the Sudano-Sahelian region to implement PACD. This number has since grown to 19. The expanded mandate of UNSO was and is a joint venture of UNEP and UNDP. (See UNSO review below.)

For the purposes of financing the Plan of Action to Combat Desertification it was recommended (recommendation 28) that in addition to traditional bilateral, multilateral and multi-bilateral assistance, and in addition to a Consultative Group for Desertification Control, a Special Account be established for the financing of anti-desertification projects drawing upon voluntary contributions for the combat of desertification by individual Governments sources. It was further recommended that a group of high level specialists in international finance be assembled to undertake a study of additional measures and means of financing for the implementation of the PACD. This recommendation resulted in three consecutive studies, the last of which was presented to the General Assembly at its 36th Session and is summarized in this issue.

The task of following up and co-ordinating the Plan of Action to Combat Desertification was originally entrusted to UNEP's Environment Co-ordination Board (recommendation 27). This activity was later placed under the jurisdiction of the newly created Administrative Committee on Co-ordination (ACC) of the General Assembly. The ACC has dealt with the question of co-ordination of the implementation of the PACD in reports to

the 8th 9th and 10th sessions of the Governing Council.

Within this basic framework specific projects and activities were undertaken by UNEP in co-operation with other UN agencies and national governments in the implementation of PACD.

### The Desertification Branch

The Desertification Branch (formerly the Desertification Unit) was established in accordance with recommendation 27 of the PACD by Governing Council decision 6/13E of 27 May 1978 to co-ordinate all activities within UNEP related to arid and semi-arid lands ecosystems and to combating desertification. Its responsibilities, in accordance with paragraph 103 of PACD are as follows:

- 1) to keep a continuous inventory of all needed programmes and activities dealing with the control and reversal of desertification;
- 2) to prepare or help to arrange preliminary surveys and technico-economic feasibility studies as a basis for formulating projects and programmes;
- 3) to prepare alternative proposals for the mobilization of the necessary capital to finance programmes and projects aimed at combating desertification;
- 4) to monitor the implementation of the Plan of Action;
- 5) to record the results of the monitoring of desertification
- 6) to prepare, compile, edit at six-monthly intervals a newsletter, giving information on programmes, results and problems related to the combat against desertification around the world.

In addition it serves as the Secretariat for the Consultative Group for Desertification Control, and for the Inter-Agency Working Group on Desertification.



In connection with item 6 the Desertification Branch has undertaken the publication of *Desertification Control* on a six-monthly basis. The Branch serves a general information function for UNEP and UN agency activities in desertification control.

Since 1977 the Desertification Branch has been responsible for presenting 12 project proposals to the Consultative Group for Desertification Control (DESCON). The Desertification Branch has been instrumental in ensuring that proper follow-up procedures are initiated concerning statements of support by member Governments and institutions for specific projects presented to DESCON. It has published six issues of the *Desertification Control* bulletin, and has initiated training seminars and workshops, including the publication of manuals in co-ordination with individual Governments. The Desertification Branch has organized preliminary missions to nine desertification-prone least developed countries in Africa and Asia, to explore their desertification problems and offer UNEP assistance in planning for combating of desertification. Two of these countries, Burundi and Tanzania, requested assistance from UNEP. Special planning missions arranged by UNEP were sent to these countries to help their respective Governments to develop their own national plans of action to combat desertification. The Desertification Branch will be responsible for co-ordinating the major stock-taking exercise in 1984 and general co-ordination of the assessment of progress in combating desertification since 1977.

#### **The Consultative Group for Desertification Control**

The Consultative Group for Desertification Control was established in accordance with General Assembly resolution 32/172 of 19 December 1977 to assist in mobilizing resources for activities forming part of PACD. The Group comprises representatives of relevant UN bodies, such other organizations as might be required, multilateral financial agencies, and developed and developing countries with a substantial interest in combating desertification.

The Consultative Group is co-sponsored by UNEP with UNDP, UN/DTCO, UNESCO, FAO, UNFPA, UNIDO WFC, and WMO. Core members are, at present, the following Governments and organizations: Australia, Bolivia, France, Federal Republic of Germany, India, Iran, Iraq, Japan, Kenya, Kuwait, Libya, Mexico, Netherlands, Niger, Senegal, Sudan, Sweden, USA, Upper Volta, Uruguay, the Arab Bank for Economic Development in Africa (ABEDA), the Arab League Educational, Cultural and Scientific Organization (ALECSO), The Arab Fund for Economic and Social Development (AFESD), the European Economic Community (EEC), the International Fund for Agricultural Development (IFAD), the Permanent Interstate Committee on Drought Control in the Sahel (CILSS), UNSO, the World Bank and the World Food Programme (WFP).

DESCON held its first meeting in Nairobi from 2 to 5 May 1978 at which it agreed on policy issues, organization and procedures. Over the next two years the Executive Director of UNEP sent missions to desertification-prone developing countries, various co-sponsors, potential donor countries and institutions to consult and prepare for DESCON-2. Twenty-seven projects prepared with the assistance of UNEP and UNSO were submitted by Governments to DESCON-2. Of these, 20 proposals covering 13 countries of the Sudano-Saharan region were submitted through the UNSO and seven proposals from five countries by the Desertification Branch.

The second session, convened in May 1980, considered these proposed projects with the purpose of securing technical and financial support. Twenty-six of the 27 proposals received expressions of support ranging from near commitment to mere expressions of interest. The recipient Governments held the main responsibility for co-ordinating and following up the expressions of support with the assistance of UNDP, as the representative of UNEP. As of this writing eight of the projects are fully financed, ten have received some commitment for finance for technical assistance, and four have received no support or have been set aside by the Governments who presented them. The ex-

perience of DESCON-2 and the process of its follow-up provided valuable lessons on organization and procedures for future DESCON meetings.

The third session of the Consultative Group for Desertification Control was held in Geneva 26-28 August 1981. A total of 12 project proposals was presented to the meeting; five with the assistance of UNEP, six with the assistance of UNSO, and one by FAO. The projects varied from specific technical assistance programmes to programmes of global significance. At the meeting potential donors were identified and the recipient Governments were guided on the means to be taken to secure the expressed financial support. The measures for improved follow-up were agreed upon along with improved procedures for identification, preparation and submission of projects to the next DESCON meeting. At present, Governments with the assistance of UNSO and Desertification Branch of UNEP are involved with the follow-up of DESCON-3 and with preparations for DESCON-4 scheduled for early 1983.

#### **Inter-Agency Working Group on Desertification (IAWGD)**

The Inter-Agency Working Group on Desertification was established in September 1978 to co-ordinate the programmes and activities of the specialized agencies and organizations of the United Nations concerned with implementation of the PACD. It is responsible for ensuring that the activities undertaken follow the mandate given by the UN General Assembly and the UNEP Governing Council. It reviews anti-desertification projects undertaken within the UN family to ensure their relevance to the PACD, to see whether these projects are effectively addressing its objectives and to identify any gaps or overlaps hindering its concerted implementation.

At its second meeting on 17 September 1979 the Inter-Agency Working Group reviewed a draft report on anti-desertification activities within the UN system relevant to the implementation of the PACD. The report was the first attempt to show the relationship between the activities of the IAWGD members and the recommendations of the PACD. Certain recommendations, it was noted,



# REVIEW OF PACD/UNEP

had been neglected. Further emphasis, for example, was needed on those aspects of the PACD concerned with socio-economic incentives and other factors relevant to bringing out the active participation of the population.

At its third meeting in September 1980 a draft "Compendium of Programmes of the UN System in the Field of Desertification" was reviewed. A second draft of this document was circulated at the fifth IAWGD meeting.

The fourth and fifth meetings of IAWGD in April and September 1981 further reviewed and defined UN activities in the implementation of the PACD and began to look forward to

- 4) Monitoring of desertification processes and affected natural resources in South America;
- 5) Establishment of a North Saharan green belt;
- 6) Establishment of a Sahel green belt.

Several component projects within each transnational project were identified and recommended for further study. Since UNCOD there have been many individual projects undertaken by the UN system which come under one or another of these transnational projects.

*The transnational "Green Belt in North Africa".* This project was created by UNEP to provide an incentive

at the end of 1981.

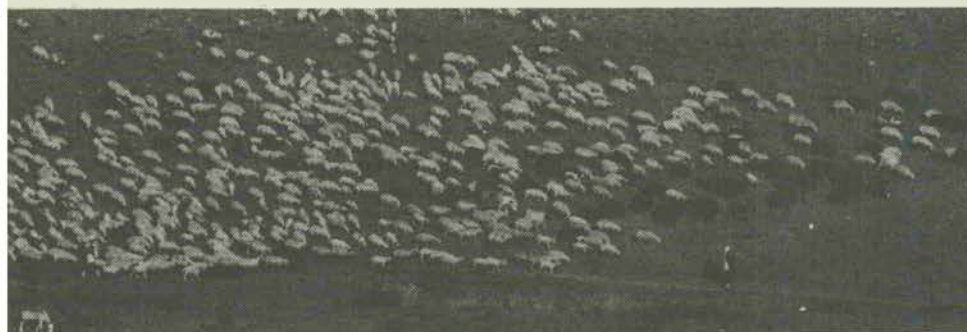
*The regional monitoring of desertification processes in south-west Asia and South America.* Three projects coming under the concept of the transnational project were presented to DESCON-2. The projects belong to a series of national monitoring projects designed by GEMS with the aim of establishing ecological monitoring units within the existing governmental facilities of Peru, Argentina and Bolivia and to use the GEMS methodology to provide vital ecological information on the state and trend of land-productive systems. The Peruvian and Argentinian monitoring projects were reconsidered at DESCON-3. Both projects as well as the one from Bolivia will be resubmitted to DESCON-4.

## Other action at the international level

A number of activities have been implemented at the international level. Some date from before UNCOD.

*UNEP/UNESCO Integrated Project on Arid Lands (IPAL—Kenya).* This project started in Kenya in 1976 within the framework of Man and Biosphere (MAB) programme of UNESCO with the objective of finding direct solutions to the most urgent environmental problems associated with desertification and mounting a programme to help the country control soil erosion and to support the training of experts in natural resource management and rehabilitation in arid lands. The project is now continued by the Government of Kenya with the financial and technical assistance provided by the Federal Republic of Germany and UNESCO. A second IPAL project began in 1978 in Tunisia which promoted integrated approaches for the improvement and rational management of arid and semi-arid rangelands. The first phase is scheduled for completion in March 1982. (See UNESCO P.42.)

*UNEP/FAO project on Ecological Management of Arid and Semi-Arid Rangelands in Africa, the Near and Middle East (EMASAR).* EMASAR phase II was implemented by FAO to design and formulate a plan of action to develop co-operation among the Governments concerned and to support regional and subregional projects and plans for the rehabilitation or the improvement of grazing land



A flock of sheep and goats grazing on a hill in Iran. Overgrazing of pastures eventually leads to their loss to desertification. J. Mohr/WHO

the major stock-taking exercise in 1984. (See NEWS)

## MAJOR UNEP-SUPPORTED PROJECTS TO IMPLEMENT THE PACD

### Activities under transnational projects

Six transnational projects were reviewed at UNCOD in 1977 and recommended as a general framework for the immediate implementation of PACD. They serve as models for large-scale regional and international co-operation to combat desertification. They are:

- 1) Management of livestock and rangelands in the Sudano-Sahelian region (SOLAR);
- 2) Management of the major regional aquifer in north-east Africa and the Arabian Peninsula;
- 3) Monitoring of desertification processes and affected natural resources in south-west Asia;

for establishment of a co-ordinating body for realization of the green belt under the aegis of ALECSO. Phase I of the project is completed; phase II is being implemented. The earlier phase helped in devising five projects for the north African countries, which were submitted to DESCON-2, where financial support was identified and procedures for their implementation initiated.

*The regional aquifers of north-east Africa and the Arabian Peninsula.* The north-east Africa component of the project has been signed by the Governments of Sudan and Egypt, as well as UNTCD and UNEP, following its submission to the Second Consultative Group for Desertification Control (DESCON-2). The aim of the project is to evaluate the potential of the regional (Nubian Sand stone) Aquifer for anti-desertification purposes and identify appropriate regional means to exploit this resource. The initial financing has been obtained, a project co-ordinator was appointed and the project became operational



resources in arid and semi-arid lands. UNEP supported a small portion of this project in its early phases.

*UNEP/FAO project on Assessment and Mapping of Desertification.* This project began in 1980 on the basis of the findings of an expert meeting held in May 1979. Its purpose is to develop an internationally acceptable methodology for the assessment and mapping of the causes and dynamics of desertification and to test this methodology in a series of pilot projects. The project is executed by FAO with the support of UNEP, UNESCO, WMO and ICSS.

*UNEP/USSR project on Combating Desertification through Integrated Development.* This project was formulated as a direct response to recommendation 4 of the PACD. It seeks the utilization of industrialization and urbanization as a means to combat desertification. A training course was organized in the USSR from 18 April to 22 May 1980. Twelve specialists from five countries attended the course. An international symposium on the same subject took place from 5 to 10 October 1981. (See News)

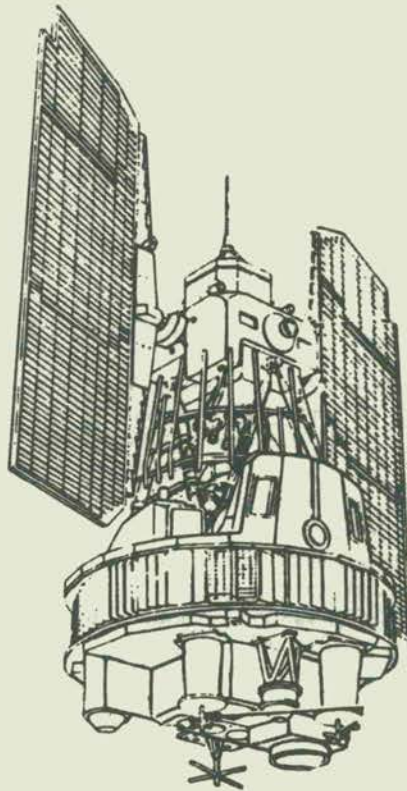
*Global Environment Monitoring System (GEMS) of UNEP.* In addition to the desertification monitoring projects under the transnational concept referred to above, GEMS is directly involved in two projects related to desertification:

- 1) Pilot Project on the Inventory and Monitoring of Sahelian Pastoral Ecosystems: The project will identify operational problems to ecological monitoring within dry regions of West Africa. It will contribute to a standard rangeland inventory and monitoring methodology.
- 2) The Use of Modern Remote Sensing Techniques in Monitoring Desertification of Natural Resources in Egypt: The Government of Egypt intends with this project to promote a national system for detecting and assessing environmental problems of arid lands ecosystems through appropriate inventory and monitoring methodologies. Special emphasis will be placed on the use of satellite remote sensing.

#### **International training courses and workshops**

Several training seminars and

workshops have been implemented since UNCOD, principally the training programmes set up in co-operation with the governments of the USSR and China. Two seminars sponsored by UNEP took place at the Institute of the Desert, Lanchou, China in 1978 and 1981. Six-week training courses on three different subjects were organized and held in the Soviet Union each year since 1978 under the project "International Training Courses on Desertification Control". In 1978 and 1979 two courses were held on each of the two topics "Sand Dune Fixation and Pasture Improvement" and "Reclamation of Saline Irrigated Soils". In 1980 and 1981 three similar courses were given including one on "Rangeland Ecology and Pasture Productivity" (see NEWS). A United Na-



*A Landsat satellite, which provides the third tier in the GEMS land resources monitoring strategy.*

tions University (UNU) workshop on training and management for arid lands, convened in the Federal Republic of Germany in Hamburg, 1979, was attended by some 30 participants from the world-wide academic community concerned with arid lands and by representatives of UNEP and UNESCO. A Workshop on the Physics of Desertification was

held in November 1980 at Trieste, Italy which was attended by 80 specialists and scientists from developing countries. The regional implementation of PACD was discussed at workshops organized by ECWA (Damascus, Syria) and ESCAP (Jodhpur, India) in May and October of 1981 respectively. (See NEWS)

#### **Action at the national level**

Several projects supported in part by UNEP were developed out of missions to National Governments upon their request for assistance in establishing National Plans of Action and identifying high priority anti-desertification projects in these countries. For example "Green Belt Around the City of Niamey" will help control desertification resulting from excessive wood cutting around the city of Niamey and will contribute to the general knowledge of desertification problems and related problems of energy and employment endemic to urban centres. Among the more recent projects is "Pilot Project for Extension and Creating Awareness in respect of Desertification Control in the Bir Lahmar Perimeter" which will develop protected areas for natural regeneration of vegetation and other strategies to combat desertification based on the participation of the local population in Tunisia's arid and semi-arid regions.

#### **Evaluation activities**

In its report to the eighth session of the Governing Council of UNEP and based on the findings of the Inter-Agency Working Group on Desertification, the ACC identified several factors it considered major constraints to the full implementation of the PACD. These were:

- 1) Governments of countries faced with desertification problems or risks are confronted with conflicting demands on their scarce financial and human resources. They appear unable at present to assign sufficiently high priority to desertification prevention or control.
- 2) There is a need to strengthen co-operation within the United Nations system so as to ensure the proper multidisciplinary approach to projects and to arrange for effective pooling of the efforts and resources of various agencies and bodies.



# REVIEW OF PACD/UNSO

- 3) Although there is a wealth of known technology in the area of desertification control, there is still a need to fill gaps in that knowledge, particularly in regard to integrated interdisciplinary approaches including socio-economic dimensions.
- 4) Insufficient financing is seriously limiting the efforts of the United Nations system to implement the PACD. There is an urgent need for external sources of financing to increase support for anti-desertification projects.

The ACC has continued to report to each session of the Governing Council on environmental matters in general and on the co-ordination and follow-up of PACD. It has been instrumental in identifying priority areas of activity for the strengthening of the efforts and co-operation of the UN system in the field of desertification control.

## UNITED NATIONS ORGANIZATIONS AND AGENCIES

### UNSO

An important feature of the follow-up to the Plan of Action to Combat Desertification in the Sudano-Sahelian region, which is perhaps the region of the world most severely affected by desertification, was the setting up of special arrangements whereby the United Nations Sudano-Sahelian Office (UNSO), on behalf of UNEP, would implement the Plan of Action. UNSO was established by the Secretary-General in 1973 originally to help the State members of the Permanent Inter-State Committee for Drought Control in the Sahel (CILSS) in implementing their drought-related medium- and long-term recovery and rehabilitation programme. Its activities include assistance in planning, programming and the mobilization of resources. With its home office at UNDP Headquarters in New York and a regional office in Ouagadougou, Upper Volta, UNSO, at the time the joint venture was established, was already dealing with a variety of problems in the CILSS countries closely related to the process of desertification.

The specific arrangements defining UNSO's responsibilities are embodied in a joint UNEP/UNDP venture, under which UNSO assists the 19 countries of the region, on behalf of UNEP, in implementing the Plan of Action.\* The joint venture was authorized by the General Assembly in December 1978, following decisions by the UNEP and UNDP Governing Councils and an endorsement by the Economic and Social Council earlier that year.

Shortly after the authorization by the General Assembly, the Executive Director of UNEP and the Administrator of UNDP signed a memorandum of understanding in Nairobi on 8 January 1979, spelling out the modalities of the joint venture. On the same date, they informed the Governments of the Sudano-Sahelian countries of the special arrangements entered into by UNEP and UNDP under which UNSO, in addition to its drought-related functions, was to assist the countries, on behalf of UNEP, in combating desertification.

In order to respond effectively to its new mandate, UNSO organized in 1979 a series of planning and programming missions. The missions, which included representatives of the concerned agencies of the United Nations system, visited Cape Verde, Ethiopia, Gambia, Kenya, Mali, Mauritania, Niger, Nigeria, Senegal, Somalia, Sudan, United Republic of Cameroon and Upper Volta. Working closely with the Governments, the missions assessed the problem of desertification in the countries visited, reviewed relevant on-going activities, discussed the preparations of national plans and the establishment of co-ordinating mechanisms for combating desertification and helped to identify and formulate additional priority desertification control projects.

In mid-1979, UNSO convened a meeting in Dakar of the UNDP Resident Representatives of the Sudano-Sahelian countries. It was addressed by the Executive Director of UNEP and attended by representatives of

\*The countries are Benin, Cape Verde, Chad, Djibouti, Ethiopia, The Gambia, Guinea, Guinea-Bissau, Kenya, Mali, Mauritania, Niger, Nigeria, Senegal, Somalia, Sudan, Uganda, United Republic of Cameroon and Upper Volta.

United Nations bodies and of CILSS. The meeting agreed on a set of conclusions which recognized the need for vigorous, concerted and immediate action through systematic national planning and co-ordination, the use of innovative approaches and the exchange of technology and experience. The meeting further stressed the importance of anti-desertification measures in the preparation of assistance programmes in the region.

UNSO began in 1980 with the presentation, jointly with CILSS, of a CILSS/UNSO Unified Plan for Combating Desertification in the CILSS Member States, which was approved by the CILSS Council of Ministers and the Heads of States Conference in January. The unified plan, which follows the United Nations Plan of Action to Combat Desertification, provides for a common approach to combating desertification in the CILSS member States.

Planning and programming missions were sent to Djibouti in 1980 and to Guinea, Guinea-Bissau, Uganda and Benin in 1981. Only one country Chad, of the 19 countries covered by UNSO's desertification control mandate has not yet been visited by an UNSO planning and programming mission, and consultations are taking place regarding the possible timing of a mission to that country.

An effective approach, which was emphasized in 1981, has been the fielding of joint missions with representatives of donor Governments for the detailed formulation of projects. There were six such joint missions during 1981, involving representatives of the Danish International Development Agency (DANIDA), the Swedish International Development Agency (SIDA), and the Governments of Finland and Yugoslavia. The joint missions had the advantage of involving the potential donors from the beginning, so that they could participate fully in the identification and formulation stages of projects. This method facilitated their decision-making process for the provision of assistance to these projects.

As a result of its various activities, UNSO has identified and formulated with the Governments of the region a total of 231 priority projects aimed at combating desertification, requiring an investment of \$693 million, of which a total of over \$350 million has



been committed from bilateral and multilateral sources leaving a total of over \$343 million in external resources still required. The principal aims of these projects are the following:

- Control of deforestation: village and family afforestation and reforestation schemes, development of fuel wood substitutes from agricultural waste products and solar and wind energy, production of fuel-efficient cooking stoves;
- Range management: fodder production, grazing management around permanent water supplies, development of alternative or supplementary sources of income for pastoralists to relieve the pressure on the land;
- Water resources management: careful use of groundwater, collection, conservation and optimum utilization of surface water through various means ranging from small earthen dams to extensive water and soil erosion control works;
- Sand dune stabilization: surveys of sand dunes and factors causing dune formation, use of mechanical and vegetative means in dune fixation.

As a result in part of UNSO assistance in planning at the national level

for combating desertification, eight Governments in the Sudano-Sahelian region have taken or are preparing measures for the formulation of national policies and strategies for combating desertification and the establishment of relevant co-ordinating machinery.

The projects assisted by UNSO focus on the main causes and manifestations of desertification in the region and respond to the priorities set by the Governments and their specific requests for UNSO assistance. In addition to the technical aspects of sound project design, UNSO emphasizes popular participation—through the full involvement of village and family units, school teachers, co-operatives and the like—which is essential for the success of desertification control projects. UNSO's working methods also emphasize flexibility and speed in responding to needs and priorities, the strengthening of national capabilities and the optimal participation of national services in project formulation, implementation and evaluation.

All UNSO-assisted projects are executed in accordance with the operating procedures of UNDP, enjoy the full benefit of UNDP's facilities and network of Resident Representatives and form an integral part of the devel-

opment process. They follow the policy guidance of the Executive Director of UNEP, reflecting the joint responsibilities assumed by UNEP and UNDP for assisting in the implementation of the Plan of Action to Combat Desertification in the Sudan Sahelian region.

#### FAO

The EMASAR project, implemented by the Grassland and Pasture Crops Group of the FAO Plant Production and Protection Division, has been in operation since 1974. The main concept of the project is to encourage country action and initiative to promote the rehabilitation or the improvement of grazing land resources in arid and semi-arid lands. It tries to foster an integrated land use approach for management of natural resources within the potential and limitations of each specific ecosystem in order to harmonize grazing lands, livestock and wildlife production, woodlands, forests and watersheds, forage and crop production with human economic needs and social conditions. Because the vegetation cover on rangelands plays a vital role in preventing and controlling desertification, particularly in arid and semi-arid ecosystems, it is clear that range management, which aims to improve and preserve the vegetation cover, must play a key role in reversing the process of desertification.

In the preliminary phase of the Project a small secretariat was established to undertake actions for the implementation of the programme, particularly to provide guidance and assistance to the countries wishing to participate in the project. However, because of their slow response in requesting assistance, an EMASAR Phase II project was developed in collaboration with UNEP in 1976. A joint FAO/UNEP Phase II was funded and implemented during 1977-78.

EMASAR Phase II was originally strongly oriented to the elaboration and publication of nine technical studies in the field of grazing land development and management, forage plant material and grassland education and training. In addition sixteen countries were invited to discuss and identify the formulation of projects. During 1979 a working document on trees and shrubs of the arid and semi-arid areas was prepared.

*In Rajasthan (India) rain water is collected in open ponds called nadis. Humans and animals use the nadis for all purposes in the absence of any other source of water. The wide surface area leads to rapid evaporation. A.S. Kochar/WHO*





## REVIEW OF PACD/WMO

The field activities of EMASAR Phase II involved in particular the formulation of projects under the EMASAR concept which strongly emphasizes the integrated nature of resource management. Specific projects include the production of fodder crops or fodder reserves development, grazing land monitoring, training, etc. Projects have been formulated for Afghanistan, Algeria, Cameroon, China, Iran, Iraq, Jordan, Kenya, Libya, Mali, Mongolia, Mauritania, Niger, Pakistan, People's Democratic Republic of Yemen, Saudi Arabia, Senegal, Somalia, Sudan, Syria, Upper Volta and Yemen Arab Republic, totalling 22 countries. Projects are financed by various donors, UNDP and UNEP.

The present EMASAR activities cover various disciplines related to the main components of rangeland ecosystems, such as environment, vegetation, animals and man, and concern also research, training, demonstration and development activities which could be undertaken according to countries' needs, separately or in an integrated way.

Three main types of projects are now in operation:

- 1) Specific projects concerned with filling the gaps in various disciplines such as collection, testing and evaluation of forage species, vegetation mapping, primary production evaluation, rangeland monitoring, training, etc.
- 2) Integrated projects oriented towards demonstration and development which take into consideration all the elements of ecosystems with regard to rangeland and livestock improvement.
- 3) Participation in other projects operated by other FAO divisions – FOR, AGL, AGDE, etc. which require technical support in the field.

In the beginning of 1981, 92 EMASAR projects were in progress in 35 countries. Collaboration with other international programmes, especially with UNESCO/MAB-3, and with national and international institutes are maintained.

### WMO

The WMO Executive Committee, in response to the UN General Assembly



*General view of cattle drinking from watering troughs in Eastern Niger. The livelihood of several nomadic tribes, including the Foulani, the Bororo and the Toureg, depends on their cattle. Banoun/Caracciolo/FAO*

Resolution 32/172 of 19 December 1977 and UNCOD Recommendation 23, adopted Resolution 17 (EC-XXX) "WMO Activities in contribution to the combat against desertification", and adopted a Plan of Action which provides the meteorological and hydrological components in activities related to desertification control. It also aims at highlighting the need to understand the role of meteorological and hydrological factors in the desertification process and to incorporate such factors in anti-desertification projects.

Within the framework of the Plan, WMO played an active part in the fight against desertification by sending an associate expert to the UNEP Desertification Branch for a period of one year in accordance with UNCOD Recommendation 27. The associate expert later undertook missions to survey the investigations and research projects in a number of developed desert-prone countries. He examined the relationship between climate and desertification and their impact on each other. The missions also collected ideas and comments on all aspects of the role of atmospheric sciences in desertification control and identified possible in-

dices, parameters and indicators, based on meteorological, hydrological and climatological data for use in the FAO/UNEP project on Desertification Assessment and Mapping in which WMO is participating as an associated agency.

WMO co-operated with UNEP and other relevant UN agencies and Member countries in the combat against desertification mainly by providing assistance to develop meteorological and hydrological data collection networks in arid and semi-arid regions. It participates in the activities of the Inter-Agency Working Group on Desertification which has been set up to co-ordinate activities of different UN agencies in the implementation of the Plan of Action, and played host to the fifth session of the Group. WMO has also been participating in the work of the Consultative Group for Desertification Control (DESCON) to ensure that meteorological and hydrological aspects are well integrated into the anti-desertification projects supported and implemented by its members.

WMO was represented at the following meetings on subjects related to desertification:

- a) Expert meeting on Management,



Conservation and Development of Agricultural Resources in the ECWA Region, Damascus, 9-15 May 1981. (See News)

- b) USSR/UNEP International Symposium on Combating Desertification through Integrated Development, Tashkent, 5-15 October 1981. (See News)
- c) ESCAP Regional Training Workshop on Implementation of the Plan of Action to Combat Desertification, Jodhpur, 20-23 October 1981. (See News)

WMO is one of the co-sponsors of the AGRHYMET Centre of the CILSS countries in the Sahel region. The aim of the project is to strengthen the agrometeorological and hydrological services of the countries to enable them to provide information for agriculture and to establish a Regional Training Centre in agrometeorology and hydrology. A study of desertification is also being included in the programme of the Centre.

In its technical assistance programme, WMO continues to assist Member countries including those in arid and semi-arid areas to improve their capacity to provide a useful contribution to agricultural production through short-term and medium-term consultancy missions. WMO has also assisted in the field of data collection, handling and processing, establishment of data banks, provision of additional instruments and equipment, and training.

In co-operation with FAO and ESA, WMO has contributed to successful training courses on satellite remote sensing applications to agricultural meteorology and rural disasters, which include aspects of desertification.

The WMO Technical Commission for Agricultural Meteorology has been active in various aspects of problems relating to arid and semi-arid ecosystems and desertification.

#### Future Plans

- a) WMO is planning to hold a workshop during 1982, in co-operation with FAO, UNEP and UNESCO, on meteorological aspects of agricultural production management in semi-arid, arid and desert areas.
- b) WMO drew up a sub-project entitled "The assessment of meteorological effects on Sahelian Pas-

toral Ecosystems" for submission to DESCON for consideration. This is a sub-project to the main FAO/UNEP Pilot Project on the "Inventory and Monitoring of Sahelian Pastoral Ecosystems".

- c) WMO is considering the proposal submitted to DESCON-3 for the establishment of a Centre similar to the AGRHYMET Centre of the CILSS countries in the eastern part of Africa covering Somalia, Ethiopia, Sudan, Kenya, Djibouti - for agrometeorological studies including desertification, and will undertake feasibility studies in due course.

#### WORLD BANK

The World Bank has been active in combating desertification before and since the United Nations Conference on Desertification (UNCOD) in 1977. Four major projects, which are located in different parts of the world, are representative examples of their activities.

In Ethiopia the World Bank has been involved in the Sirinka Catchment Reclamation Pilot Project. The project is located in the Wollo Administrative Region of Ethiopia and covers two overlapping problem areas. Its dual objective is to test effective and low-cost, replicable means of dealing with (1) the erosion of the highlands of the North Central Massif and (2) the drought problems of the surrounding areas.

Soil denudation on steep slopes rather than rainfall deficiency is the cause of the low support capacity of the first area. The degraded highlands in the North Central Massif extend over an area of 70,000 sq km and are chronically prone to famine. Efforts are being made to improve land productivity by stabilizing the soil and by conservation along with extension training and services. The second area is located around the peripheries of the massifs, and consists of hills and lower lands. It extends over an area of 50,000 sq km and has a higher potential support capacity. However, it is frequently affected by droughts which, if they occur in succession, lead to acute regional famines. Efforts are directed towards water conservation, on-farm improvements and extension service campaigns. The latter include the introduction of locally acceptable,

drought-resistant crop varieties, improved grazing control and intensifying fodder production methods.

In Kenya, the World Bank Project is situated on the edge of the country's main semi-arid region and covers a variety of ecological types. The project itself is called the Baringo Pilot Semi-Arid Areas Project. The area's two major features are the substantial changes in flora (from grass to acacia bush) which have occurred over the past 60 years, and the occurrence of scattered pockets which are suitable for arable agriculture in an area which would not normally sustain it. The project's aim is to experiment in soil and water conservation, water harvesting, crop production and range utilization. These projects are not only technically viable but are also managerially and socially acceptable to the local population.

The Drought Rehabilitation Project in Somalia involves rehabilitating nomads who were gravely affected by the successive droughts of 1973 and 1974. This will be done by:

- a) establishing three agricultural settlements in the southern part of the country;
- b) establishing fisheries settlements along the coastal areas; and
- c) initiating measures to arrest deterioration of rangelands.

Farm operations in the three settlement areas started in 1976. However, one settlement area has to be abandoned because of soil salinity. Although the project initially stressed labour-intensive methods, it was found that crops could not be grown successfully under such arrangements. Therefore a trial programme using high technology with a highly mechanized approach was started in

*Farmer in Rajasthan (India) fitting pipes to redirect to his fields the water from a well dug into the underground rock. A.S. Kochar/WHO*





# REVIEW OF PACD/UNESCO

1980. The results were encouraging and the trials continue.

In Zimbabwe the woodlands are experiencing tremendous pressures as a result of agricultural development and of population pressures around main cities. To relieve the pressures, the Government of Zimbabwe has devised a rural afforestation project. The project will encourage people to develop their own woodlots for fuel and wood poles. The project proposals which would be the first phase of a long-term rural afforestation programme and which is in its last stage of preparation, would consist of:

- a) setting up 150 nurseries of mainly eucalyptus in 32 districts, where wood shortage is severe, each nursery will include a small seedling production plot and a 10-ha demonstration woodlot;
- b) developing facilities in each nursery where plants would be sold to farmers and district councils wishing to establish woodlands;
- c) providing extension services by the Forestry Commission for running of nurseries and woodlands;
- d) developing block plantings of eucalyptus in forest areas;
- e) establishing fuelwood lots at major urban areas.

When in full production, the 150 nurseries would have a planting potential of some 10,000 ha annually, allowing for a 30 per cent loss of seedlings. The project's substantial training component will be funded by the Government of Zimbabwe.

## IFAD

The magnitude and range of projects supported by IFAD to combat desertification is extensive. However, the Sudano-Sahelian region has been given priority attention by IFAD. IFAD's commitments to the region and activities currently under consideration are as follows:

### Basic loans

Approximately 130 million dollars worth of loans have been extended to nine countries of the Sudano-Sahelian region for purposes of agricultural and rangeland development, irrigation projects and general rural development. In addition similar loans are being prepared for more countries in the region including a loan of 145 million dollars for agricultural development of the Eastern Ord region of

Upper Volta.

### Technical assistance

IFAD has extended technical assistance grants for projects preparation in Gambia, Kenya, Mali, Senegal and Upper Volta. A technical assistance grant for training farmers in rice production is under preparation for Mauritania. Technical assistance provided by IFAD for the countries in the Sahelian region has been at a total cost of 1.3 million dollars.

In designing projects in the Sudano-Sahelian region IFAD attempts to take into account the need to combat desertification. In this regard the Fund is of the view that social and economic considerations should be given attention to encourage the rational use of available natural resources.

### UNESCO

From the beginning the MAB programme of UNESCO has emphasized problems of arid and semi-arid zones, first, because their ecosystems are particularly fragile and varied and, second, because the programme started when the international community realized the seriousness of these problems, particularly after the drought of the late 1960s and early 1970s in the Sahel zone.

Several operational activities (training, acquisition of new knowledge, popularization and demonstration) have been undertaken in different regions of the world. Among the great number of projects in arid and semi-arid zones only five will be briefly considered here. They are:

- IPAL-Kenya Project
- IPAL-Tunisia Project
- REMDENE Project in Egypt
- PPS project in Mali
- Post-graduate course in integrated range management in the Sahel.

### Integrated Project on Arid Lands (IPAL)—Kenya

The IPAL-Kenya Project has been in operation since 1976 and was initially supported financially by UNEP. It is a pilot project aimed at developing solutions to combat desertification and the degradation of soils in arid zones. Since 1980 the project has been financed by the Federal Republic of Germany. It covers a working area of 22,500 km<sup>2</sup> between Lake

Turkana and Marsabit in northern Kenya, which is inhabited mostly by nomadic pastoralists.

During its first phase, studies were undertaken on the following aspects:

- Natural resources inventory of biotic (vegetation, animals) and abiotic components (climate, soils, water) of the ecosystem;
- Analysis of the main processes responsible for desertification and application of adequate techniques in order to combat this phenomenon;
- Study of the constraints that impede the development of the pastoral sector.

Training and demonstration activities were also undertaken to ensure the popularization and extension of the results of these studies.

Precise experiments were undertaken in the following areas:

- the conditions and requirements for the spontaneous regeneration of vegetation;
- the response of certain plant species to different soil and water conditions;
- appropriate feeding and husbandry practices of the principal animal species in the area.

All these experiments provided large amounts of readily available data which permitted a greater understanding of the processes under investigation.

The project makes use of the available data concerning the natural and socio-economic environment in order to emphasize these factors in the elaboration of a management plan for the working area.

### Integrated Project on Arid Lands (IPAL)—Tunisia

This project, also supported by UNEP, is very different from the IPAL-Kenya project in that it expands upon projects which were already in existence and is designed to investigate more fully certain points which received only superficial attention previously. The project complements earlier projects such as the Research Project for the Development of Central Southern Tunisia and Desert-Biome.

The IPAL-Tunisia project focuses on three main subjects as follows:

- a) the problem of regeneration of plant species for application in sand dune fixation activities;



- b) the dynamics of wind erosion and the implementation of techniques to decrease its destructive effect;
- c) camel husbandry.

This project emphasizes as well the importance of training and demonstration activities.

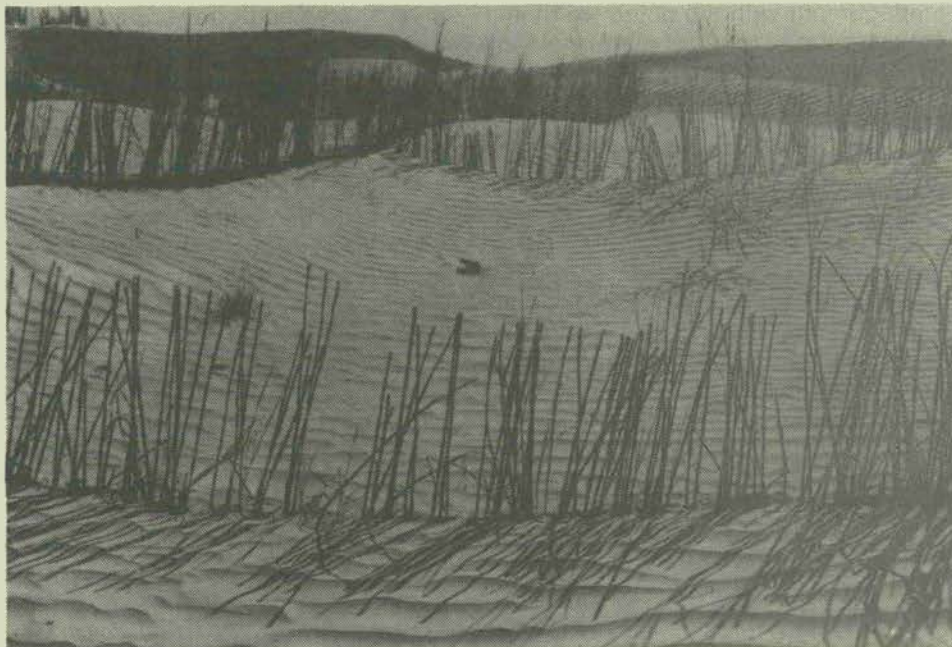
The experiments and observations are undertaken in the Jeffara zone, an pre-desertic zone where the average yearly rainfall is between 100 and 200 mm and where the degradation is mainly caused by increasing animal and human pressure on the environment. As these studies are quite recent it is very difficult to give final conclusions. However some observations on wind erosion can be made:

- Natural wind damage in the working area is relatively limited;
- Desertification is not linked to sand invasion but is a result of local destabilization in a fragile ecosystem;
- Incorporation of plant cover (straw, plant mulch) on soils decreases wind erosion and increases agricultural productivity.
- Human activity seems to be an important initial cause of land degradation.

Finally some studies on socio-economic problems related to the utilization of water resources in view of the integrated management of pre-Saharan areas in Tunisia are being undertaken within the framework of other programmes such as that of the Arid Zone Institute of Medenin with which the IPAL project is associated.

**Regional Environmental Management of Mediterranean Desert Ecosystems of Northern Egypt (REMDEME)**

The REMDEME project started in 1979 as an extension of a similar project started five years earlier in 1974 called the SAMDEME Project or Systems Analysis of the Mediterranean Desert Ecosystems of Northern Egypt. Both are associated with Egyptian scientific organizations such as the University of Agriculture in Alexandria. Funds are provided by bilateral aid from the United States and scientific experts from the United States, Great Britain and France participate. The first phase (SAMDEME) was designed to provide basic studies related to the knowledge of ecosy-



*A dune fixation and afforestation experiment in Libya near Tripoli: planting Saccharum aegyptiacum by the grid system. FAO*

stems in the northern Egyptian desert. The second phase (REMDEME) is concerned with:

- inventory and evaluation of natural resources;
- effects of different land-use patterns (grazing, settlements, etc.) on the environment;
- development of guidelines using the information collected and aimed at the development of natural resources and production.

After a detailed study on the different components of ecosystems and the principal irrigation systems the project has produced maps as a basic tool for management purposes in the new working area. The project is intended through the rational management of pastoral resources and the appropriate utilization of pastoral and agricultural land, to ensure the improvement of livestock potential and the regeneration of degraded vegetation. The overall objective is to find a better balance between different kinds of activities in order to ensure the rational development of the resources available while taking into account the needs of the population.

**Primary Productivity Project in the Sahel (PPS) - Mali**

PPS was set up within the framework of bilateral co-ordination between the Netherlands and Mali. Studies were carried out by research workers from the University of Agriculture

of Wageningen (Netherlands) and the Rural Economy Institute of Mali. Their main objective was to study the influence of the principal environmental factors on primary production under Sahelian conditions. Observations and tests were carried out between 1976 and 1980 in Niono, in the north of Mali.

One of the major findings of the studies is that primary production in the Sahelian environment is limited much more by the trophic level within the soil than by the volume of water available during the rainy season. The studies further investigated the possibility of using fertilizers. Although their use could be incorporated into existing means of production, economic constraints were found to prohibit their extensive application. Nevertheless the results of this project have contributed to the training and specialization of a great number of Malian cadres which will ensure the continuation of research and training activities within the framework of Malian national institutions.

**Post-graduate Course on Integrated Pastoral Management**

In view of the inadequate number of specialists in pastoral management in the Sahel countries, and the importance of the pastoral sector in their economy, UNESCO and the Sahel Institute/CILSS set up a post-graduate course on integrated pastoral



management with the objective of increasing the number of specialists in the subject and creating a permanent training centre within the region.

Financed by UNEP and UNSO, with the collaboration of the Sahel Institute and FAO, this project started in October 1980 within the framework of the Inter-State Institute of Science and Medicine (Dakar).

Consideration was given both to an integrated approach to land-use problems and to practical work on the job in order to ensure at the end of each training cycle (nine months) that the best preparation of the participants in the field of natural resources management and grazing lands planning was achieved.

## Conclusions and discussions

With some exceptions, MAB projects are national projects which can be supported by contributions from outside countries. These contributions are necessary because most of the countries affected by drought are some of the poorest and successful action requires constant effort over the long term. The projects are in regional and interregional networks so that publication of their results will benefit not only the country directly but also other countries which have to cope with similar problems. Three regional networks of integrated pilot projects related to Africa, Latin America and Asia are being developed. Interregional exchanges will be ensured within the major project framework of Trends in Research and in the Application of Science and Technology for Arid Zone Development, launched by UNESCO in 1980. UNESCO cooperates closely with organizations belonging to the United Nations (FAO, UNEP, UNSO) as well as with non-governmental scientific organizations involved in arid zone problems.

It is important to understand that the solutions generally proposed to combat desertification and improve the living conditions of the population in arid zones are not easy to implement because of costs and constraints imposed by the local inhabitants themselves. The objective therefore should be to find out reasonable solutions which take into account the needs and wishes of the population concerned. Towards this end, an increasing number of socio-economic

surveys have been developed as well as training and demonstration projects which aim at removing these constraints.

As the solutions are complex and require a basic understanding of the techniques to be implemented at the local level adequate techniques must be identified not only according to environmental considerations but also with a view toward making the population aware of their correct use. Therefore the fight against desertification combines rational rehabilitation of lands aimed at improving the local population's living conditions and the preservation of natural resources. It is in this light that the investigations and the actions within the MAB programme are implemented.

## NON-GOVERNMENTAL ORGANIZATIONS

### Introduction

All over the world non-governmental organizations (NGOs) are involved in combating desertification processes. Through research, action projects and public information campaigns, they are promoting awareness and activities in the varied fields related to desertification - arid land agriculture, tree planting and afforestation, water management, land use policies, animal grazing and ranching, desert ecology, climatology, energy and associated socio-economic issues.

More than 76 NGOs participated in the 1977 UN Conference on Desertification. In the years since that time both the number of groups concerned with this issue, and the scale of their outreach efforts in Africa, Asia, South America and Australia has increased.

Desertification is a multi-faceted problem. Sometimes NGO's work has been focused on a single aspect - for example, developing a food crop species capable of survival under arid conditions - but most often the necessary work must be an integrated effort incorporating several facets at once such as the development of village self-sufficiency in a dry-land area through the establishment of tree nurseries, water sources and marketing structures.

## Research activities

Academic, scientific and research institutions have been involved in desertification research and in the exchange of research information through meetings and publications.

- The International Geographical Union, Australia, sponsored a working group from 1972-1980 on "Desertification in and around arid lands". It sponsored an international meeting in Tucson, Arizona, in 1979 and another in 1980 in Japan at the Institute of International Studies and Training. It has been concerned with problems of resource management and with the human and social aspects of desertification.
- The International Federation of Institutes of Advanced Study (IFIAS), Sweden, has joined other NGOs in a "Save Our Soils" (SOS) Project which focuses attention on the socio-economic restraints that prevent the application of modern technology for control of soil erosion. The project is based on case studies in both semi-arid zones and the humid tropics. A workshop on Tropical Forest Management was held at the Forest Research Institute in 1981 in India. A new programme of IFIAS, called "Processes of Environmental Change", includes a section on the effects over time of the destruction of tropical forests and soils. And as a follow-up to their climate programme, a "Drought and Man" workshop is scheduled for January 1982, and *Drought and Man - The 1972 Case* will be published in 3 volumes during 1981-1982.
- The Desert Ecological Research Unit in Namibia has projects in dune biology, the adaptation of plants and animals to desert environment, desert geomorphology and paleoecology. The Unit maintains a climate data bank, a reference collection of flora and fauna, several laboratories available to visiting scientists, and a dark room. Over 100 scientific papers have been published.
- The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India, is engaged in plant species research with sorghum, pearl millet, chick pea, and groundnuts. It hopes to improve crop yields, resistance to pests,



nutritional value and drought tolerance in these crops which are the main source of calories for millions of people living in the semi-arid regions of the world.

- The International Development Research Centre (IDRC), Canada, has 5 satellite centres around the world working on various agricultural and agroforestry research questions. Some are specifically concerned with attempts to improve food species, such as cowpeas, which have long been a major food protein in Sahelian Africa. An IDRC film, *Pods of Protein*, shows that any attempt to improve this traditional crop must take into account local tastes and food processing methods.
- SAMDEME Egypt, collects and synthesizes information about desert ecosystems to be used for research, development of land use schemes, and to evaluate the impact of human manipulation of the environment.
- The American Association for the Advancement of Science followed up on the Science Associations' 1977 Nairobi Seminar with a session at its annual 1978 meeting and published a report in 1980. The co-sponsoring organizations were the British Association of Science, Association Francaise pour L'Avancement des Sciences, Indian Science Congress, Inter-ciencia and the East African Academy.
- The Science Committee on Problems of the Environment (SCOPE), part of ICSU, France, has worked on desertification problems with the Ecological Research Committee of the Natural Science Research Council in Sweden.
- The International Union of Societies of Foresters, in England, with 21 national forestry societies covering 30,000 members, has stated its concern with issues of semi-desert lands.
- L'Arbre au Sahel, France, helps to organize students of biology and agronomy to spend their research periods working in the Sahel on problems of desertification and reafforestation.
- International Institute of Tropical Agriculture, Nigeria, engages in re-

search about hydrology and watershed management, including forest clearing erosion, nutrient losses in water run-off, and biotic environment changes.

#### Action projects

NGOs often express their concerns through action projects. Many of these are in support of local development efforts to halt desertification processes or to enable communities to satisfy basic needs more effectively within existing arid conditions. The projects may include erosion control, agricultural improvements, water resources development, or the introduction of appropriate technologies for energy or household purposes. As is true with much of the research work undertaken by NGOs, many projects are carried out jointly between NGOs in different countries. Some are international NGOs, some are locally organized groups.

- Oxfam, with its home-base in England, began as a famine relief organization and has evolved into an educational and fund-raising group that supports integrated projects with funds and personnel. For example, it has:

- a) established a rural foundation in the drylands of northeast Brazil, including a school, local industry, farming equipment, tree nurseries and construction of reservoirs;

- b) strengthened a community near Madurai, India, by providing agricultural wells, adequate drinking water, adult education classes for women, and nursery schools for children. This project was carried out with another NGO, Island of Peace;

- c) undertaken the introduction of new farming and irrigation methods in the drought stricken area of Onahigonya, Yatenga, in Upper Volta and formed an agricultural and marketing cooperative with a warehouse, cold storage facilities, and transport.

- The International Union for the Conservation of Nature (IUCN), Switzerland, has decided its major emphasis in desertification will be on demonstration projects for the conservation of dryland species and ecosystems. It will continue working with UNEP, UNESCO, FAO and the World Wildlife Fund on the related tasks of rangeland management and rural development.

- Volunteers in Technical Assistance (VITA), USA, has provided assistance to numerous projects requiring technology adaptations to local needs, including projects in the Sahel region. Of particular importance has been their work on cookstoves that use less wood more efficiently and thus reduce the pressure on forest cutting.

*An oasis in Kordofan, Sudan, on the fringes of the Sahara; water is used first for washing and then for irrigation. Mark Edwards/Earthscan*





# REVIEW OF PACD/MTP AND SWMTEP

- Instituto Mexicano de Tecnologías Apropriadas, S.C., Mexico, is working on integrated development in desert communities developing, for example, plant-based and other non-conventional foods and experimenting with hydroponics and the production of *Spirulina* as a source of protein.
- The International Organization for Advanced Technicians of Hydraulics and Rural Equipment, Upper Volta, has worked on various water projects as part of its concern with arid land problems.
- Euro-Action (ACORD), Switzerland, is an international consortium of NGOs working in Sahel countries.
- Co-ordination in Development (CODEL), USA, is a consortium of church-related organizations whose goal is to provide assistance to self-determined development activities overseas. Some of these are specifically related to arid region issues; for example, in the arid areas of the Dominican Republic a rural potable water project is being supported.

## Tree planting

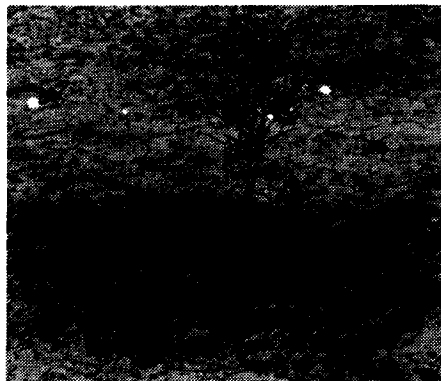
Numerous NGOs are engaged in substantial tree-planting projects. While many of these have been developed in response to the depletion of forests as an energy resource and the loss of locally available firewood, many projects are also a response to increasing awareness of the role trees and forests play in withstanding desertification processes and maintaining the overall ecological health of the globe. Church groups, women's organizations, community development and environment groups all over the world are joining the campaign to save our forests.

- SOS Sahel International, Senegal, is creating nursery and water points to combat desertification by reforestation and to satisfy the need for drinkable water.
- The Native Forests Action Council, Australia, has been cited by Friends of the Earth's new publication *ACCESS*, as "The group that campaigns most actively for the protection of ... forests in Australia."
- Auroville in southeast India, an international community based on a religious philosophy, settled in 1968 in an area that "consisted of

some scrub bushes, eroded gullies and a few desert weeds eking out an existence on cement-like baked sand and clay ... 300,000 flowering forest trees, 400,000 casuarina pines and 4,000 fruit trees have been planted ... The water table is beginning to rise due to the construction of dams, reservoirs, reforestation and digging terraces or ditches to prevent water run off during the monsoons."

-- The Chipko Movement-- Dasholi Gram Swarajya Saryh, India, is becoming well known for its effective public protest and action in protecting forests from being cut for commercial uses.

- Numerous other Indian NGOs have also organized tree-planting campaigns among villagers, youth groups and school children.



*Acacia melanoxylon* was among the drought-tolerant species tried in arid lands of Pakistan. The study was carried out by the Pakistan Forest Institute with assistance provided by a United Nations Special Fund Project (Peshawar, 1964). P. Almasy/UNESCO

## Public information

NGOs are an essential link to the public in providing information and education about desertification issues. Many of them provide articles to general periodicals or publish their own journals and reports, some for general audiences, and some for readers with particular interests. These may also reach government policy makers and shapers of public opinion.

- Worldwatch Institute, USA, publishes a continuing series of papers on different environment and development topics. Two of these relating to desertification are: *The Worldwide Loss of Cropland* and *Planting for the Future*

*and Forestry for Human Needs.*

- *The Sahel Bibliographic Bulletin* is published by Michigan State University's Sahel Documentation Centre in the USA.
- The Environment Training Programme (ENDA), Senegal, offers numerous training programmes on various environment issues of importance to its region. It also publishes reports such as *Nouveau Foyer au Sahel* (1980).
- The Indian Society of Naturalists (INSONA) publishes a quarterly journal called *Environmental Awareness* devoted to the cause of environmental conservation for human welfare. This has included such substantial articles as "The Encroaching Desert: Manmade or Natural" by Jimo Omo-Fadaka (April-June 1980) and "The Drought in the Sahel is over but the lessons learned there should be applied to large areas of the world" by Dr. S. Dillon Ripley (January-March 1978).
- The European Environment Bureau, Belgium, has outlined its programme of work for 1982 to include running an "information project for environment organizations on the subject of deforestation."
- VITA, USA, has published papers on "Reforestation in Arid Lands" and a booklet on *Wood Conserving Cookstoves*.
- The Australian Conservation Foundation's magazine, *Habitat*, carries fine short articles such as "Protecting a Dune System in WA (Western Australia)" and "The Arid Inland" (February 1981).
- IUCN, Switzerland, has printed articles in its *Bulletin* such as "IUCN joints the desert war".
- The Scientists' Institute for Public Information, USA, publishes *Environment* with articles such as "The Desert Blooms - At a Price" (April 1981).

## MEDIUM-TERM PLAN AND SYSTEM-WIDE MEDIUM-TERM ENVIRONMENTAL PROGRAMME

The Governing Council of UNEP at its ninth session reviewed a note by the Executive Director which called for the development of a system-wide medium-term environment programme (SWMTEP) to serve as a plan-



ning reference tool for the United Nations system as a whole during the period 1984-1989 and requested the Executive Director to consult with other agencies of the United Nations system on the proposed programme taking into account the views expressed by the delegations to the Council and submit a draft system-wide programme to the tenth session of the Governing Council. In addition a Medium-Term Plan (MTP) 1982-1983 was presented to the Governing Council at its ninth session to enable it to decide on the contents of the environmental programme and the level of funding by UNEP for its implementation during the period which bridges the gap between the end of the present Environment Fund biennium (December 1981) and the initiation of the system-wide medium-term environmental programme (January 1984).

The Medium-Term Plan for the Environment Programme 1982-1983 outlines, under the UNEP budget line for Arid and Semi-Arid Lands and Desertification, fifteen objectives of major importance to the programme in the upcoming two years. A major consideration is the assessment and monitoring of desertification hazards and natural resources of arid and semi-arid lands and preparation for a major stocktaking exercise in 1984 on the activities and achievements in the implementation of the Plan of Action to Combat Desertification since its adoption by the General Assembly in December 1977. Training, education, and technical assistance are also seen as major roles for UNEP in the near future. UNEP is also to undertake an informational role not only to make information on desertification and desertification control more accessible to the affected nations but also to disseminate information to raise awareness of the need to control desertification among decision makers, planners, scientists, educators and the general public.

The System-Wide Medium-Term Environment Programme has been developed in conjunction with the United Nations family as a whole to provide guidelines for the purpose of planning the Environment Programme through the 1980s. The document is divided into fourteen chapters covering major programme areas. Each programme area is divided into sub-programmes where necessary and included as a

section to each chapter. "Arid and semi-arid lands and desertification control" is a sub-programme of programme number four, "Terrestrial bio-productive systems" and is included as a section to that chapter.

The Arid and Semi-arid Lands and Desertification Control section reviews briefly the legislative authority behind UNEP programmes in the field, presents the programme objectives, outlines the expected situation in 1983 with respect to these objectives, and then describes the system-wide strategies to meet the objectives for the period 1984-1989. The general objectives are described as:

- 1) Improved understanding of the processes and causes of desertification and promotion of rational management of arid and semi-arid lands ecosystems for sustained productivity;
- 2) Contribution to the international, regional and national efforts aimed at preventing and arresting the advances of desertification and where possible reclaiming desertified land for productive use.

Specific objectives are listed as, among other inventory and monitoring activities, studies on the functioning of arid and semi-arid ecosystems, pilot projects for their sustained productivity, promotion of guidelines for National Plans of Action to Combat Desertification, strengthening of national capabilities for/and public participation in management of arid and semi-arid lands resources, and development of co-operative programmes and actions for combating desertification.

By the end of 1983 about 12 national programmes for monitoring and assessment of arid and semi-arid land resources will have been established, 15 countries will have prepared National Plans of Action, 60 projects in developing countries will have been prepared and presented for international financing, several hundreds of cadres from developing countries will have been trained, various activities to raise the awareness of adverse land-use practices will have been undertaken and methodology on desertification assessment will have been made available.

The strategy of the UN system in this areas will be based on an appreci-

ation of the fact that the management of programmes on arid and semi-arid lands and on desertification control remains primarily the responsibility of the national governments. However, international assistance is an essential component for the success of national efforts. Significant activities in implementation of programmes for arid and semi-arid lands ecosystems and programmes and/or projects to combat desertification are expected to be carried out through the efforts of Economic Commissions as well as by FAO, UNESCO, WMO, UNCTD, etc.

It is proposed that UNEP concentrate on the following activities, in co-operation with the indicated UN agencies for the medium-term period 1984-1989:

- Development of methodologies for assessment, monitoring and management of arid and semi-arid lands ecosystems. (FAO, UNESCO, WMO, ISSS);
- Assessment and analysis of information and data on desertification to allow for a global assessment of desertification in 1984. (FAO, UNESCO, UNU);
- Establishment of pilot projects for better land-use practices and for testing and perfecting methodologies for increased sustained productivity. (FAO);
- Through technical assistance, preparation of national plans to combat desertification and of high priority anti-desertification projects. (UN Agencies);
- Application of isotope techniques for arid zone hydrology (IAEA);
- Organization of regional and international training programmes and dissemination of information through manuals, films, radio, newspaper articles, slides, etc. (FAO, UNESCO);
- Strengthening of institutional set up for co-operative research in appropriate technology and the transfer of such technologies. (UN/DTCD and other UN Agencies);
- Convening DESCON meetings and organizing financial support for tens of anti-desertification projects as well as preparation of alternative proposals for the mobilization of the necessary capital to finance anti-desertification programmes. (FAO, UNDP, UN/DTCD, UNESCO, UNFPA, UNIDO, WFC, WMO).



## NEWS FROM UNEP

### GENERAL ASSEMBLY RESOLUTIONS ON DESERTIFICATION CONTROL

#### THIRTY-FIFTH SESSION

TWO resolutions by the General Assembly in its thirty-fifth session bear directly upon the implementation of the Plan of Action to Combat Desertification. Resolution 35/72 "Implementation in the Sudano-Sahelian region of the Plan of Action to Combat Desertification" applauds the addition of Djibouti, Guinea and Guinea-Bissau to the list of countries receiving the assistance of UNSO and suggests that Benin be included in that list as well. Further support of UNSO is urged on the part of Governments, agencies of the UN system, especially UNEP and UNDP in their joint venture, and other intergovernmental bodies. Resolution 35/73 requests, among other things, that UNEP institute, in co-operation with other UN agencies, specific programmes for research and training at the national, regional and international levels. It also requests the Secretary General in consultation with UNEP to undertake feasibility studies and make concrete recommendations for the implementation of the additional means of financing the Plan of Action to Combat Desertification and to report on the results to the thirty-sixth session.

In response to the critical food situation in the countries of the Sahel and considering the nature and magnitude of the needs of these countries, the General Assembly passed resolution 35/86 "Implementation of the

medium-term and long-term recovery and rehabilitation programme in the Sudano-Sahelian region" which calls upon the international community "to continue to strengthen its action of solidarity in support of the recovery efforts and the economic development of those countries".

Governments are urged to support financially the United Nations Sudano-Sahelian Office so that it might continue to co-operate fully with and meet the requirements of the Governments of the States Members of the Permanent Inter-State Committee on Drought Control in the Sahel (CILSS). The strengthening of the close co-operation between these two organizations was invited. Governments, agencies of the United Nations system, intergovernmental organizations, private organizations and individuals were called upon to increase their assistance in response to requests from affected Governments.

#### THIRTY-SIXTH SESSION

THREE resolutions were adopted by the General Assembly at its thirty-sixth session related in full or in part to the implementation of the Plan of Action to Combat Desertification (PACD). They were: 36/190 Implementation in the Sudano-Sahelian region of the Plan of Action to Combat Desertification; 36/191 Study on financing the Plan of Action to Combat Desertification; and 36/192 International co-operation in the field of the environment.

Resolution 36/190 dealt with the implementation of the Plan in the Sudano-Sahelian region and suggested action by the Governing Council in response to this resolution. Resolution 36/191 requested the Secretary General, in co-operation with the Executive Director of UNEP,

to obtain the views of Member States on the additional measures for financing PACD, on the modalities of obtaining additional concessionary funds and on the establishment of an independent corporation for the financing of anti-desertification projects. The views of the Governments will be presented, as requested in the resolution, to the General Assembly at its thirty-seventh session.

The General Assembly endorsed the Report of the Governing Council of UNEP on the work of its ninth session which contains, among other things, the report on co-ordination and follow-up of the implementation of PACD, and singled out in its resolution 36/192 soil degradation and deforestation as examples of very severe deterioration of natural resources in developing countries that call for particular attention.

### GOVERNING COUNCIL DECISIONS ON DESERTIFICATION CONTROL

#### NINTH SESSION

THE Governing Council of UNEP at its ninth session in May 1981 adopted two decisions related to desertification control. One (Decision 9/15) (A and B) called for the further development and support in 1982 and 1983 of integrated pilot projects on arid lands in the Sahelian and North African regions. The other (Decision 9/22 A + B) deals with the further co-ordination and follow-up of the implementation of the Plan of Action to Combat Desertification and the application of General Assembly resolution 35/72.

In the general debate that preceded discussion of programme matters many representatives expressed concern over the increasing problems of desertification. UNEP's co-ordination of the

activities of the UN system for implementation of the Plan of Action to Combat Desertification was supported, including the co-operation between UNEP and UNDP through UNSO in combating desertification in the Sudano-Sahelian region. In the discussion of programme matters this support was reiterated. The Director of UNSO gave an account of UNSO's work methods, outlined areas of concentration for 1982-1983, and appealed for the intensification of interagency co-operation. Many delegates emphasized the need for regional co-operation in research and training in desertification control.

A discussion of the monitoring and mapping of desertification ensued. One delegation felt that too much emphasis was placed on this activity in the medium-term plan and that more practical approaches should be adopted. Another delegation felt that monitoring systems should be established only after regional meetings were held to identify what needed to be done and what indicators should be monitored. The joint FAO/UNEP mapping project should be reviewed in light of the high cost of initial activity and the questionable utility of a map at a scale of 1:5 million. The representative of UNESCO indicated that the Man and Biosphere (MAB) programme, an interdisciplinary problem-oriented research and training programme, was being implemented successfully. The integrated pilot and demonstration projects under the MAB, including the IPAL projects in Kenya and Tunisia, should receive further support.

### THIRD MEETING OF THE CONSULTATIVE GROUP FOR DESERTIFICATION CONTROL (DESCON-3)

THE Consultative Group for Desertification Control held



its third meeting for the mobilization of financial resources for the implementation of proposed desertification control projects in developing countries on 26-28 August 1981. The Group also considered methods and procedures for effective follow-up to ensure that statements of support are backed with concrete action.

The Group heard an opening statement from the Executive Director of UNEP, Dr. Tolba, in which he expressed his belief that the projects to be considered at the meeting reflected some of the aspirations of the United Nations Conference on Desertification and the concepts of the Plan of Action.

Twelve projects were submitted, five through the Desertification Branch of UNEP, six through the United Nations Sudano-Sahelian Office, and one by the Food and Agriculture Organization. They are to implement such activities as ecological monitoring of desertification, development of water resources, erosion control, afforestation, rangeland improvement, brush-fire control, and integrated agricultural development. The 11 projects submitted through UNEP and UNSO included 7 from Africa, 2 from Asia and 2 from Latin America. Of the 12 projects, 10 received initial expressions of interest from donor countries and organizations.

The Group considered the progress report on DESCON-2 and agreed to take steps to improve both the follow-up mechanisms and the procedures for preparation and submission of projects. Each country submitting a project was requested to establish a focal point immediately after DESCON to be responsible for follow-up and to contact the parties which expressed interest in its project. Projects considered for submission to DESCON should be circulated to UN specialized agencies and bodies at an early stage of preparation to allow for their inputs,

improving technical aspects and overall presentation. The projects must fall within the priority areas identified by the Consultative Group.

A general discussion on ways and means of improving the work of the DESCON machinery resulted in the decision that, bearing in mind that project proposals were sent to DESCON members and co-sponsors six months before the meeting, the members and co-sponsors should communicate to the Secretariat of the Group their technical remarks three months after receiving the projects. This should be accompanied by information on what they were doing in the field to give a full picture of how the proposed projects fit within the overall implementation of the Plan of Action. The Secretariat will communicate such remarks to the country or organization submitting the project and obtain replies and any additional information and comments required.

The Group put forward several ideas and proposals during the general discussion. These include:

- a) Some DESCON members should make field visits and obtain first-hand experience of practical difficulties experienced in the preparation and execution of projects.
- b) DESCON projects should avoid indications of unrealistically high value of return or levels of output as these may turn out to be counterproductive.
- c) Public or popular participation, essential for the success of anti-desertification projects, should receive due consideration while developing project proposals.

Attendance at the meeting was as follows:

#### Co-sponsors

UNDTCD  
UNIDO  
UNEP

UNDP  
UNFPA  
FAO  
UNESCO  
WMO

#### Members

Australia  
France  
Federal Republic of Germany  
India  
Japan  
Kenya  
Mexico  
Netherlands  
Senegal  
Sweden  
USA  
ALECSO  
Economic Commission for Europe  
UNSO  
World Bank

#### Observers

Belgium  
Nigeria  
Norway  
Saudi Arabia  
Turkey  
UK  
Arab Gulf Programme for UN Development Agencies  
ILO  
IISD

#### PREPARATIONS FOR THE FOURTH MEETING OF THE CONSULTATIVE GROUP ON DESERTIFICATION

PREPARATIONS for DESCON-4, to be held in early February 1983, are under way. Five projects have been identified by Governments and assistance from the Desertification Branch of UNEP for their formulation and tentative costing has been requested. The countries involved include Oman, Tanzania, Chile, India and Bangladesh. A consultant has been hired to develop the project for Oman, a soil and water conservation programme. The project for Bangladesh will probably involve the development of a national forestry policy to establish communal and farm tree plantations with the active participation of the

local population. The Chilean and Indian projects involve the monitoring of desertification and will be handled by GEMS. A mission to Tanzania was undertaken in November 1981 to reformulate the project on soil erosion which was originally prepared for DESCON-3 and will now be submitted to DESCON-4. Two monitoring projects in Argentina and Peru will also receive further consideration at DESCON-4. Missions to be sent to Governments in January and March of 1982 to formulate project proposals, finalize project budgets and identify implementing agencies. After these early developments the proposals will be sent to the UN agencies and potential donors outside the UN system to solicit their interest in taking part in further development of the projects and in the financing of their implementation.

UNSO is assisting Sudano-Sahelian region countries in developing 11 project proposals for DESCON-4. UNSO will probably obtain financing earlier for a substantial number of these projects so that the number of projects actually submitted to DESCON-4 will be fewer. The UNSO-assisted projects cover various priority areas of desertification control, three of them on afforestation, four on mixed agricultural activities, two on water resources development and watershed management and two regional projects, one on sand dune fixation, and one on training.

As with the UNEP-sponsored projects, missions will be sent by UNSO to each country for the formulation of project proposals, presentation papers will be drafted, and consultations undertaken with co-sponsoring agencies and potential donors. Substantial lead time has been established to allow for a thorough and complete review and study of the project proposals to ensure that they are well received and adequately supported.



## INTERAGENCY WORKING GROUP ON DESERTIFICATION

### FOURTH MEETING

THE fourth meeting of the Interagency Working Group on Desertification was held 7 and 8 April 1981 at ILO Headquarters in Geneva and was attended by the following agencies and organizations of the UN system: UNDP, UNDRO, UNESCO, UNEP, UNFPA, ILO, FAO, WHO and UNSO.

The meeting reviewed the 15 objectives of the programme budget line "Arid and Semi-Arid Lands and Desertification" as they appear in the Medium-Term Plan of UNEP for 1982-1983. The objectives as a whole were approved with some reservations as to the effectiveness of sending planning missions to developing countries for assisting Governments in preparation of national plans of action to combat desertification. It was agreed that such missions should be sent only at the specific request of the Government concerned.

The urgent need for translating the awareness of desertification problems into practical programmes with public participation was stressed. Responsibility for this was placed upon the Governments as the main actors in the field with the assistance of international organizations.

Also the issue of agreeing upon an acceptable definition of desertification was addressed. The definition would determine which countries were eligible for anti-desertification projects under the aegis of the Consultative Group for Desertification Control.

A suggestion to use mobile teams for monitoring and assessment of desertification, in addition to currently used methods, was presented for consideration.

The meeting discussed ways and means of implementing General Assembly resolution 35/73 para. 10 calling upon UNEP, in its catalytic and co-ordinating

role, to institute, in co-operation with the UN system, specific programmes of research related to combating desertification.

It was agreed that agencies list and analyse their existing activities in training and research and submit concrete proposals on perceived gaps in research. They were asked to provide, as well, information on private foundations and other grant-making institutions and their areas of interest or specialization in relation to desertification. Arrangements were made for the evaluation and use of this information. It was further agreed that in developing regional training and research centres the existing ones be favoured over the establishment of new ones, as new regional centres seldom evoke the degree of financial and political support necessary for effective operation.

### FIFTH MEETING

THE fifth meeting of the Interagency Working Group on Desertification was held on 15 September 1981 at the WMO Headquarters in Geneva.

The meeting was chaired by Mr. Y.J. Ahmad of UNEP and was attended by representatives of the following agencies and organs of the United Nations: ECWA, FAO, ILO, UNEP, UNESCO, UNFPA, UNSO, UNDP, UNDTCD, UNIDO and WMO.

In his opening statement Mr. Ahmad informed the meeting of the pledges for contributions made so far to the Special Account to Combat Desertification (Bangladesh, Brazil, Chile, Mexico, and Sudan). He also informed the meeting of the results of the Study on

Additional Measures for Financing the Plan of Action to Combat Desertification which the Secretary-General has submitted to the General Assembly at its thirty-sixth session.

The meeting was presented with a Note and Draft Work Plan for the implementation of UNEP Governing Council Decision GC-9/22A paragraph 4. It was agreed that United Nations bodies and agencies, taking note of the importance of the stock-taking exercise in 1984, would prepare an assessment of their achievements in the implementation of the Plan of Action to Combat Desertification. UN organizations were requested to send their written views and proposals on the Work Plan. The Desertification Branch expressed a need for assistance from other UN agencies in the implementation of the Plan through the donation of their professional staff for specific functions.

The Group then considered the implementation of General Assembly resolution 35/73 para. 10, which calls upon UNEP to institute in co-operation with the UN system specific programmes of research and training in combating desertification. The Group reviewed a working paper prepared by the Desertification Branch and agreed on the specific actions required to implement the programmes. The principal objectives of a world-wide programme of scientific and technological research were agreed to be:

- "i) to ensure that countries prone to desertification develop at the national level the various capabilities required to utilize available scientific and technological knowledge in implementing

- corrective measures to combat desertification.
- "ii) to fill gaps in scientific knowledge related to processes of desertification and the rehabilitation of desertified lands."

A second draft of the Compendium of Projects and programmes of the UN system in the field of desertification was circulated. The members were requested to study it with particular reference to the sections which concerned them respectively. The final version will be presented to the UNEP Governing Council Session of a Special Character.

## SPECIAL ACCOUNT FOR THE IMPLEMENTATION OF THE PLAN OF ACTION

THE creation of a Special Account for financing anti-desertification activities was endorsed by General Assembly resolution 32/172, and it was established in March 1979. The Executive Director of UNEP has on several occasions invited Governments to give favourable consideration to contributing generously to the Special Account. To date it has received pledges of support from five countries. Three countries, Chile, Sudan and Mexico have already made contributions, totalling \$25,000. Brazil and Bangladesh have each pledged to contribute an unspecified amount, the latter in local currency.

## INTERNATIONAL SCIENTIFIC SYMPOSIUM "COMBATING DESERTIFICATION THROUGH INTEGRATED DEVELOPMENT"

THE International Scientific Symposium "Combating Desertification through Integrated Development" was held in Tashkent, capital city of the Soviet Uzbekistan, from 6 to 14 October 1981.



Seventy-eight scientists and specialists from 27 countries and international organizations took part in the symposium. This included 9 participants from 6 countries in Asia; 14 from 9 African countries; 5 from 2 countries of Latin America; 6 from Australia, France, Federal Republic of Germany and USA; 5 from FAO, WMO, ECWA, CILSS, IIASA; and 39 from the USSR. Ninety-three scientific papers were submitted.

The symposium was aimed at consolidating the efforts being made by Governments, international and national organizations towards implementing the Plan of Action to Combat Desertification; at promoting the exchange of opinions and experience in the study and control of the desertification process; and at strengthening the co-operation between scholars sharing the same views. Fourteen thematic sessions were held on the world experience in the field of combating desertification through integrated development in the context of its possible application under the specific conditions of the developing countries.

The symposium successively considered and discussed the following theoretical and practical aspects of combating desertification which constitute the necessary framework for the formulation of integrated programmes of arid and semi-arid land development:

- desertification processes: causes, factors, magnitude;
- methodology of studying desertification processes and scientific fundamentals of their control;
- major economic sectors and peculiarities of economies in arid lands: mining, agriculture and

- animal husbandry;
- industrialization, urbanization, and settlement patterns;
- world experience of arid land development.

The closing sessions of the Symposium were devoted to the discussion of methodology to be used in the drawing up of arid land integrated development programmes, and of the scientific fundamentals of arid land environmental monitoring.

#### UNEP/USSR INTERNATIONAL TRAINING COURSES ON DESERTIFICATION

IN the USSR, three training courses were organized by the USSR Commission for UNEP, in association with the USSR Academy of Sciences. The courses have been given annually as part of a continuing project financed by UNEP since 1978. The main objectives of these courses were to contribute, through the training of post-graduates from developing countries, to a better understanding of different processes of desertification and to develop teaching and audio-visual aids based on these courses for dissemination elsewhere. The courses, held in 1981, were:

- a) Rangeland Ecology and Pasture Productivity, 18 May to 22 June 1981; 20 participants attended this course.
- b) Reclamation of Saline Irrigated Soils, 31 August to 12 September 1981; 16 participants attended the course.
- c) Sand Dune Fixation, 13-22 September 1981; 20 participants.

Each course consisted of both a theoretical part and a practical part. The participants visited many state and collective farms, research institutes, experimental stations as well

as water pumping stations, irrigation and drainage systems and experimental reclamation sites. The field studies enabled the lecturers and instructors to extend the scope of their lectures and to illustrate better the practical aspects of the issues addressed.

Similar courses are planned for 1982.

#### DESERT CONTROL TRAINING SEMINAR FOR DEVELOPING COUNTRIES

29 August - 21 Sept. 1981  
Desert Institute, Lanzhou, China

IN co-operation with the Environment Protection Office of the People's Republic of China and the Lanzhou Institute, UNEP helped plan and organize a Training Seminar on Desertification Control. Taking part in the four-week programme from 29 August to 21 September 1981 were 15 qualified post-graduates from 9 developing countries. The participants included 2 from Egypt, 1 from Somalia, 2 from Turkey, 2 from Senegal, 1 from Peru, 2 from Kenya, 1 from Mexico, 2 from Tanzania, 2 from Democratic Yemen. The principal objective was to increase the managerial expertise with regard to desertification control among responsible individuals who could be expected to disseminate and use within their own countries the information and knowledge provided through the seminar.

The course work was undertaken in the following areas:

- monitoring, management and development trends of desertification;
- improvement of rangelands;
- establishment of tree belts and new oases;
- exploitation and utilization of surface water;

- selection and culture of sand-stabilizing trees and shrubs.

Various field trips were taken to reinforce the theoretical class work.

In view of the extensive experience achieved by the People's Republic of China, especially in the field of range management, shelter belts, etc., it is hoped that the rest of the world benefited from the exchange of information and expertise made possible through the seminar. The course is expected to be repeated sometime after 1983.

#### REGIONAL WORKSHOP TO CONSIDER IMPLEMENTATION OF THE PLAN OF ACTION TO COMBAT DESERTIFICATION IN THE ESCAP REGION

THE Economic and Social Commission for Asia and the Pacific (ESCAP), in co-operation with the Government of India, organized a regional technical workshop to consider the implementation of the Plan of Action to Combat Desertification in the Asia and the Pacific region. The workshop, held at the Central Arid Zone Research Institute in Jodhpur, India, 20-23 October 1981, was funded in part by the Australian Government in the amount A\$ 80,000.

Experts from 12 countries (Afghanistan, Australia, Bangladesh, France, India, Indonesia, Iran, Nepal, Philippines, Thailand, USA and USSR), three UN agencies (UNESCO, WMO, WFP) and two regional organizations (Press Foundation of Asia (PFA) and South Asia Co-operative Environment Programme (SACEP), attended.

The workshop considered country papers from Australia, Bangladesh, India, Indonesia, Iran, Nepal, the Philippines, Thailand and the USSR and found that in the ESCAP region desertification



phenomena are encountered in four distinct environmental situations.

- a) Desertification resulting from the pressures on the ecological system from excessive pastoralism, as for example in Afghanistan, India, Iran, the USSR;
- b) Water logging and soil salinization induced by improper irrigation in arid and semi-arid regions of countries (such as Pakistan and Afghanistan), resulting in the degradation of the biological productivity of the irrigated areas;
- c) Degradation of the forests and land productivity as a result of shifting cultivation and deforestation, as in Indonesia, Nepal, the Philippines and Thailand;
- d) Desertification problems resulting from large variations in the amount of seasonal rain as in the case of Bangladesh.

All the reporting countries are implementing the Plan of Action to Combat Desertification as an integral part of their overall development programmes. The execution of such projects and evaluation and monitoring of areas affected by desertification have been initiated by almost all region countries. However, it was felt that these countries require greatly increased man-power training and education, especially in scientific and technological fields such as irrigated agriculture, soil erosion control and ground-water exploitation. Most still require a national-level co-ordinating agency, apart from existing sectoral departments.

The representatives of the various UN organizations and SACEP outlined their respective roles in the implementation of the Plan of Action to Combat Desertification with special attention to programmes and projects pertaining to the ESCAP region. UNESCO through its Man and

Biosphere (MAB) programme and WHO and WFP through their regular programmes offered their services in a co-operative effort with ESCAP to further the control of desertification in the region.

The ESCAP workshop developed several recommendations for the combat of desertification in the region calling for, among other things, further technical research and monitoring activities and increased co-ordination and communication among Governments, scientists and the general public. Countries that have not already done so were encouraged to set up a national planning and co-ordinating body on desertification. Formation of subregional grouping of countries was also suggested. ESCAP was requested to prepare an inventory of existing educational institutions concerned with desertification to identify possible regional training centres. Emphasis in the recommendations was placed on the need to consider the socio-economic environment, i.e. the interaction of human activities and natural processes that led to desertification, in formulating research and development projects for its control.

#### **EXPERT MEETING ON MANAGEMENT, CONSERVATION AND DEVELOPMENT OF AGRICULTURAL RESOURCES IN THE ECWA REGION**

**9-15 MAY 1981,  
Damascus, Syrian Arab Republic**

THE Expert Meeting on Management, Conservation and Development of Agricultural Resources in the ECWA region, organized by the Economic Commission

for Western Asia (ECWA) in pursuance of General Assembly resolution 32/172 of 19 December 1977 requesting follow-up by the Regional Commissions to UNCOD, was held in Damascus, Syrian Arab Republic, 9-15 May 1981. The Food and Agriculture Organization of the United Nations (FAO) and the Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD) co-sponsored the meeting, which was hosted by the Ministry of Agriculture and Agrarian Reform, Syrian Arab Republic.

The meeting was attended by 61 experts representing various disciplines. Their country or agency distribution was: Lebanon (1), Saudi Arabia (1), Syrian Arab Republic (25), United Arab Emirates (1), Yemen Arab Republic (1), ECWA (10), FAO (12), UNESCO (1), WMO (1), ACSAD (4), AOAD (1), ICARDA (2) and IUCN (1).

The meeting discussed general issues and the nature of the problem of desertification in the ECWA region. This region has the greatest proportion of its land in arid and semi-arid zones. The meeting then went on to discuss major issues and case studies of resource conservation and management, operational problems and methodologies. There were also two Workshops. Workshop I included techniques in conservation and management of resources in arid and semi-arid areas. Workshop II was on the socio-economic dimensions of resource conservation and desertification control.

#### **IUCN GENERAL ASSEMBLY**

##### **FIFTEENTH SESSION**

THE International Union for Conservation of Nature and Natural Resources held its fifteenth General Assembly session on 11-23 October 1981. With the unanimous adoption of the IUCN programme, 378 participants from 57 countries set a policy course for the next three years. Twenty-nine resolutions were passed including 15/29 "Action Points", which instructs the Council to initiate appropriate measures for the implementation of the passed resolutions. Of particular pertinence to the combat of desertification is Action Point B.12 which urges members of IUCN and its commissions to offer assistance to the Government of the Arab Republic of Egypt in the preparation and implementation of a conservation strategy for the Sinai peninsula and surrounding area.

Further Action Points of general relevance to the combat of desertification include A2 and B1. A2 recommends that social scientists, community development experts and environmental education experts become involved in the implementation of the World Conservation Strategy in general and of the development and execution of environmental education focused especially on the conservation of nature and natural resources. B1 urges Governments to provide assistance for the establishment of biosphere reserves particularly in arid, semi-arid and mountain regions of the world and for the implementation of research in such reserves to aid in the assessment of the sustainability of resources development.



## NEWS FROM GOVERNMENTS

### UGANDA

FOLLOWING consultations with the Government and the Resident Representative of the UNDP in Uganda, a UNSO Desertification Control Planning and Programming Mission visited Uganda from 2-16 May 1981. The purpose of the mission was to hold discussions with the Government on the preparation of its national strategy and machinery for combating desertification, to assess relevant ongoing activities and to help identify and formulate priority anti-desertification projects for which the Government wished UNSO assistance in resource mobilization.

Uganda had just experienced a serious drought. It was clear to the Mission that there was a need for planning and programming measures to assist the Government in:

- a) coping with the effects of droughts, both recent and future, which accelerate the process of desertification, and
- b) its efforts at combating desertification in the basically fragile ecosystems of the sub-humid lands of north-eastern Uganda, especially in Karamoja and in adjacent sections of the Acholi and Teso districts.

The Mission, in consultation with the various ministries of the Ugandan Government, the United Nations agencies and other international and national institutions, formulated 14 high-priority desertification control projects in agricultural development, water resources management, range management, forestry, and the conservation of game parks, reserves and wildlife. Special emphasis was placed

on the need for establishment of a Desertification Control and Arid Lands Development Authority within the Government to plan and co-ordinate desertification control activities.

The Government has included various objectives in its 1981-1990 Development Programme which, while not explicitly aimed at combating desertification, should nevertheless contribute to arresting or containing the encroachment of desert-like conditions. Among these are reconstruction and development of the agricultural sector including the rehabilitation of its physical infrastructure, the expanded processing of agricultural products, and an improvement in the security situation.

### SOMALIA

RANGELANDS cover 79 per cent of Somalia's land area or about 503,000 square kilometres. The livestock industry is of greater relative importance in Somalia than in any other country of Africa. It accounts for about 46 per cent of the gross domestic product (IBRD) and provided for over 80 per cent of the export earnings in 1979. These are part of the findings of a UNSO Rangeland Mission that visited Somalia 27 April-13 May 1981.

Following the drought of 1973-1974, during which a substantial portion of Somalia's livestock population perished, and considering the importance of livestock production and effective rangeland management to the economy and basic survival of the human population in Somalia, the Government initiated a concerted effort to address the problem of rangeland degradation. Two early activities begun in 1973-1974

were the Rangeland Conservation and Development Project, financed by UNDP and implemented by FAO, and the Food-for-work programme of the World Food Programme. These projects developed certain range management practices and run-off water conservation techniques which were incorporated into the major project for Northern Rangelands Development (NRDP). This project which began in 1976 and a later one, the Central Rangelands Development Project (CRDP) based on the same philosophy, provide for the establishment of grazing reserves, grazing associations and co-operatives, soil and water conservation measures and stockwater points.

The National Range Agency (NRS) was established in 1976 as an autonomous agency to design and implement a national range development strategy. It has prepared the Range Agency Development Plan for the 1980s. The objectives of this plan are:

- a) primarily, to utilize the rangeland resources bearing in mind ecological principles, i.e. to increase the productivity of the rangeland whilst maintaining or preferably improving its condition;
- b) secondarily, from the range management point of view, although of prime importance from the socio-economic aspect, to increase per capita rural incomes.

The Mission found the Government's large-scale field projects to have already shown good results and concentrated on complementing on-going activities by increasing the capability of the Government in training, both field workers and land users, and data collection. Six priority projects were identified for implementation in these areas.

A UNEP mission visited Somalia from 22 March to 2 April 1981 and reviewed the environmental impacts of the refugees who left the Ogaden Region of Ethiopia in large numbers to live-in camps provided by the Government of Somalia and advised the UN High Commissioner for Refugees, Branch Office for Somalia, on the possible solutions to recurring environmental problems. The impact of the refugees was found to stem mainly from the use of wood for construction of their huts and as fuel for cooking. The recommendations made were:

- a) to take necessary measures to avoid absolute clearance of woody vegetation in camp areas;
- b) to provide the fuel for cooking on a sustained basis;
- c) to protect already destructed woodlands surrounding refugee camps;
- d) to launch a tree planting programme in refugee camps;
- e) to establish fuel wood plantations with quick growing tree species.

### TANZANIA

AN exploratory mission from the Desertification Branch of UNEP was sent to Tanzania from 8 to 15 August 1979 to consult with the Government on the possibility of preparing a National Plan of Action to Combat Desertification (NPACD). A planning mission was sent in September 1980 to prepare a study of on-going regional plans which relate to desertification problems and in particular to assess major regional projects. A Draft National Plan of Action was prepared. From 24-29 November 1981, a mission of the Desertification Branch considered the priority activities identified in NPACD.



# NEWS FROM GOVERNMENTS

The mission discussed the possibility of reviving a project entitled "Soil Erosion Control in Kondoa District" which was withdrawn from DESCON-3 because of economic difficulties faced by the Government.

Dodoma region (Kondoa District) is one of four large regions characterized by semi-arid climatic conditions. One of the major problems appears to be created by firewood consumption for domestic needs. The forested area in the total region is estimated at only 7 per cent. The Forestry Department is aiming at increasing it to 20 per cent through both plantations and village afforestation. However, even with very much improved yearly increases of introduced soft woods versus indigenous woodlands, the rate of afforestation does not appear likely to be able to keep pace with the increasing demand from rural areas and from the town of Dodoma which is expected to double its population of 80,000 in 5-10 years time on becoming the capital city of Tanzania.

It is expected that by 1984 the current financial crisis which requires that all external assistance go towards increasing food production and importing food from abroad will be over. Since the project could be ready for implementation only by the beginning of 1984 it was agreed that the formalities for presentation of the project proposal to DESCON-4 be initiated.

This project will combat desertification through reseeding as the primary mechanism to restore productivity of the soil in an area of more than 10,000 ha in the Kondoa District. Reseeding not only controls soil erosion but improves soil quality through the improvement of its structure and its infiltration moisture characteristics. In addition the project will undertake

feasibility studies on watershed lands and livestock which will contribute to an integrated approach to the combat of desertification in the area.

## AFGHANISTAN

IN terms of desertification, Afghanistan is one of the most severely affected countries, with problems of regeneration of grassland, deforestation, waterlogging and salinity of the soil. Progress has been made particularly in the social sector, in combating those problems through a programme of radical reorganization aimed at the establishment of social equity. The struggle against desertification had been accorded the highest priority in government policy in the context of planned economic and social development through national reorganization. Degradation of rangelands was the most serious form of desertification and affected the majority of the population in Afghanistan. A grazing law has now been promulgated and provision has been made in the five-year plan for efficient organization and facilitation of the seasonal migration of herdsmen. The field investigations through a vegetation-mapping project have been completed for an estimated three fourths of the total area of the country. High priority has also been given to revegetation of watersheds and the creation of a green belt around the capital city, in order to combat desertification related to rapid urban growth. Soil conservation measures and stabilization of moving sands have been undertaken through projects of the Rural Development Department. The Institute of Cartography and Geodesy has been considerably strengthened in

recent years, especially in its mapping and remote sensing capabilities, in order to conduct and co-ordinate an ecological assessment of the whole country. With regard to the deleterious effects of dry farming, legal limits to cultivation by mechanical ploughing in marginal dry lands which were better suited to grazing are provided for in the new land-holding law. The solution of problems caused by waterlogging and salinization in the Helmand Valley has also received high priority in development planning.

Because of the urgent need for afforestation, Afghanistan has recently undertaken the responsibility to act as the focal point in the field of "social forestry" under SACEP. Afghanistan has also participated in the UNEP south-west Asia transnational monitoring project. The Government claims to have the necessary political will and determination to combat desertification, but the progress in implementation is constrained because of the lack of technical information and know-how. Development and strengthening of various subregional and regional programmes by ESCAP, UNEP and other international and intergovernmental agencies is strongly suggested.

## BANGLADESH

BANGLADESH is endowed with rich soil, criss-crossed by three of the world's major

rivers, the Brahmaputra-Jamuna, the Ganges and the Meghna, with their tributaries and distributaries. However, Bangladesh is experiencing desertification as a result of continued cyclical natural phenomena such as floods and drought almost every year, as well as man-made action, causing damage to the landscape. This in turn reduces productivity and increases social distress. The great variations in precipitation, the rate of evaporation, temperature, change in the rainfall pattern, gradual but definite reduction of perennial water resources, increased salinity intrusion from the sea (causing deterioration of ground water and increasing soil salinity) and reduction of soil moisture are some of the major parameters leading to the process of desertification in Bangladesh.

Since the adoption of the Plan of Action in 1977, the Government of Bangladesh has taken a number of positive steps to combat desertification; some significant ones are the following:

- a) An assessment and evaluation of the desertification process up to 1980 has been made;
- b) The Water Development Board has undertaken studies for updating the master plan, especially for the south-west regions, for optimum utilization of water from the Ganges. Hydrological and groundwater surveys are also under way;
- c) Resuscitation of dead and dying rivers for water conservation and excavation of new canals to supply areas of water shortage are being undertaken through public participation, with



- the necessary institutional support provided by local administration;
- d) Efforts are being continued to increase the forest area through a number of programmes, such as village wood-plot development over approximately 0.6 million acres, afforestation programmes, establishment of 113 forest extension centres, strip plantations along the slopes of roads, railway lines, embankments and canal banks etc.;
- e) A food insurance scheme has been established to overcome losses produced by catastrophes such as

droughts, floods, cyclones and other natural disasters.

#### NEPAL

A NATIONWIDE inventory in Nepal showed that parts of the country have suffered from desert-like conditions for a long time and that others are undergoing desertification at an alarming rate. The major factors are:

- a) Indiscriminate tree felling;
- b) Cultivation of marginal lands without conservation practices;
- c) Human and cattle population growth;
- d) Use of land beyond its capability;
- e) Hill migration;
- f) Fuel, fodder and timber

- demands;
- g) Traditional agricultural practices;
  - h) Geology and soil conditions.

The actions taken by the Government to combat desertification are as follows:

- a) Water resources planning, development and management;
- b) Range and livestock development;
- c) Soil and water conservation;
  - i) Integrated watershed management programmes;
  - ii) Integrated rural development programmes;
  - iii) Inventory and monitoring;
- d) Development and management of irrigated lands;

- e) Protection of vulnerable lands;
- f) Conservation of flora and fauna;
- g) Application of science and technology;
- h) Research on alternate energy sources;
- i) Conservation, education and extension programmes;
- j) National machinery for co-ordination.

The Government has given priority in its forthcoming plans and programmes to:

- a) Management of critical areas leading to environmental disaster;
- b) Regional co-ordination and co-operation;
- c) Law and policy formulation.

## BOOK REVIEWS

### REPORT ON SOCIAL ASPECTS OF DESERTIFICATION

S. P. Malhotra, M.L. Purohit, L. P. Bharara  
*Division of Economics and Sociology, Central Arid Zone Research Institute, Jodhpur, India, 1980, pp.202 (mimeographed)*

IN January 1976 UNEP initiated and funded jointly with the United Nations Research Institute for Social Development (UNRISD) an international research programme entitled "The Role of Perceptions, Attitudes and Values of People in Relation to Environmental and Developmental Measures and Programmes". Three case studies were undertaken under the project to investigate developmental situations with significant

environmental impacts, focusing on the manner in which people's perceptions, attitudes and responses affected the developmental process and its environmental consequences. Of the three studies two have been completed and published. One, entitled "The Social Aspects of Desertification," presents detailed information on the nature and extent of socio-economic, cultural and environmental factors related to the desertification process and on the levels of awareness, perceptions, values and reactions of people involved. The report makes recommendations for the strategies and steps to be taken to bear, reduce or modify the consequences of desertification.

Four representative tracts in district Nagaur in the arid zone of the Rajasthan area are investigated in detail. They are a pastoral tract, a rainfed agricultural tract, an irrigated agricultural tract and an "Operational Projects Research Area" which had been exposed to technologies developed at the Central Arid Zone

Research Institute of Jodhpur, India. In each tract data were collected on basic socio-economic and demographic topics such as population and population growth trends, education, earning strength and occupational distribution, socio-economic stratification, land use patterns and ownership as well as extensive data on agricultural and animal husbandry practices including agricultural productivity, rangeland quality, migration patterns, livestock population and composition. Finally, special emphasis was placed on determining the population's awareness of factors contributing to desertification, and an assessment of individuals' perceptions of trends in population, productivity, land and water quality and availability, ground cover, rainfall and general landscape was carried out.

Among the more salient findings of the study are the extremely high population growth rate and the breakdown of traditional

occupational structures based on the caste system with the resulting overdependence of the population on agriculture. Both factors contribute to an ever-decreasing man/land ratio, the pressure of which leads to desertification. The growth rate of the population during 1901-1971 averaged 140.77 over the four tracts, relatively higher than the growth rate of the non-arid areas of the country. Indications of the substantial population growth likely in the near future are: (1) the declining rate of mortality; (2) the large percentage (75 per cent) of people belonging to the younger age group (under 30); (3) the high percentage of the female population in the reproductive period; (4) the persistence of the traditional practices of early marriage; and (5) the predisposition for having many children.

The report provides extensive data on several socio-economic factors facing the four tracts and clearly demonstrates some



interesting differences between them. For example, the number of workers as a per cent of the total population was 27.38, 28.21, and 28.48 in tracts A, C and D respectively while tract B had 46.55 of the population actively employed. This was due to a significantly greater proportion of females (35.35) having been enumerated as workers. It was found that 70.83 per cent of the households in tract A, 3.29 in tract B, 36.37 in tract C, and 100 in tract D use a single source of water for their drinking and home consumption. Unfortunately the report fails to venture an explanation in many cases for these differences.

The final section of the main body of the report deals with the awareness of desertification among the population. It was found that in the four tracts the population was aware of both the escalation of their numbers and the decreasing man/land ratio. Sand dune movement was found by a significant portion of the population not to have changed while the problems of blowing of fertile soil and the covering of fertile soil by moving sand was reported by 82, 81, 68 and 89 per cent of tracts A, B, C and D respectively. Almost all the respondents of the four tracts stated that the amount of rainfall received in their regions is now much less compared with 25-30 years

ago. A majority felt that the different types of vegetation had decreased in the different tracts. The study outlines the various development programmes undertaken by the Government to combat desertification but does not attempt to measure the reaction of the population to those initiatives.

The summary and recommendations section provides an excellent overview of the otherwise lengthy study. Various recommendations are made for the combat of desertification in the area, such as improved animal husbandry practices concentrating on quality rather than quantity be instituted including the possible restriction on the raising of sheep and goats which are particularly conducive to desertification. Soil conservation strategies are recommended to increase agricultural productivity. Several interesting legislative measures are recommended, especially legislation enforcing existing religious and cultural customs for preserving vegetation and legislation curtailing the current practice of subdividing the land over generations as the result of current inheritance laws. The report recognizes the paramount need for family planning and birth control education and encourages the development of new avenues of employment other than agriculture and the use of traditional institutions to maintain a heterogeneous composition of occupations among the population.

The report provides excellent source data for the study of the socio-economic factors facing the population of the Rajasthan region of

India and the factors contributing to desertification. Copies are available from the Desertification Branch, UNEP, Nairobi, Kenya.

### DESERTS OF THE WORLD, FUTURE THREAT OR PROMISE?

Jane Werner Watson  
*Philomel Books, New York,*  
1981 122 pp., \$13.95

WRITING in clear and simple prose, Jane Werner Watson provides with this book a highly readable account of the nature and origins of the world's deserts, the many efforts to control their spread, and the potential threat or promise deserts represent in the critical question of feeding the world's growing population. Many attractive full-colour and black and white photographs and instructive diagrams complement the text to further capture the interest of young readers in the problem of desertification and its control.

In the early chapters, Ms. Watson outlines the extent of the world's deserts, their variety of characteristics, and the natural phenomena which create them. This is followed

by an account of the many fantastic ways in which animals, plants and man himself have adapted to the harsh conditions of desert life. The constant search for and intricate ways of storing water are clearly dramatized. The process by which deserts are created through the over-use of arid lands, i.e. "People as Desert Makers", is described and explained as both an ancient and a modern phenomenon. Ms. Watson goes on to review the many ways scientists have developed to control and even to reverse this process, such as the creation of "green belts", irrigation and desalinization. Other uses of the desert such as specialized natural products, solar energy, and minerals are investigated.

Although by no means a very technical or rigorous account of the process of desertification and the means for its control, *Deserts of the World* provides a much-needed simplified review of the issues, ideal for young people who will certainly face these issues in their future adult lives. For this reason it is a very welcome addition to the literature on the subject.



## PHOTOGRAPHS FOR DESERTIFICATION CONTROL COVERS

The Editor of *Desertification Control* is seeking photographs for consideration as bulletin covers. All submissions should be addressed to:

The Editor  
*Desertification Control*  
UNEP  
P. O. Box 30552  
Nairobi  
Kenya

### Technical Requirements

Photographs must be colour transparencies of subjects related directly to desertification: deserts, process of desertification, lands, animals, human beings, structures affected by desertification, control of desertification, reclamation of desertified lands, etc. Submissions must be of high quality to be enlarged to accommodate a 30 x 42 cm (12 x 17 1/2 in) format.

### Captions

A brief caption must accompany each photograph giving a description of the subject, place and country, date of photograph and name and address of photographer.

### Copyright

It is assumed that all submissions are the original works of the photographer and all the rights are owned by the photographer. *Desertification Control* gives full credit to photographers for the covers selected, but does not provide remuneration.

## DESERTIFICATION CONTROL

invites articles from the world's scientists and specialists interested in the problems arising from or associated with the spread of desertification.

### Desertification Control

is an international bulletin published at six-monthly intervals by the

United Nations Environment Programme (UNEP) to disseminate information and knowledge on desertification problems and to present news on the programmes, activities and achievements in the implementation of the Plan of Action to Combat Desertification.

### Audience

The bulletin addresses a large audience which includes decision makers, planners, administrators, specialists and technicians of countries facing desertification problems, as well as all others interested in arresting the spread of desertification.

### Language

The Bulletin is published in English. All manuscripts for publication must be in English.

### Manuscript preparation

Manuscripts should be clearly typewritten with double spacing and wide margins, on one side of the page only. The title of the manuscript, with the author's name and address, should be given in the upper half of the first page, and the number of the words in the main text should appear in the upper-right corner. Subsequent pages should have only the author's name in the upper-right corner.

### Metric system

All measurements should be in the metric system.

### Tables

Each table should be typed on a separate page, should have a title and should be numbered to correspond to its point of reference in the text. Only essential tables should be included and all should be identified as to source.

### Illustrations

Line drawings of any kind should each be on a separate page, drawn in black china ink and double or larger than the size to appear in the bulletin.

They should never be pasted in the text. They should be as clear and as simple as possible.

Photographs in the bulletin are printed black-and-white. For satisfactory results, high quality black-and-white prints, 18 x 24 cm (8 x 10 in) on glossy paper are essential. Diapositive slides of high quality may be accepted; however, their quality when printed black-and-white in the bulletin cannot be guaranteed.

All line drawings and photographs should be numbered in one sequence to correspond to their point of reference in the text, and their descriptions should be listed on a separate page.

### Footnotes and references

Footnotes and references should be listed on separate pages at the end of the manuscript. Footnotes should be kept to an absolute minimum. References should be strictly relevant to the article and should also be kept to a minimum. The style of references should follow the format common for scientific and technical publications: the last name(s) of the author(s) (each) followed by his initials, year of publication, title, publisher (or journal), serial number and number of pages.

### Other requirements

*Desertification Control* publishes original articles which have not appeared in other publications. However, reprints providing the possibility of exchange of views and developments of basic importance in desertification control among the developing regions of the world or translations from languages of limited audiences are not ruled out. Short reviews introducing recently published books in the subjects relevant to desertification and of interest to the readers of the bulletin are also accepted. Medium-length articles of about 3,000 words are preferred, while articles longer than 4,500 words are not accepted.

A reasonable fee is paid for articles accepted for publication, and 50 reprints are provided to the authors.



