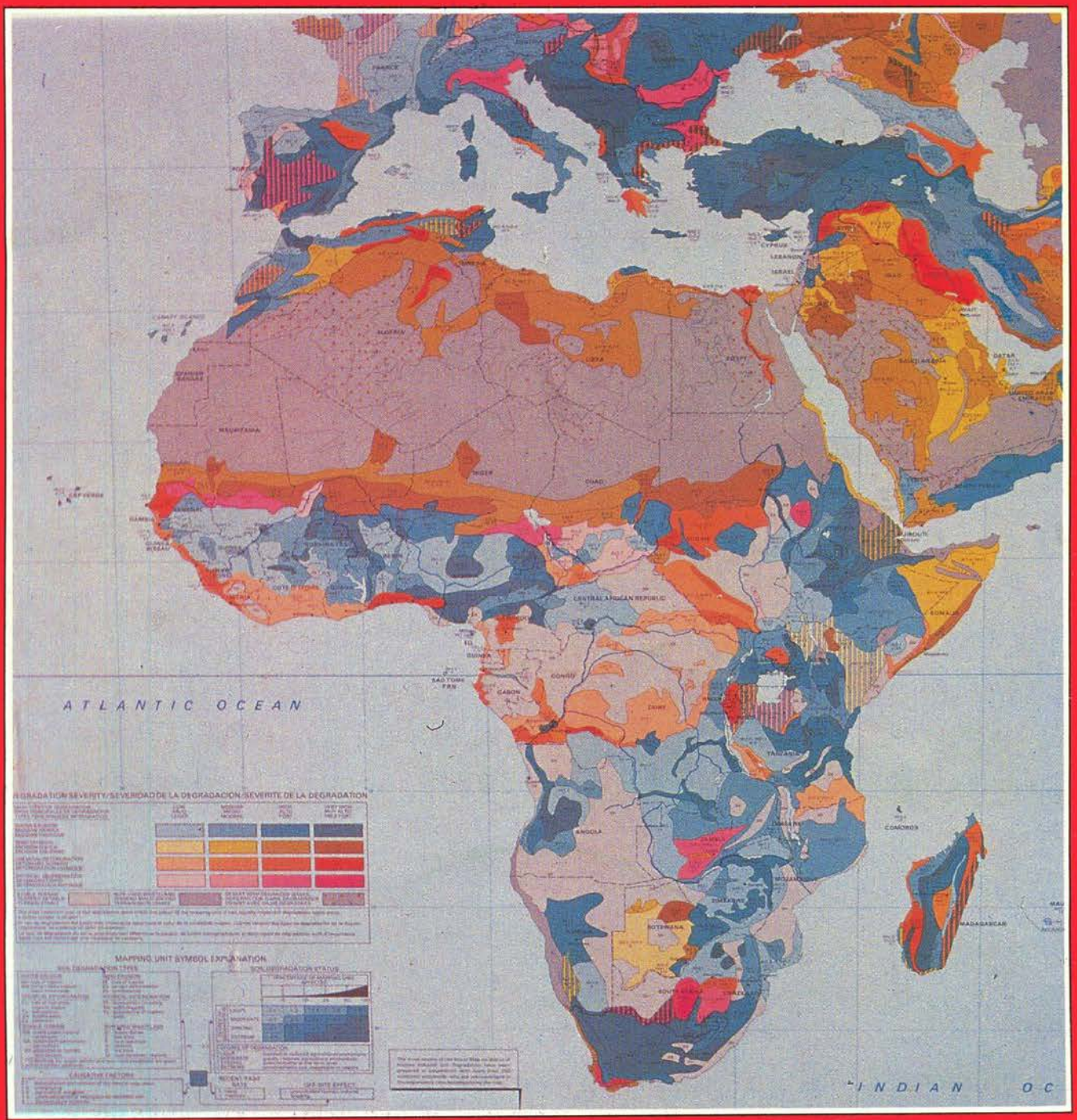
United Nations Environment Programme

ISSN 0379-2455

Desertification Control Bulletin

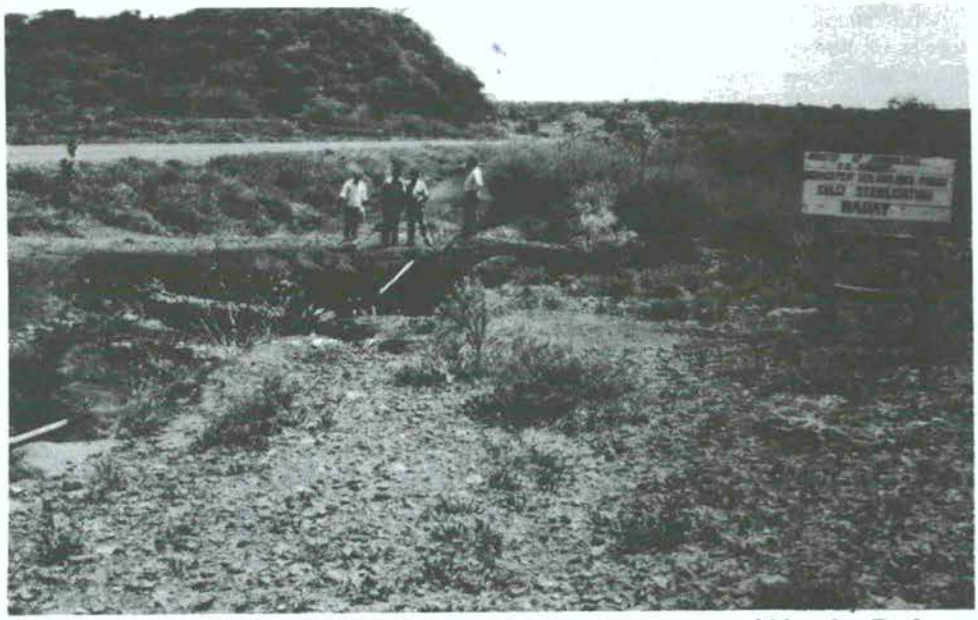
A Bulletin of World Events in the Control of Desertification, Restoration of Degraded Lands and Reforestation

Number 18, 1990



United Nations Environment Programme

Desertification Control Bulletin



Baringo Pilot Study Area (Semi-Arid) Desertification Assessment and Mapping Project, see page 28 (Photo: Yukika Matsumoto)

Number 18, 1990

1 **Dunes Encroachment on the Cultivated Land in Egypt**
S.M. Abu EL-Ennan, K.J. Dalsted and M.Z. Salem

6 **Applying Remote Sensing Data in Desertification Monitoring**
F. Jaskolla and A. Hirscheider

13 **Remote Sensing of Arid and Semi-Arid Regions: The State of the Art**
Prof. M.-C.Girard and Dr L.A. Isavwa

19 **NEWS FROM UNEP**

31 **Insert: The Definition of Desertification and its Programmatic Consequences for UNEP and the International Community**
Prof. Richard S. Odingo

71 **NEWS OF INTEREST**

***Cover Picture**: Global Assessment of Soil Degradation map (see article on page 29)*

The United Nations Conference on Desertification (UNCOD) was held in Nairobi from 29 August to 9 September 1977. This was the first worldwide effort initiated to consider the global problem and responsibilities posed by the spreading menace of desertification. 95 States, 50 United Nations offices and bodies, 8 intergovernmental organisations and 65 non-governmental organisations participated. The United Nations Conference on Desertification prepared and adopted a world-wide 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 Unit was established within UNEP to assist 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 Unit was to prepare, compile, edit and publish at six-monthly intervals a newsletter giving information on programmes, results and problems related to the fight against desertification around the world.

In 1985 the Desertification Control Programme Activity Centre (DC/PAC) was created on the basis of the Desertification Unit by UNEP's Executive Director with approval from the Governing Council. DC/PAC is a semi-autonomous office with increased flexibility to respond to the demands of following up and implementing the PACD.

Desertification Control Bulletin is an international bulletin published at six-monthly intervals by the United Nations Environment Programme (UNEP) to disseminate information on, and knowledge of, 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 *Desertification Control Bulletin* do not imply expression of any opinion on the part of UNEP concerning the legal status of any country, territory, city or area, or its authorities, or concerning the delimitation of its frontiers or boundaries.

Enquiries should be addressed to:

The Editor,
Desertification Control Bulletin,
UNEP, PO Box 30552, Nairobi,
Kenya

Cover photographs:

The Editor of *Desertification Control Bulletin* is seeking photographs for consideration as bulletin covers. All submissions should be sent to the address above.

Technical requirements:

Photographs must be colour transparencies of subjects related directly to desertification, land, 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 square 18 cm x 18 cm.

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 of the photographer and all the rights are owned by the photographer. *Desertification Control Bulletin* gives full credit to photographers for the covers selected, but does not provide renumeration.

Articles:

Desertification Control Bulletin invites articles from the world's scientists and specialists interested in the problems arising from or associated with the spread of 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 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 hand corner. Users of word-processors are welcome to submit their articles on diskette in (MS-DOS format), indicating the programme used.

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 in the text. Only essential tables should be included and all should be identified as to source.

Illustrations and Photographs:

Line drawings 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 and should be as clear and 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. Dia-positive 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/her initials, year of publication, title, publisher (or journal), serial number and number of pages.

Other requirements:

Desertification Control Bulletin 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: articles longer than 4,500 words are not accepted. A nominal fee is paid for articles accepted for publication and 25 reprints are provided to the authors.

Editor: Ms Marti Colley
Technical Advisor: Ms Yukika Matsumoto

Dunes Encroachment on the Cultivated Land in Egypt

S.M. Abu EL-Ennan[1], K.J. Dalsted[2] and M.Z. Salem[3]
[1]AL-Azhar University, College of Agriculture, Soils and Water Department, Nasr City, Cairo, Egypt; [2]Office of Remote Sensing, South Dakota State University, Brookings, S.D., USA; [3]National Research Center, Cairo, Egypt.

Abstract

Zones of the active and inactive sand dunes were recognized in the studied area in Egypt from the interpretation of the Landsat satellite imageries at different times. These areas of sand accumulations are located to the west and east of the Nile Delta; south and west of the Fayoum and Wadi EL-Rayan depressions; EL-Kharga Oasis; Nile Valley (south-west EL-Minya); north-west of Lake Nasser and north of the Sinai peninsula.

The characteristics of these dunes and sand areas were described and a map of the active and inactive sand dunes in the studied area was prepared. The results of the interpretation of the Landsat satellite imageries revealed that the aeolian deposits were easily delineated due to the associated high spectral reflectance.

Considerable attention should be focussed on monitoring the processes of the migration of the sand dunes towards the fertile cultivated land in Egypt.

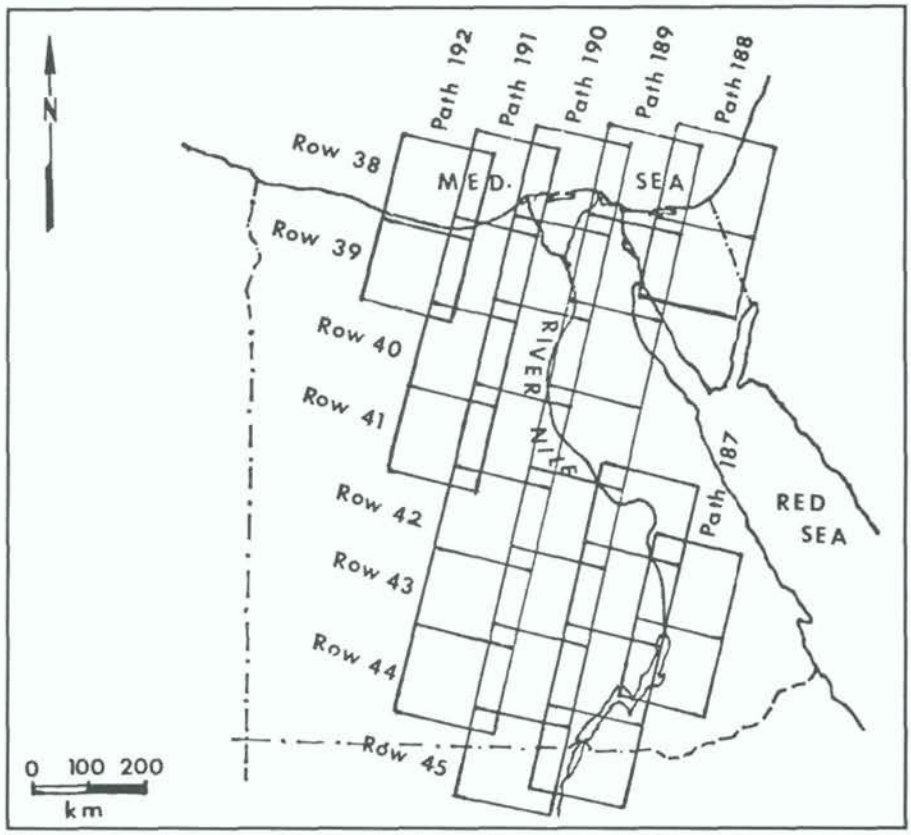


Figure 1: Landsat scene location for the study area

Introduction

Egypt is almost entirely desert; only about 4 per cent of the total area (approximately 1 million km^2) is cultivated. The climate is arid in southern and central Egypt and semi-arid in the north.

Topographically, Egypt is divided into four major regions: (1) Nile Valley and Delta where the majority of the population (55 million in 1988) is located; (2) western desert; (3) eastern desert and (4) Sinai peninsula. The annual growth of the population is approximately 2.5 to 3% (1 million each year). Therefore, Egypt needs to increase the cultivated area rather than lose areas to the desert.

Several investigators have studied the sand dunes in Egypt. Among them, Said, (1962) in his geological studies about Egypt, mentioned that different sizes and types of sand dunes are located in the western desert. EL-Shazly et al. (1975a and 1975b) found that some aeolian accumulations are covering considerable areas in the eastern part of the Suez Canal and western part of the Nile Delta. EL-Baz (1978) studied the desert colour using the Apollo-Soyuz photographs in the western desert and indicated that there are some sand dunes accumulated in the western part of the Nile Delta. Dalsted and Worcester (1979) used remote sensing techniques to identify active sand dunes and other features as indicators of desertification in Western Africa. EL-Baz and Wolfe (1982) studied the movement of the sand dunes in the western desert and concluded that there are relationships between the direction the sand moves and the orientation of dunes and wind velocity and direction.

This study aimed to delineate the sand dunes that are encroaching on the cultivated land in the selected areas by using manual remote sensing techniques.

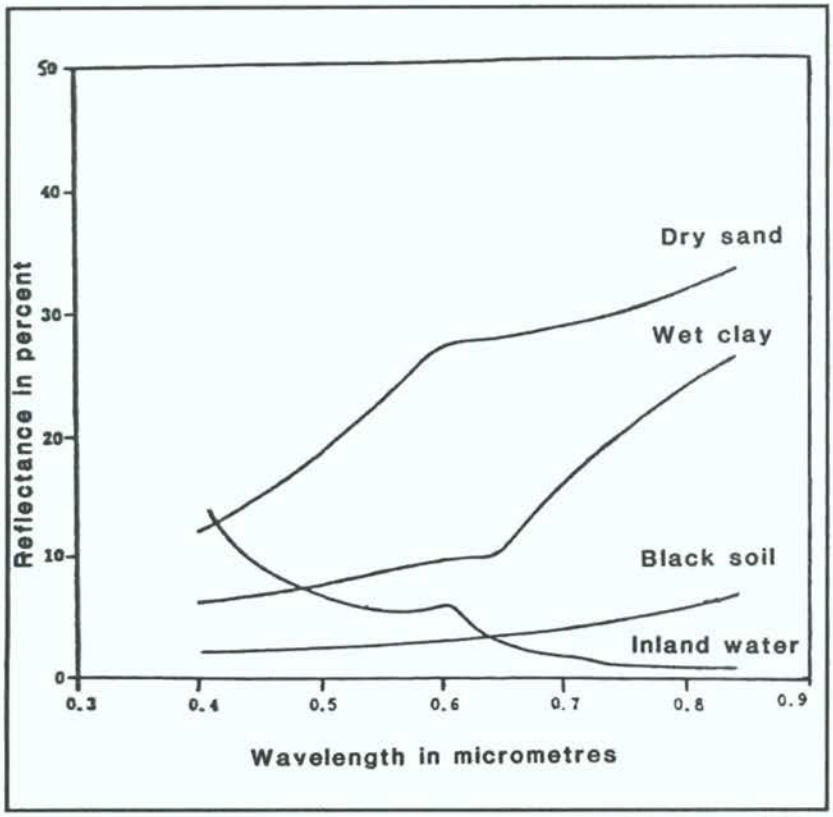


Figure 2: Reflectance range for natural materials (after G.K. Moore, 1977)

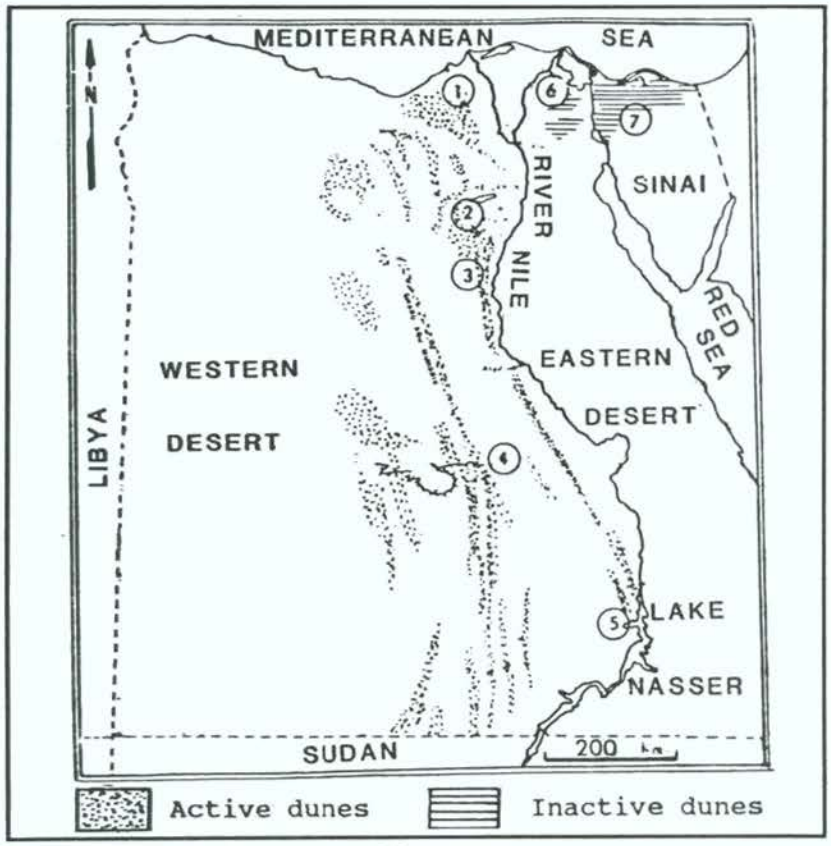


Figure 3: Active and inactive sand dunes map
1: West of the Nile Delta 2: The Fayoum and Wadi EL Rayan 3: The Nile Valley 4: The Kharga Oasis 5: North-west Lake Nasser 6: East of the Nile Delta 7: Sinai Peninsula

Materials and Methods

Egypt is covered by 63 Landsat Multi-spectral Scanner (MSS) scenes which lie along 10 paths (from path 185 to 194) and 8 rows (from row 38 to 45) and is covered by 60 Landsat Thematic Mapper (TM) scenes which lie along 10 paths (from 172 to 181) and 8 rows (from 38 to 45). Twenty-nine Landsat MSS scenes were needed to cover the study area (approximately 48 per cent of the total Landsat MSS scenes covering Egypt). Due to the unavailability of the Landsat TM scenes for the total selected area, the study used one scene with different bands for the east Nile Delta area. The entire study area is defined by the Landsat scene locations shown in Figure 1. The Landsat satellite imageries, prints and transparents were interpreted at a nominal scale of 1:1,000,000 across different dates, 1972, 1973 and 1984.

The individual Landsat scenes were visually interpreted and a zoom transparent scope was used to transfer the results to a base map. The interpretation involved delineation of the sand dunes and aeolian areas with respect to their size, shape, colour and deposition pattern. The area (km^2) of the different aeolian features was measured using an electronic planimeter.

Results and Discussion

Spectral reflectance characteristics

The interpretation of the Landsat imageries of the study area revealed that sand dunes and aeolian deposits of different types, sizes, colours and orientation cover considerable areas in the western desert, east of the Nile Delta and north of the Sinai peninsula. These dunes and accumulations belong to the Quaternary sediments (Pleistocene and Holocene). Figure 2 shows how dry sand areas typically have high reflectance (Moore, 1977) and, thus, they can usually be delineated on the Landsat imageries. The contrast of the sandy areas to the other less reflective materials allow easy separation. The sandy deposits appear in distinctive light yellowish colours on the Landsat false colour composite imageries and as light grey tones on black and white imageries. The longitudinal and transversal sand dunes are also easily located by their very distinct alignment while sand sheets are

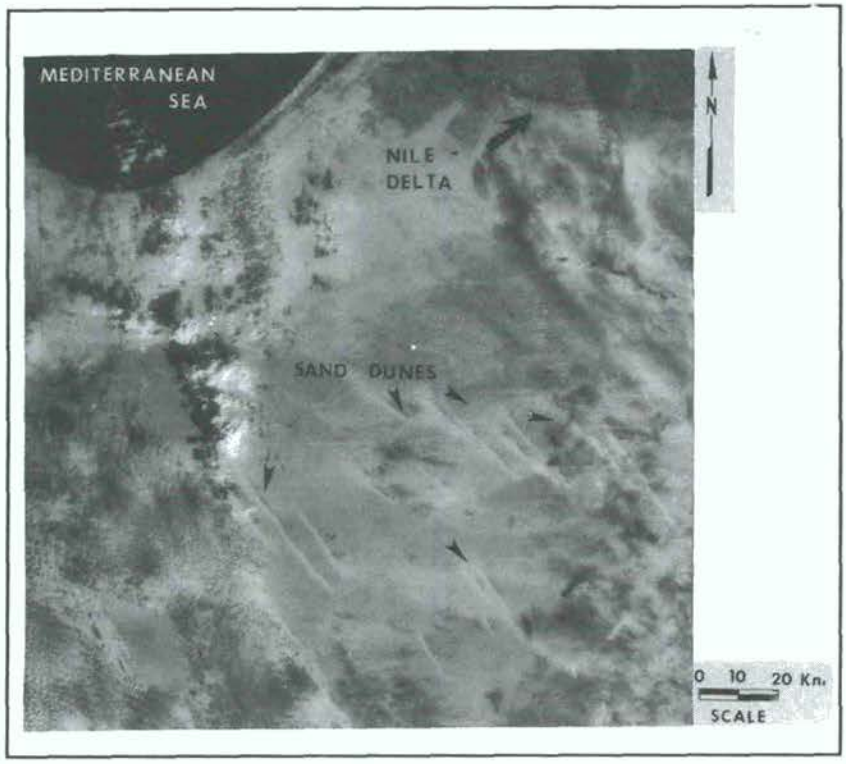


Figure 4: Landsat band 7 (near infrared) image, scene 1106-00060 (Path 191, Row 38) dated 5 January 1973, showing the sand dunes (NW-SE direction) west of the Nile Delta. A part of the Nile Delta appears in the upper right corner and a part of the Mediterranean Sea in the upper left corner.

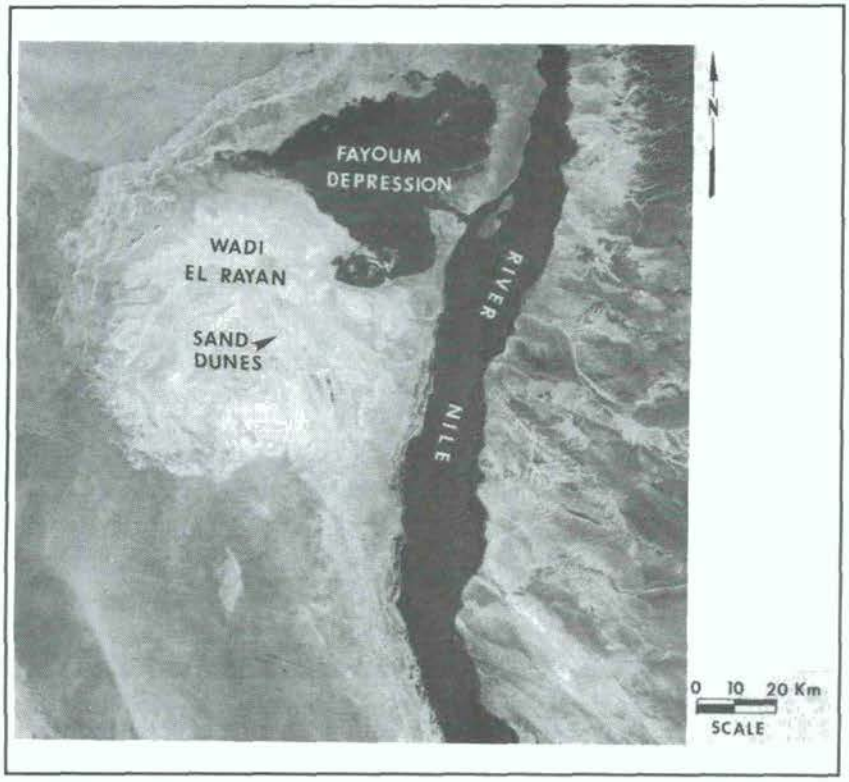


Figure 5: Landsat band 6 (near infrared) image, scene 1165-00050 (Path 190, Row 40) dated 3 January 1973, showing the encroachment of the longitudinal dunes into the Fayoum and Wadi EL-Rayan depressions.

characterized by sand ripples and homogeneous texture and colour.

Active sand dunes

An interpretation map was prepared (Figure 3) showing the location of the different aeolian features, i.e., active and inactive sand dunes in the study area. From this map five discernable areas are identified as having serious sand dune encroachment: (1) west of the Nile Delta; (2) south and west of the Fayoum and Wadi EL-Rayan depressions; (3) the Nile Valley (south-west EL-Minya); (4) EL-Kharga Oasis, and (5) north-west of Lake Nasser.

1: **West of the Nile Delta**: This area (Figure 4) is mainly covered by active sand accumulations characterized by undulating relief and some scattered gravel. These aeolian sediments have reddish to yellowish colour on the Landsat colour composite imageries. The dimensions of this area are 20 to 35 km in length and 5 to 15 km in width. These sand accumulations have an area of about 255 km^2. The orientation of these sediments is towards the western and south-western sides of the cultivated land in the Nile Delta. Besides the spectral appearance, sand ripples and sand mounds beneath desert shrubs (EL-Baz, 1979) indicate that these sandy accumulations are active and migrate in response to the prevailing winds which shift direction.

2: **The Fayoum and Wadi EL-Rayan depressions**: Sand dunes occur to the south and west of the Fayoum and surrounding the Wadi EL-Rayan depressions. These aeolian deposits have a yellowish colour and fine to medium texture and are aligned from north-west to south-east in response to the prevailing wind direction. These aeolian sediments can be classified into three types: (1) longitudinal dunes around Wadi EL-Rayan depression, ranging from 35 to 45 km in length and 10 to 15 km in width, and covering an area of about 480 km^2; (2) sand sheets at the west of the Fayoum depression characterized by flat surfaces and whitish colour with an area of about 240 km^2;

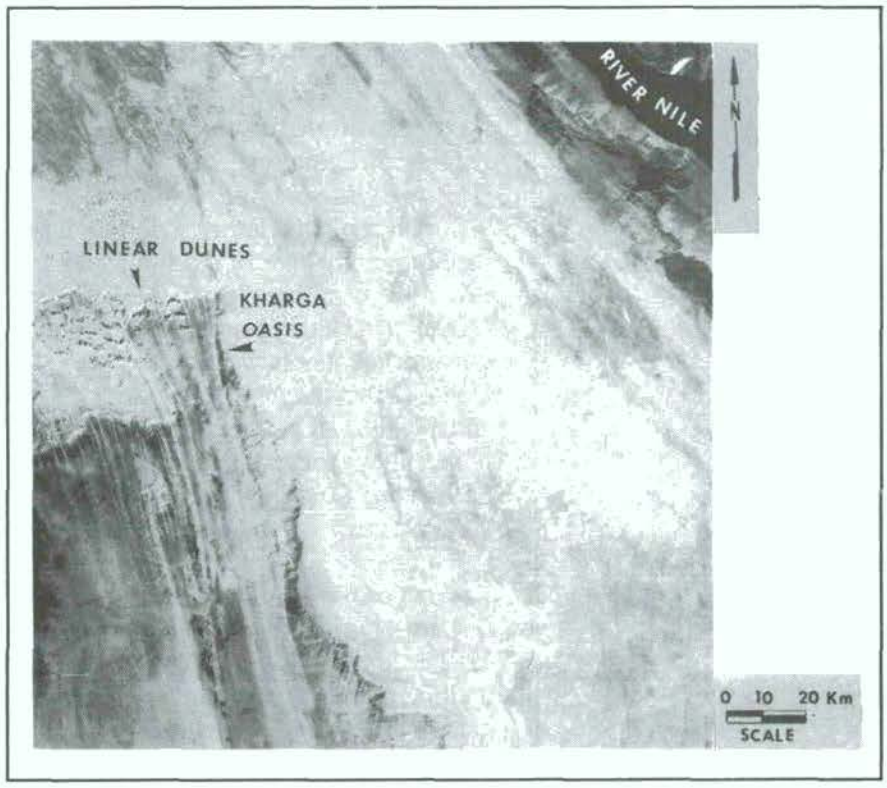


Figure 6: Landsat band 7 (near infrared) image, scene 1110-07560 (Path 190, Row 41) dated 10 November 1972, showing the linear dunes in the Kharga Oasis. A part of the Nile Valley appears in the upper right corner.

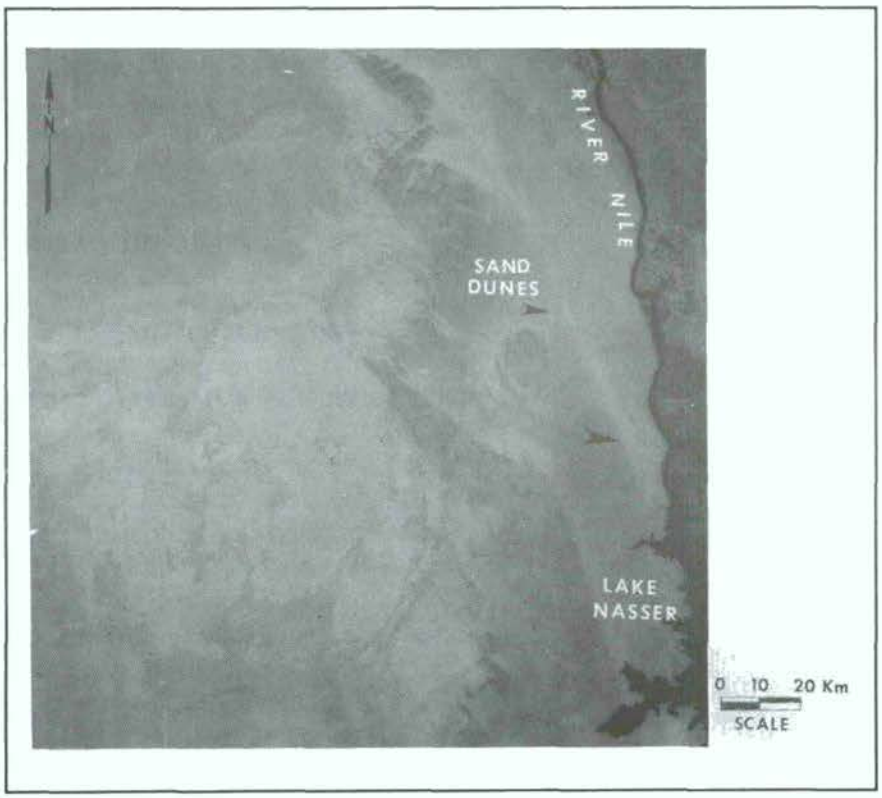


Figure 7: Landsat band 7 (near infrared) image, scene 1109-07504 (Path 191, Row 44) dated 9 November 1972, showing the active dunes north-west of Lake Nasser.

and (3) barachan sand dunes with low elevations located at the south and south-west of the Fayoum depression. Their dimensions are 20 to 35 km in length and 5 to 10 km in width and cover an area of about 160 km².

In the area of the Fayoum and Wadi EL-Rayan depressions the climate is arid with annual precipitation of generally less than 55 mm and characterized by a hot, dry summer from May to October and a relatively cool winter from November to April. So virtually no desert vegetation exists. According to Griffiths and Soliman (1972) the wind direction in spring and summer seasons is generally from north/north-west to south/south-west. Due to the arid climate and the wind, the sand sediments are actively attacking the western and southern sides of the Fayoum and Wadi EL-Rayan depressions (Figure 5). Observations made during a field trip to this area from 10 to 15 May 1987 confirmed that sand accumulations of approximately 3-5 metres covered the cultivated land in the south and south-west of the Fayoum depression (8 km south of EL-Gharak EL-Sultani) and some irrigation canals are dried and covered by the aeolian deposits. The farmers grow some desert trees to stand against the advance of sand dunes.

3: **The Nile Valley**: Linear, parallel sand dunes occur in the area which lies to the south-west of EL-Minya. These dunes have steep slip faces on both sides and are oriented from north-west to south-east parallel to the prevailing wind direction. These aeolian deposits are 30 to 35 km in length and 5 to 8 km in width and have an area of about 350 km². They are characterized by yellowish to whitish colour. Some of these dunes are actively encroaching on fertile cultivated land at the west side of the Nile Valley.

4: **The Kharga Oasis**: Longitudinal and linear dunes characterize the area. These dunes are approximately 40 to 55 km in length and 10 to 15 km in width, covering an area of about 400 km² and extending parallel to the

wind direction from north-west to south-east. This area is characterized by less than 2 mm annual precipitation. Due to the aridity, wind direction and the flat topography, the dunes are active and migrate from the north/north-east to the south/south-east with the wind directions, especially in the hot and dry seasons. The source of the mobile dunes is the Great Sand Sea in the western desert, and the north/north-western edges of the Kharga Oasis are covered by these aeolian accumulations. This phenomenon is clearly observed and delineated on the Landsat scenes (Figure 6). The desert roads between EL-Kharga and EL-Dakhla Oasis and EL-Kharga to Naga-Hamadi were buried by these mobile dunes.

5: **North-west of Lake Nasser**: Longitudinal and barachan dunes are located about 3 to 5 km to the north-west of Lake Nasser and cover the irregular topographic area which extends from north-west to south-east. These dunes migrate to the south and south-east directions. The longitudinal dunes show parallel lines and have generally low elevations. They are characteristically 30 to 40 km in length, 15 to 20 km in width and cover an area of about 320 km^2. These dunes, having light grey tones on black and white imageries and yellowish to white colour in colour imageries, are easily distinguished from the other landform units on the Landsat scene, as illustrated in the area around Lake Nasser (Figure 7). The Landsat imagery interpretation revealed that these longitudinal dunes are attacking the north-west edges of the lake.

Inactive sand dunes

The following two major areas were characterized by inactive sand accumulations.

6: **East of the Nile Delta**: Some longitudinal and barachan dune types are observed in the area between east of the Nile Delta and north of the Gulf of Suez. These dunes have low elevations (2 to 5 metres), are approximately 2 to 5 km in length and 1 to 2 km in width. These aeolian deposits are trending from north to south. Also some sand sheet accumulations were delineated surrounding these dunes which are characterized by flat to undulating surfaces. These dunes and sand accumulations are inactive and currently not posing any threat to the cultivated land in the Nile Delta.

7: **Sinai Peninsula**: The second zone for the inactive sand dunes is located in the north of the Sinai peninsula, particularly between the east extent of the Bitter Lakes and north of Wadi EL-Arish. This area is characterized by a sandy coastal plain strip extending parallel to the Mediterranean shoreline and is distinguished by white colour and fine, homogeneous texture. These sand accumulations are trending approximately from north-east to north-west of the Sinai peninsula and are nearly flat with a gradual sloping towards the north. They are inactive and occur far from the fertile cultivated land in the Nile Valley and Delta.

Summary and Conclusions

From the interpretation of the multidate Landsat satellite imageries covering the area surrounding the cultivated land in Egypt, the active and inactive sand dunes were recognized and delineated. The characteristics of these dunes were discussed according to their colour, tone, shape, size, texture and signatures and a map of the active and inactive sand dunes was prepared. From the results and discussion, we can conclude that: (1) Five zones were recognized as the active sand dunes; (2) The Landsat imagery is an excellent tool with which to study the desert areas through mapping dunes and other aeolian features; (3) The aeolian deposits were easily observed on the Landsat imageries, primarily by their spectral reflectance; (4) Considerable attention should be focussed on the processes and migrations of the sand dunes, especially surrounding the fertile cultivated land in Egypt; and (5) Monitoring the rate sand dunes encroach on agricultural areas can assist in planning amelioration actions.

References

DALSTED, K.J. and B.K. WORCESTER, 1979. Application of remote sensing to detection of desertification processes. In J.R. Goodin and D.K. Northington (ed.) *Arid Land Plant Resources*. International Center for Arid and Semi-Arid Studies, Texas Tech. University, Lubbock. pp. 622-628

EL-BAZ, F., 1978. *The meaning of desert colour in Earth orbital photographs*, Photogrammetric Engineering and Remote Sensing. Vol. 44 (1) pp. 69-73

EL-BAZ, F. and R.W. WOLFE, 1982. Wind patterns in the western desert. In *Desert landforms of south-west Egypt: a basis for comparison with Mars*, National Aeronautic and Space Administration, Washington, D.C. NASA CR. 3611. pp. 119-139

EL-SHAZLY, E.M. and M.A. ABDEL HADY, 1975a. *Geological geophysical investigations of Suez Canal Zone*, Egypt Remote Sensing Research Project, Academy of Scientific Research and Technology, Cairo, Egypt

EL-SHAZLY, E.M. and M.A. ABDEL HADY, 1975b. *Geological interpretation of Landsat satellite image for west Nile Delta, Egypt*, Remote Sensing Research Project, Academy of Scientific Research and Technology, Cairo, Egypt

GRIFFITHS, J.F. and K.H. SOLIMAN, 1972. The northern desert (Sahara). In Griffiths, J.F. (ed.) *Climates of Africa*, Amsterdam, Elsevier, pp. 604

MOORE, G.K., 1977. *Satellite surveillance of physical water quality characteristics*, U.S. Geol. Survey, Sioux Falls, South Dakota, U.S.A.

SAID, R., 1962. *The geology of Egypt*, Elsevier, Amsterdam and New York, pp. 377

Applying Remote Sensing Data in Desertification Monitoring

F. Jaskolla and A. Hirscheider
AGF-Working Group Remote Sensing
Institute for General and Applied Geology
University of Munich Luisenstr. 37
D-8000 München 2
Federal Republic of Germany

Introduction

Since 1984 the European Community (EC) and Joint Research Center/Ispra Establishment have been implementing a project to apply remote sensing data to monitor the problems of desertification on the fringes of the Sahelian Zone in Western Africa - "Caractérisation par les techniques de la télédétection de la dynamique de la désertification à la périphérie du Sahara" - which aims to:

- demonstrate the suitability of remote sensing data of different scales and appropriate image processing techniques for an improved management of desertification problems; and to:
- provide a methodological concept which can be transferred to developing countries.

In its first phase, a German-French group provided encouraging results from a test site in the (ecological) transition zone of the Sahel in Mali on the basis of first generation remote sensing data. The following three thematic maps (1:200,000) were prepared: Synthetic terrain classification; Land-use and vegetation (1972/76) including morphodynamics; and Changes in areas of rainfed agriculture, vegetation and vegetation burn-off (1952/53-1972/76).

On the basis of these first-hand results from phase I, the EC decided to continue the investigation with the integration of second generation remote sensing data and to concentrate on specific tasks, such as the evaluation of wind erosion occurrence.

This article outlines the selected procedures, the most striking results and experiences gained from the second phase of the project and highlights possible future areas of development for application of advanced space-borne remote sensing data.

The test site in Mali covers the map sheet for Sokolo 14°- 15°latitude north and 6°- 7° longitude west of greenwich). This area of about 12,000 km² partly includes the irrigation systems of the Canal du Sahel in the East and, from there 110 km of savannah to the west.

Although the investigations were conducted at a local scale, the selected methodology was considered for application in other regions of the Sahelian zone.

Remote Sensing

In the last decade remote sensing has proven its potential for earth observation and has become a powerful tool in many fields. The application fields of available operational datasets can be categorised as follows:

- **small-scale surveillance** of real time changes in ecological and vegetation status using low resolution meteorological satellites such as Meteosat and NOAA.
- **regional planning** activities in areas of special interest supported by the application of medium to high resolution satellite data, like Landsat Multispectral Scanner (Landsat-MSS), Landsat Thematic Mapper (Landsat-TM) and SPOT.
- **local investigations** to support community planning activities etc. using high resolution data which, until now, could only be provided by aerial surveys.

At a regional level, data from the Landsat-MSS system created new and unexpected possibilities by providing unbiased, current, synoptic and multi-temporal images. This opened up new horizons, particularly in land-cover mapping and monitoring on medium to small-scales. However, the insufficient sensor parameters limits the application of Landsat-MSS, e.g. in spectral and spatial resolution.

The situation was improved when data from the second generation earth observation satellites became available, in particular that of Landsat-TM and SPOT. This increased the potential for applying remote sensing satellite data to practical ends, such as in monitoring desertification, and inspired the EC to realize this project.

Objectives and requirements

Phase II of the project has three main aims:

- to evaluate the aeolian processes of desertification - magnitude, manifestation and dynamics (eg, extension, shape and direction of elongation/displacement of dune elements
- to evaluate changes in vegetation cover caused by fuelwood cutting, bush fencing, feeding and overgrazing: changes in land-use such as rain-fed and irrigated agriculture on new settlements: degradation of soils and their connection with the dynamics of desertification
- to elaborate an operational methodology on the above which

is transferable to developing countries.

Desertification and related decreases in agricultural and vegetation resources pose an urgent need for a workable methodology, not an endless testing of scientific approaches. To effectively utilize remote sensing in the field of desertification monitoring, consideration of the fundamental requirements for its operationality in the whole Sahelian Zone and other affected areas is essential.

In particular, the following needs to be taken into account:

- Continuous observation of the Landsat quick-looks of the test site in Mali showed that in the years 1987, 1988 and 1989 frequent cloud coverage can appear, even in arid areas. In all, 54 quick-looks were taken between July and December, of which only 18 were free of clouds. Of the oher 36, cloud cover (in %):
  -10% (6): -20% (3): -30% (5): -40% (2): -50% (4): -60% (4): -70% (2): -80% (6): -90% (0): -100% (4).

A significant improvement can only be expected by using data of all weather monitoring systems (Radar). However, this data does not yet fulfill the requirements for an operational methodology.

- The data applied have to be available multi-temporarily for the whole areas of the relevant zones. Ignoring their high cost, the second generation data are preferable because of the higher spectral and ground resolution they provide. Landsat-MSS data have some distinct restrictions on their applicability but from the cost point of view its application cannot be excluded. Furthermore, they provide information dating back to 1972 which allows comparative study of the changes.
- Geometric and spectral characteristics of the data must enable a sufficient discrimination of relevant surface features (eg, different types of soil, dunes, vegetation and "human activities", such as settlement, field structures, etc.)

SPOT Multispectral Data

	1	2	3
1	1.000	0.985	0.633
2	0.985	1.000	0.881
3	0.633	0.881	1.000

Landsat-TM Data

	1	2	3	4	5	6
1	1.000	0.919	0.921	0.348	0.664	0.787
2	0.919	1.000	0.939	0.554	0.805	0.845
3	0.921	0.939	1.000	0.338	0.745	0.869
4	0.348	0.554	0.338	1.000	0.726	0.479
5	0.664	0.805	0.745	0.726	1.000	0.909
6	0.767	0.845	0.869	0.479	0.909	1.000

Figure 1: Comparison of the correlation matrix of corresponding Landsat-TM and SPOT data over vegetated area.

The Practical Scenario

A critical examination of the state-of-the-art of the technology and the requirements of desertification monitoring show that the success of the application of remote sensing is subject to:

- data to be used; and:
- information extraction

Information here reflects specific spectral properties of all surface phenomena. These properties should be arranged for thematic applications at the later step of information integration. This also means that the same spectral signature can be interpreted in a different way for different tasks.

Data to be used: Some of the vast potential of the Landsat-MSS was demonstrated in Phase I. Currently, data from the second generation earth observation satellites, Landsat-TM and SPOT, are available which show significant improvements in geometric and spatial aspects.

The following can be stated from a brief evaluation of the two satellite systems on the basis of the gathered experiences.

SPOT shows better geometric characteristics due to its high ground resolution of 10 m in the panchromatic band and its stereoscopic interpretation capabilities. The spectral abilities of Landsat-TM offer better application possibilities than SPOT as can be seen from the correlation matrix of Landsat-TM and SPOT data over the same vegetation area (Figure 1). This data displays the similarity of the 2 SPOT bands in the visible spectrum, which in fact reduces SPOT from a 3-dimensional to a 2-dimensional spectral system. The equivalent Landsat-TM bands show a wider variance, implying a better possibility of distinguishing relevant surface phenomena.

From these observations a combination of both data by adequate digital methods was considered to

be the ideal methodology for obtaining suitable data for the purpose of the project. However, the combined data does not yet exist operationally and must be developed, tested and approved in the future. Therefore, recommendations for further application of remote sensing in desertification monitoring programmes must be restricted to say only that the use of Landsat-TM data is indispensable due to the significant increase in possibilities for identifying surface phenomena. In addition, Landsat-TM data delivered from ESA/ESRIN are geometrically rectified to the UTM projection by pre-processing. This can reduce much of the computer work.

Costs: The following rough estimate from an example covering Europe demonstrates the relative costs of the various systems.

These figures show that SPOT data are too expensive, especially taking into account their restricted application. Despite Landsat-TM data costing six times as much, the difference in cost of Landsat-MSS and -TM data was considered to be insignificant, because of the improvements which can be obtained using Landsat-TM.

Number of Landsat scenes for Europe	250
Repetition rate (per year)	3/a *
Cost per scene **	
Landsat MSS	900—AU
Landsat TM	5,100—AU
SPOT ***	10,920—AU
Total costs for data	
Landsat MSS	675,000—AU
Landsat TM	3,825,000—AU
SPOT	57,330,000—AU

* Owing to cloud cover, it is unrealistic to expect a suitable coverage of 3 times per year, (before, during and after the rainy season) even in arid areas.
** all data costs are based on 1986 prices and given in Accounting Units (AU), representing the ECU
*** with SPOT approximately 7 scenes are required to cover the area of 1 Landsat frame. The cost for panchromatic and multispectral data are AU 5,460 each.

Information Extraction: Successful application of these advanced satellite data depends on available hardware and software, data enhancement and data interpretation.

Hardware and Software: A broad variety of hardware configurations and software packages which enable sophisticated treatment of spaceborne remote sensing data has long been available. However, the crucial point is the necessity to transfer entire image processing facilities to a country lacking essential logistics and very often with unfavourable environmental conditions. On the other hand, there is a great demand for an operational software working on "low-cost" hardware, e.g. AT or Personal Computer.

CHIPS software developed by a team of the Institute of Geography at the University of Copenhagen is already available on an operational level. It works on a standard IBM-AT compatible computer. The package was developed basically for the processing of Advanced Very High Resolution Radar (AVHRR) data and meets all the requirements, such as being easy to learn and operate and with great flexibility and stability. Our team plans to improve the filtering techniques and the Intensity-Hue-Saturation (I-H-S) procedures of the CHIPS package which are indispensable for a successful processing of the Landsat-TM data.

Data Enhancement: The purpose of data enhancement is to generate combinations of the spectral information which give an optimized presentation of the different spectral behaviour of relevant surface phenomena. Overall, two methodological approaches need to be considered: automated classification techniques and image enhancement techniques. It is of great importance that relevant phenomena are determined automatically, especially for monitoring purposes. Nevertheless, two aspects prohibit the application of such classification techniques:

- lack of a standardized procedure which allows operational application and guarantees indispensable accuracy over the entire Sahelian Zone with its very different conditions; and:
- multitemporal attempts of automated classification can only be realized on the basis of digital terrain models, covering the entire Sahelian Zone at suitable scales (1:100,000). These terrain models would need to take into account the influence of a significant morphology and differences in height of targets on the comparability of the recorded signal, eg. because of variations in illumination and atmospheric absorption. However, this would be too expensive and could not be realized under the present timescale of the project.

Due to the above reasons, it was considered that the well-established techniques of data enhancement in combination with conventional visual photo-interpretation offer the best integration of remote sensing data. The overall scheme of this procedure is shown in Figure 2.

To date, only false colour presentation of spectral information has been applied in the framework of desertification projects, owing to its familiarity, well-known interpretation key and the quality of data available. However, on the basis of the extended spectral possibilities offered by Landsat-TM, additional procedures for information enhancement and presentation can be explored.

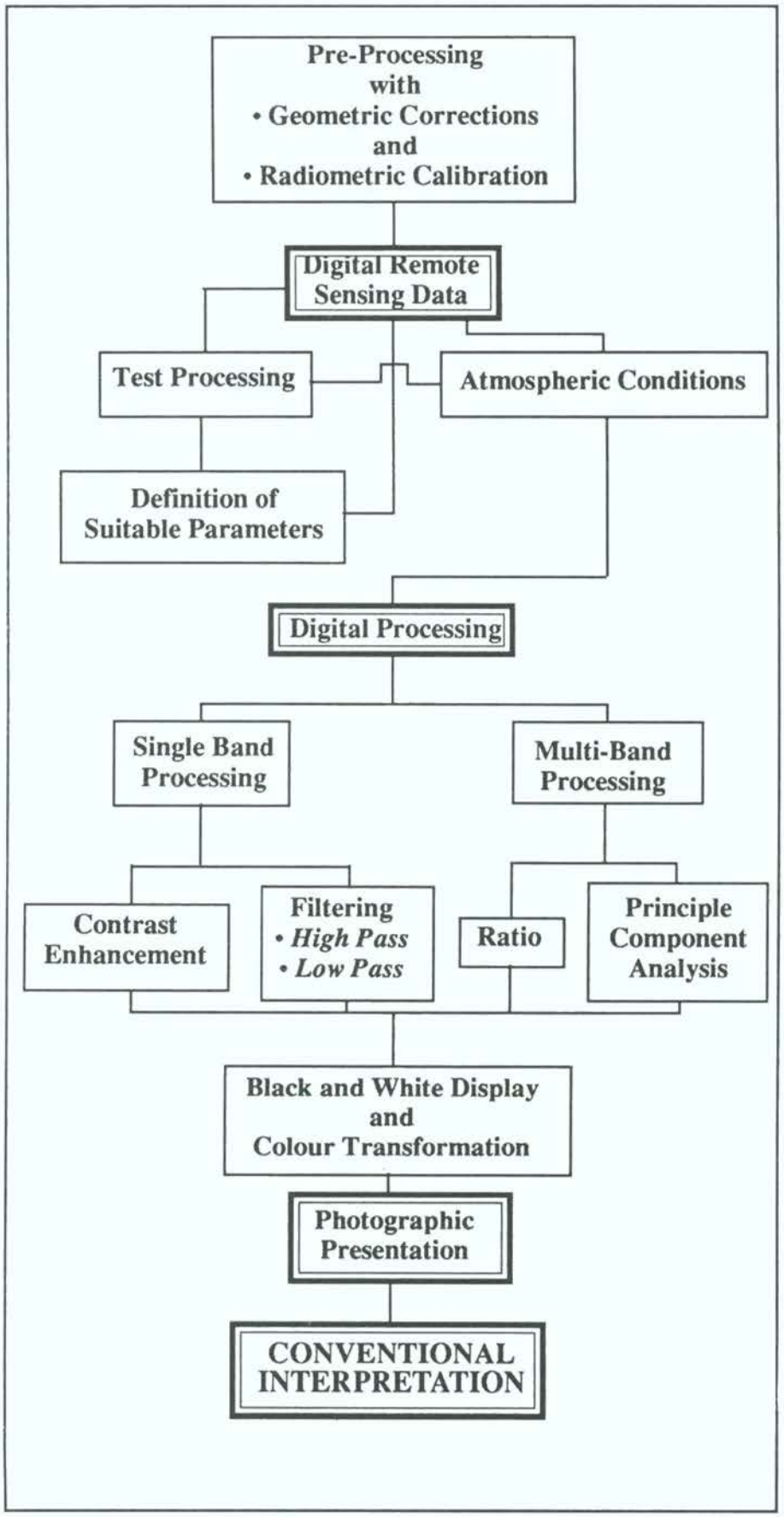


Figure 2: Scenario for an optimized preparation of remote sensing information for the tasks of desertification monitoring at medium scales (eg, 1:100,000 - 200,000)

Besides the conventional false-colour-composite (in the case of Landsat-TM bands 2-3-4, defined as blue-green-red), the combination of bands 1-4-7 (defined as blue-green-red) shows high potential for visual photo-interpretation (Figures 3.1 and 3.2).

For the objectives at the test site in Mali, the combination 1-4-7 would be preferable because of the following reasons: wide-spread ferric luvisols give good results in TM-band 7 owing to the high reflectance of iron in this Short-Wave-Infra-Red (SWIR) band; Landsat-TM band 4, a Near-Infra-Red (NIR) band, gives high reflectance of chlorophyll, implying good results on healthy vegetation; bare soils and vegetation and different stages of degradation have no significant influence in the spectral range of Landsat-TM band1 making it suitable for an improved separation of colour composites. Nevertheless, this selection of bands should be considered only as a first attempt because more experience needs to be gained on the possibilities of Landsat-TM-bands 3 and 5 in differentiating types and conditions of vegetation.

A further step in the development of operational digital image processing products is the consideration of multi-band combinations. Attention should be focussed on ratios and, initially, on the combination of Landsat-TM bands 4 vs 1 (4/1) and 7 vs 1 (7/1). The division with the blue-band effects higher visual differentiation capability by an enhancement of the vegetation signal (4/1) and of the bare ground signal (7/1) (see Figure 3.3).

Our recent experience has shown that the combination of satellite information through the I-H-S approach is also well suited due to its capability to modify the particular components without mutual influence; combine different data sets (e.g. Landsat-TM and AVHRR or MOS) or image processing products (e.g. ratio and principle

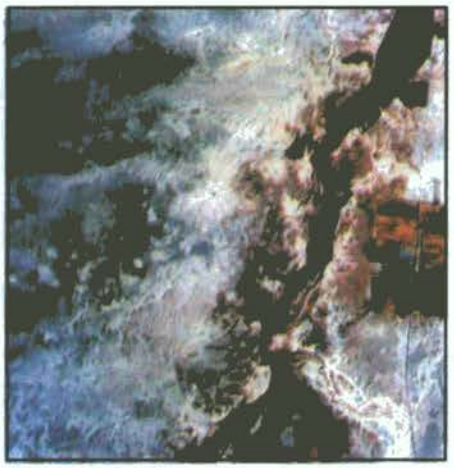


Figure 3.1: Conventional False Colour presentation of the Landsat-TM bands 2, 3 and 4

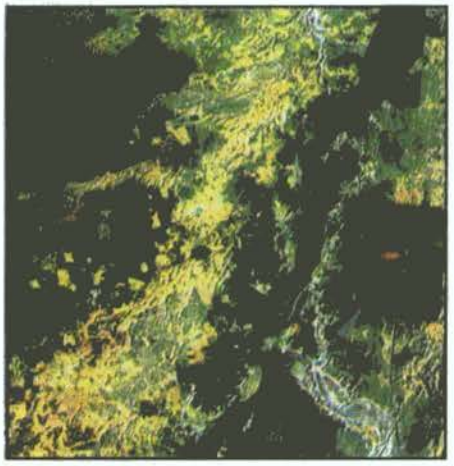


Figure 3.2: Colour presentation of the Landsat-TM bands 1, 4 and 7 via the I-H-S transformation

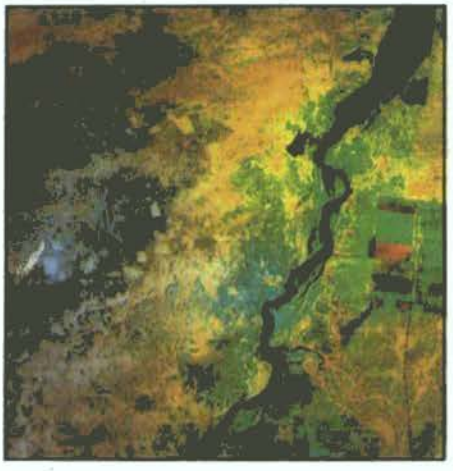


Figure 3.3: Colour combination of ratios 4/1 and 7/1 of Landsat-TM bands

Figure 3: Comparison of different image processing products of Landsat-TM data of a test site in Mali.

The example shows a part of the flooding area of the Canal du Sahel south of the village Niono, within the irrigated fields of a huge plantation. Surprisingly the pillar of smoke of an "active" burn-off area can be detected.

These examples show the increased information content of advanced image processing product (3.2 and 3.3) vs the conventional false colour composite. It is obvious that the definition of a standard product serving all application aspects is not possible (eg Figure 3.2 gives much more detail on structures of vegetation and dunes while Figure 3.3 enables an improved differentiation of soils).

component transformations) in a rational way; and therefore processing of algorithms and products can be standardized, allowing unique interpretation.

The conventional presentation of multispectral data by applying the false colour approach means superpositioning by assigning the different data to the colours blue-green-red. In the case of Landsat-MSS, for example, bands 4 (green), 5 (red) and 6 or 7 (near-infra-red), nowadays called 1-4, are associated with these colours. Therefore all phenomena with a high reflectance in the near-infra-red region are characterized by red colours which represent healthy vegetation. Contrary to this, the I-H-S approach describes colour in terms of its intensity, hue and saturation. The principal advantage of the approach for the study is that the influence of single input data can be separated and interpreted unambiguously.

Data Interpretation: A suitable strategy for the selection of information is the most crucial element in successful application of remote sensing data. Automated procedures for information extraction are presently not suited for this task, therefore it is recommended that remote sensing be integrated systematically into on-going desertification control activities through digital data enhancement and conventional visual photo-interpretation.

This is a well-known and versatile procedure which can be transferred easily through training programmes to the countries of the Sahelian Zone. The principles of conventional photo-interpretation are well documented and therefore are not discussed here.

Proposal for Implementing a Suitable Methodology in Sahelian Countries

Beside investigations into the more technical aspects of an improved application of remote sensing data for monitoring desertification problems, it is vital to pave the way to implementing a suitable methodology in the affected countries. Hereby it has to be taken into account that a successful application of remote sensing techniques can only be guaranteed if national authorities act as the body responsible for this application. In its implementation, the following activities were considered crucial to be included in the provision (Figure 4).

- **Identification of the problem** must be the basis of all future activities and should include a definition of the overall tasks and the nationally desired categories of relevant surface features. These should be harmonised with the realities of how remote sensing data can be applied. As a result, a catalogue of specific mapping units must be provided according to the individual needs of every region, based on inputs made by experienced scientists in the area (eg, soil and dune types, types of vegetation, land use, etc).

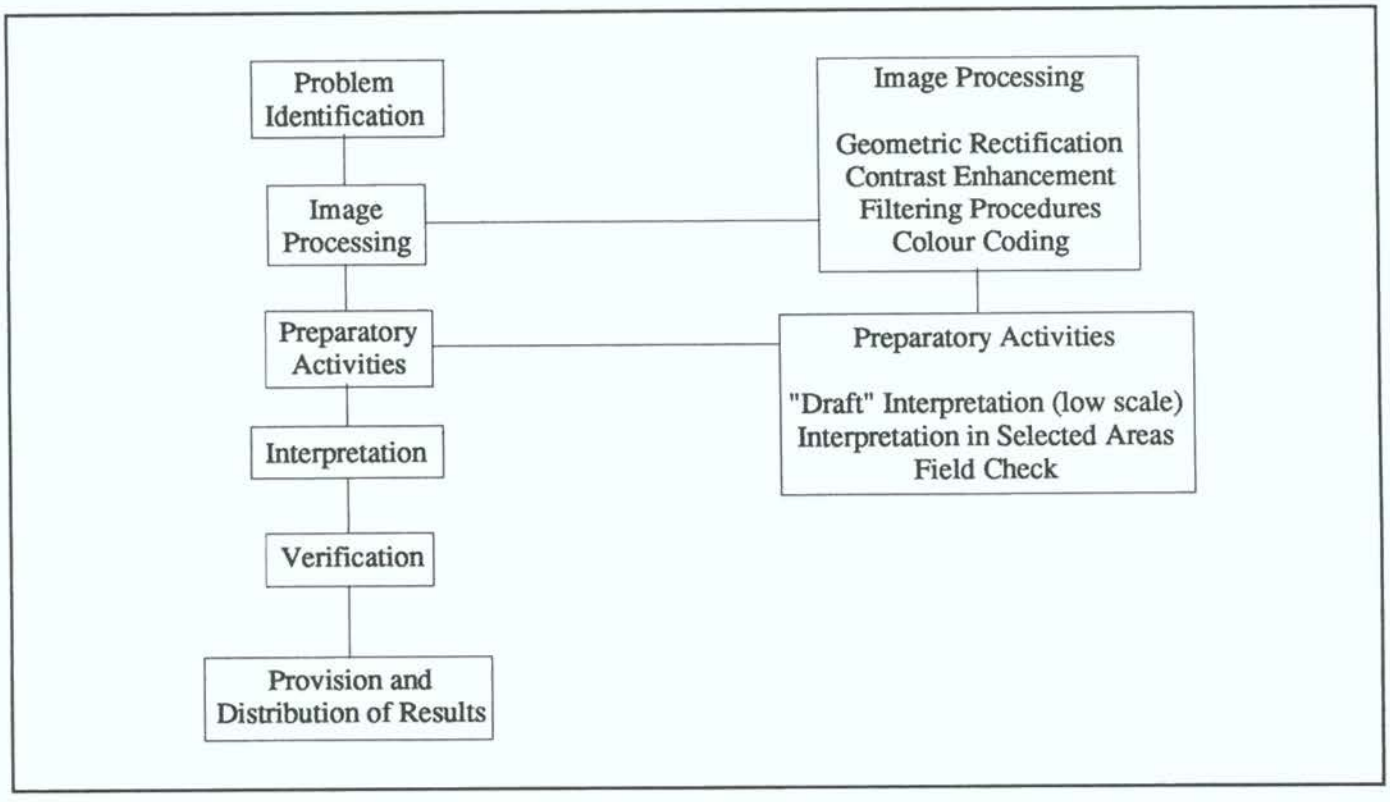


Figure 4: Proposed methodology for the application of remote sensing data for desertification monitoring and control programmes.

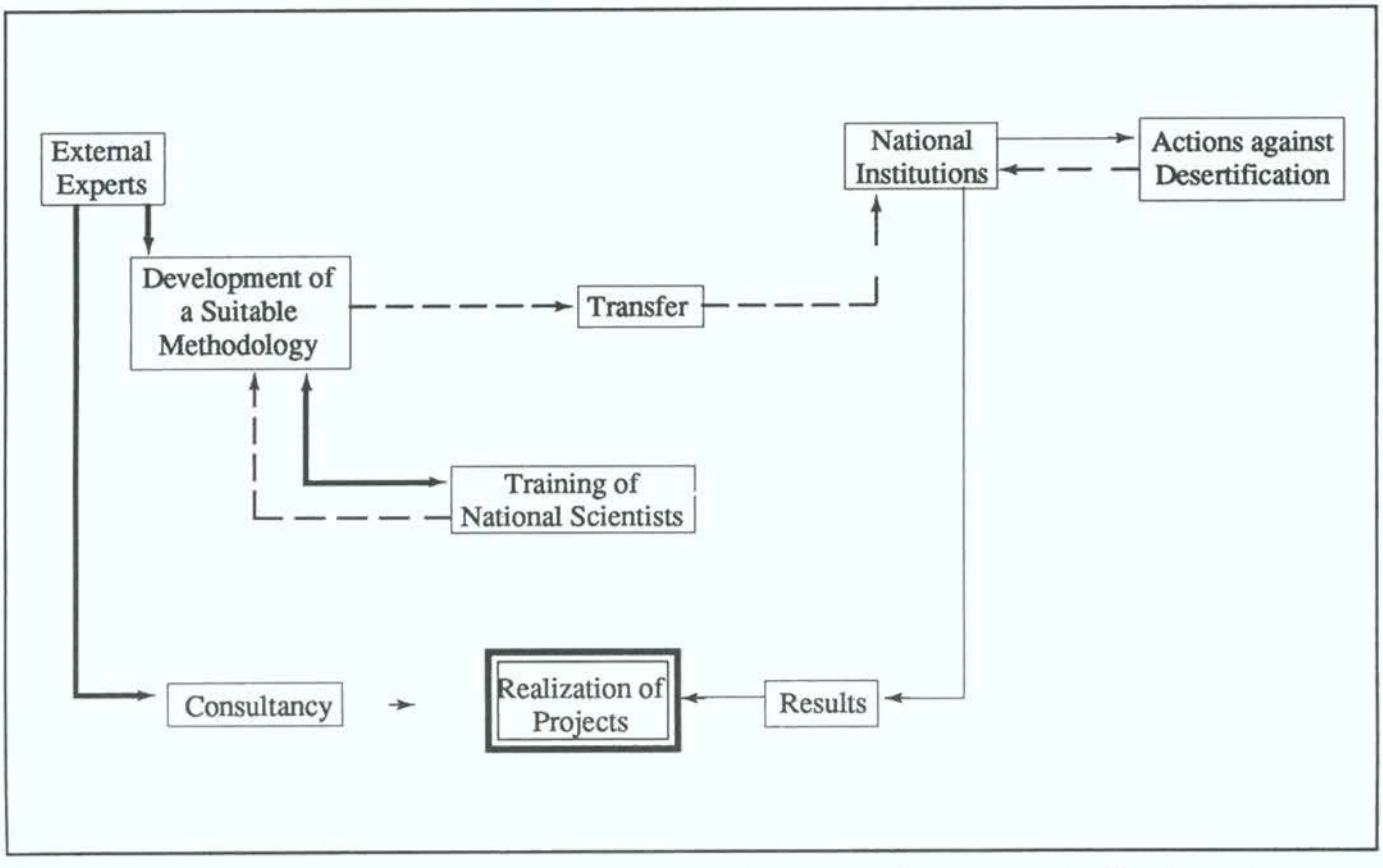


Figure 5: Scenario for the realization and implementation of desertification control programmes in affected countries.

Near waterholes and villages, ground vegetation can be completely removed by trampling and grazing of livestock.

- **Image processing** should be realized on the basis of a flexible, not too sophisticated, software running on a "low-cost" hardware. Although many other low-cost systems exist, a modified version of the CHIPS software can be considered as a powerful tool in this context.

- **Preparatory activities** will stream-line investigations in larger areas and should consist of: low-scale draft interpretation where critical areas (ie, areas of significant decrease in natural vegetation, around settlements or watering places and, in general, influenced by human activities) have to be delineated; a detailed interpretation within the test areas selected, inclusive of a field-check to provide a final interpretation key and feedback towards modification of the image processing method. Finally, **verification** is required to revise the interpretation of the entire study area by ground control points.

- **Training of National Experts**: Practical training of nationally selected scientists from affected countries is a fundamental requirement. Through this training, scientists will gain experience in the realistic capabilities of remote sensing data for specific tasks of desertification monitoring and control.

- **Consultation in project implementation**: One essential aspect of the proposed methodology is that the project is realized under the responsibility of national institutions. However, it is felt that an advisory council of external experts is necessary, not to control the activities or results provided by the national experts but to give positive support in contested opinions at critical stages of project implementation.

Figure 5 summarizes a scheme for application of remote sensing data based on our experiences. It is essential that this methodology is developed, tested and implemented through joint actions of external experts as well as national institutions and scientists since successful adoption and application can only be guaranteed if the counterparts in desertification-affected countries are integrated from the very beginning. It is, of course, still essential to refer to available experiences of different groups in other parts of the world, but the specific features of a regional and local nature necessitate integration of national experts.

Conclusion

This article is intended to demonstrate how remote sensing data can be applied for the purposes of desertification monitoring. To guarantee the most successful results, consideration of the following topics is required:

- use of operationally available data: it is proposed to use remote sensing data with Landsat-TM as a base. This is because of its improved spectral and spatial characteristics and the consequently improved elaboration of surface phenomena.
- information selection should be based on a combined application of digital image processing and visual photo-interpretation by trained and regionally experienced experts. Digital data processing can be realized without sophisticated facilities by the use of modified Danish CHIPS software working on "low-cost" hardware.

Acknowledgements

The two basic studies [contracts 958 (83) TEL 1 and B 9460/87] were carried out in 1987/1988 within the framework of the *Desertification Control Programme* of EC. We wish to thank Mr Gregoire/DG VIII for his great interest in our investigations and Mr Berg and Mr Malingreau/JRC for their excellent and engaged control of the projects. Phase I was implemented under the direction of Prof. F.K. List/Free University of Berlin, by L. Allewelt (Berlin), M. Bord (Reims), G. die Bernado (Munich), H. Kusserow (Berlin), Prof. M. Mainguet (Reims), S. Sommer (Munich) and the authors. In addition we wish to thank our Danish colleagues, Mr Sorgard and Mr Holm, Institute of Geography, University of Copenhagen, Denmark, who developed the original CHIPS software and made it available to our team.

Remote Sensing of Arid and Semi-Arid Regions: The State of the Art

Prof. M-C. Girard
Laboratoire de Science des Sols et Hydrologie
Institut National Agronomique Paris-Grignon
Centre de Grignon
78850 Thiverval-Grignon
France

Dr L.A. Isavwa
Regional Centre for Services in Surveying, Mapping and Remote Sensing
PO Box 18118
Nairobi
Kenya

Introduction

Remote sensing is an extremely useful technique that provides objective information about the interaction between radiation and matter, without modifying the object under study, over a fairly large area (3,600 km² to 324,000 km²), and with a resolution spot size of 100 m² to 5,000 m².

We are concerned here with establishing how remote sensing has contributed to the study of arid and semi-arid regions.

Determining factors in arid and semi-arid regions

The desertification of regions is not only associated with environmental features but, equally, with the impact of their human inhabitants.

The environment may be studied in relation to: the climate; plant biomass; animal biomass; human beings; soil; and water.

Climate

The most important climatic features for these regions are precipitation and wind, followed by temperature. Precipitation is nearly always unevenly distributed over the course of one or more years. When it occurs it is very heavy, of extremely short duration and extremely local; average precipitation figures can therefore give no useful idea of actual conditions.

It might therefore be thought that geostationary satellite images would provide information on the subject, but what they show are the clouds - which do not necessarily produce precipitation. Nevertheless, rain-forecasting studies are currently being carried out and the initial results look interesting (Seguin et al., 1987; Hielkema, 1988). Radar could be used, as suggested by Buznikov, but it would be necessary to select wavelengths of around 4.5 GHz, which provide information about humidity and are only slightly, or not at all, sensitive to vegetation or surface roughness (King, 1979).

The wind is a major cause of erosion and hence of desertification. It increases evapotranspiration and dries the atmosphere so that humidity can fall from 20% to 43% (in south-west Egypt) to 7% for several days (Alaily et al., 1987). Although the wind is not detectable on a picture, its ground-level effects can be seen in the relief it imprints on the soil.

Arid and semi-arid regions exist in both warm and cold climates but most of the studies done are on regions with a warm climate, a typical feature of which is a great temperature differential between day and night, which tends to fragment and disintegrate the soil. Studies could be undertaken to compare daytime and night-time data from the thermal infra-red bands.

One obvious reason for using remote sensing in these regions is that there are very few weather stations and extrapolation from these stations is difficult, the variations being very marked, very local and very rapid. Satellite imagery can provide highly useful information provided that the repetition rate is high. It is therefore a better idea to use images from geostationary satellites even if the spatial resolution is often poor (with spot sizes of the order of 1 km).

Plant biomass

Plant cover is easily detectable on satellite images, but one needs to know whether it is green biomass or a mixture of green and dry, and also what species are present. Deforestation and bush fires are forms of human activity that must be taken into account.

Vegetation is easily detectable

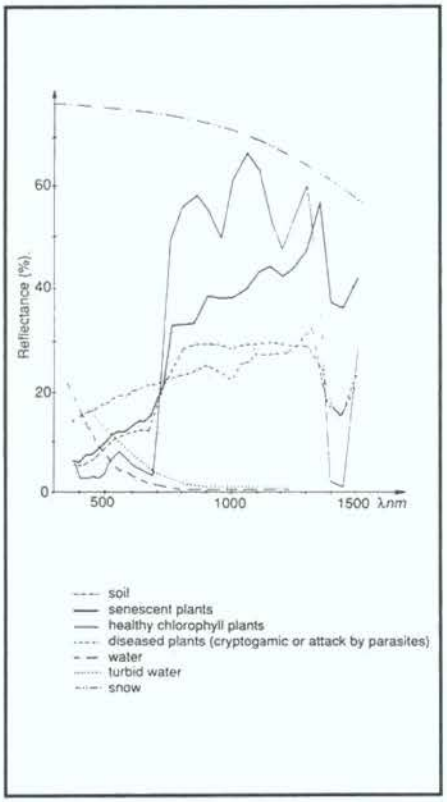


Figure 1: Reflectance curves for water, soil and vegetation (Girard and Girard, 1989)

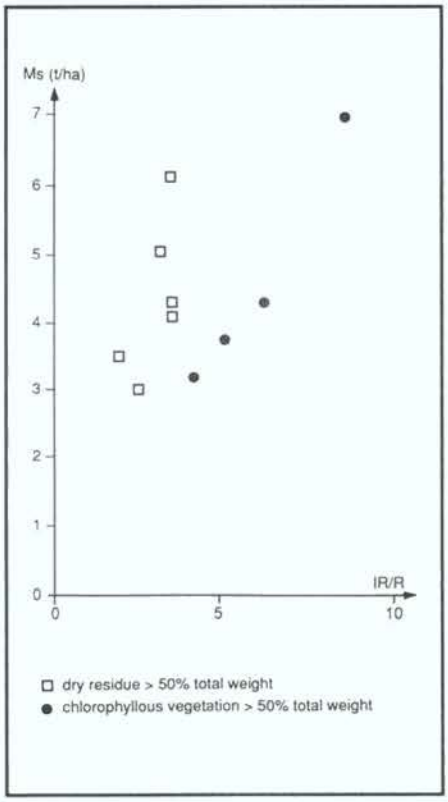


Figure 2: Influence of dry residue on the relationship between biomass and the IRIR index (Girard, 1987)

using the red and infra-red bands (Figure 1). It can easily be distinguished from soil or water. But it must be realized that the "plant biomass" response is visible on a satellite image only if the vegetation covers at least 30% of the pixel area. That is why the olive groves in southern Tunisia were not visible on the Landsat-MSS images: the olive trees were too far apart and the luminance of the soil swamped the luminance of the olive trees.

A relationship can be established between the standardized vegetation index and the biomass (Tucker, 1979), but it is vital to know whether the vegetation under consideration is green or dry. In arid and semi-arid regions there is frequently a mixture of green and dry plants. In such conditions the index can no longer be easily related to the quantity of biomass (Tucker, 1979; Girard, 1987; Kharin, 1974, Figure 2):

Field data are therefore essential for interpreting the satellite data. As Isavwa (1989) has observed, such data should be collected by people living in the area.

The behaviour of the vegetation may also be predicted if the species commonly present are known. This makes it possible to cut down on field checks, but predictions of plant biomass production based solely on the computation of a vegetation index have proved to be extremely conjectural. The species must also be known in order to estimate secondary production (see below).

It is interesting to note that deforestation can be easily followed from satellite images when felling covers an area larger than the resolution cell: 10 m for System Probatoire d'Observation de la Terre (SPOT) HRV, 30 m for Landsat-TM. The identification of bush fires poses no problem if the images are taken shortly afterwards (Figure 3). Bush fires are of great significance in the ecosystems studies by Kharin (1989).

Animals

The animals in semi-desert areas have a very considerable impact on the environment. Their food supply is governed by the areas where grass grows, the location of waterholes and the habits and customs of the shepherds. Other factors that must be taken into account are the number of herds and the species of which they are composed and their size, since feeding habits and ground compaction vary with the species, as do patterns of new growth and plant species grazed.

Aerial photography can also be put to good use, as M'Baye demonstrated at the symposium (1989) by means of a poster. The size and number of the herds drinking at a waterhole determine the paths they take, as do the shepherds' customs and the routes they follow. Such paths lead to compaction of the soil surface, making it impossible for many plant species to grow again. The paths most frequently used can often be detected on SPOT images and are clearly visible on aerial photographs.

Lastly, the feeding pattern of the herds depends on the animal species concerned. Some animals do not eat certain plants. It is a well known fact that animals do not eat fully grown *Imperata cylindrical* - a plant that gives a detectable and unmistakable chlorophyll response when it grows again immediately after a bush fire. It would be wrong to assume on the basis of signs of vegetation that such primary plant production automatically leads to secondary animal production.

Human beings

Human activity contributes very significantly to alteration of the landscape in arid regions, but in a way that is not directly detectable on satellite images. Mention has already been made of the grazing of herds whose movements depend on the customs of the shepherds. But

there is also gathering of firewood, which leads to the deforestation associated with human communities and their expansion. On the other hand, certain action to prevent erosion may be detected on satellite images and its effect can then be followed as time passes.

Soil

The conditions of the soil surface can be monitored by remote sensing (Mulders, 1987; Escadafal, 1989; Escadafal et al., 1988; Pouget et al., 1984; Alaily, 1989). They include: any plant cover; the size of various coarse features (gravel, pebbles, stones and boulders) and finer features (sand and silt) and their frequency and distribution; the roughness of the surface; the colour; variables such as levels of lime, gypsum, salts, organic matter, iron and moisture. These conditions can also be interpreted by remote sensing (Girard and Girard, 1989; Escadafal, 1989; Courault, 1989).

As for vegetation, indices may be used. The ones proposed by Courault and Girard in 1988 are as follows:

Lime-level index SK = r(450) + R(650) with R(X) = percentage of reflectance for wavelength X (Escadafal, 1988)

Organic matter index SO = R(750)/R(450) (Courault and Girard, 1988)

Iron index RF = R(750) - R(900) (Cervelle et al., 1988)

Mineralization index (according to Escadafal, 1989) IM = TM1/TM2

Instead of indices it is better to use analyses based on the intersection of two spectral channels. Thus it is possible first to construct a model of the colour of soil using the blue and red channel (Figure 4); secondly to identify gypsum, limestone and quartz (Figure 5); and thirdly to note levels of roughness (Figure 6).

Soil surface conditions are important because they constitute the interface between the atmosphere and the pedosphere. As in arid and semi-arid regions, plant cover is neither very heavy nor present all the year round, clouds are infrequent and surface conditions are very often visible on satellite images.

The interpretation of surface conditions in arid and semi-arid regions is of vital importance. These conditions represent the most vulnerable part of the soil cover. Among the features that may be noted are: structural changes; crust formation, roughness caused by cultivation or wind, evaporation or rain; changes in salt and water levels; and porosity, which determines heat and moisture flows. These parameters affect the soil climate and hence the biological potential for micro-organisms and seeds.

Another feature of the soil is its water-retention capacity at varying soil horizons. In this connection it is necessary to take account of capillary action and groundwater at varying depths, both free and confined. Remote sensing can provide information on this subject through the study of data obtained in the thermal and microwave bands. Time-series studies are also extremely important (Courel, 1985).

But it should be borne in mind that surface soil conditions are not always dependent only on the soil: they also depend on climate, vegetation and morphology. It is sometimes possible, however, to establish a soil map from satellite images (Alaily and Pohlman, 1983).

Water

Water is, of course, the determining factor in arid and semi-arid regions because of: its relative scarcity in the semi-arid regions; the extreme temporal variations in precipitation; the extremely scattered occurrence of water; its highly regular evaporation in all these regions; its extremely local condensation.

The spectral behaviour of water is very different from that of soil and plants. Free water may therefore be identified without any difficulty by remote sensing in the near infra-red. It is also possible to identify cloud masses as well as air temperature and humidity, which suggests the possibility of rain prediction (Seguin et al., 1987). It is extremely easy to monitor the changes in water courses by comparing satellite images taken at different times (Boyadiev, 1977).

The value of remote sensing

Remote sensing makes various contributions to the study of arid and semi-arid regions, providing: an understanding of the physical phenomena associated with the interaction between radiation and matter based on the information contained in the various wavelengths; the possibility of conducting time-series studies; the possibility of studying vast areas; the possibility of conducting detailed analyses (resolution); and the possibility of studying the relief.

Remote sensing as a physical phenomenon

It is possible to detect automatically a whole series of indicators that contribute to a better understanding of the organisation of arid and semi-arid regions by making use of the features of different bands: near infra-red and microwave to detect water and humidity; red, near infra-red and middle infra-red to detect plants; blue, green, near and middle infra-red for soil; and radar waves for hydrological studies.

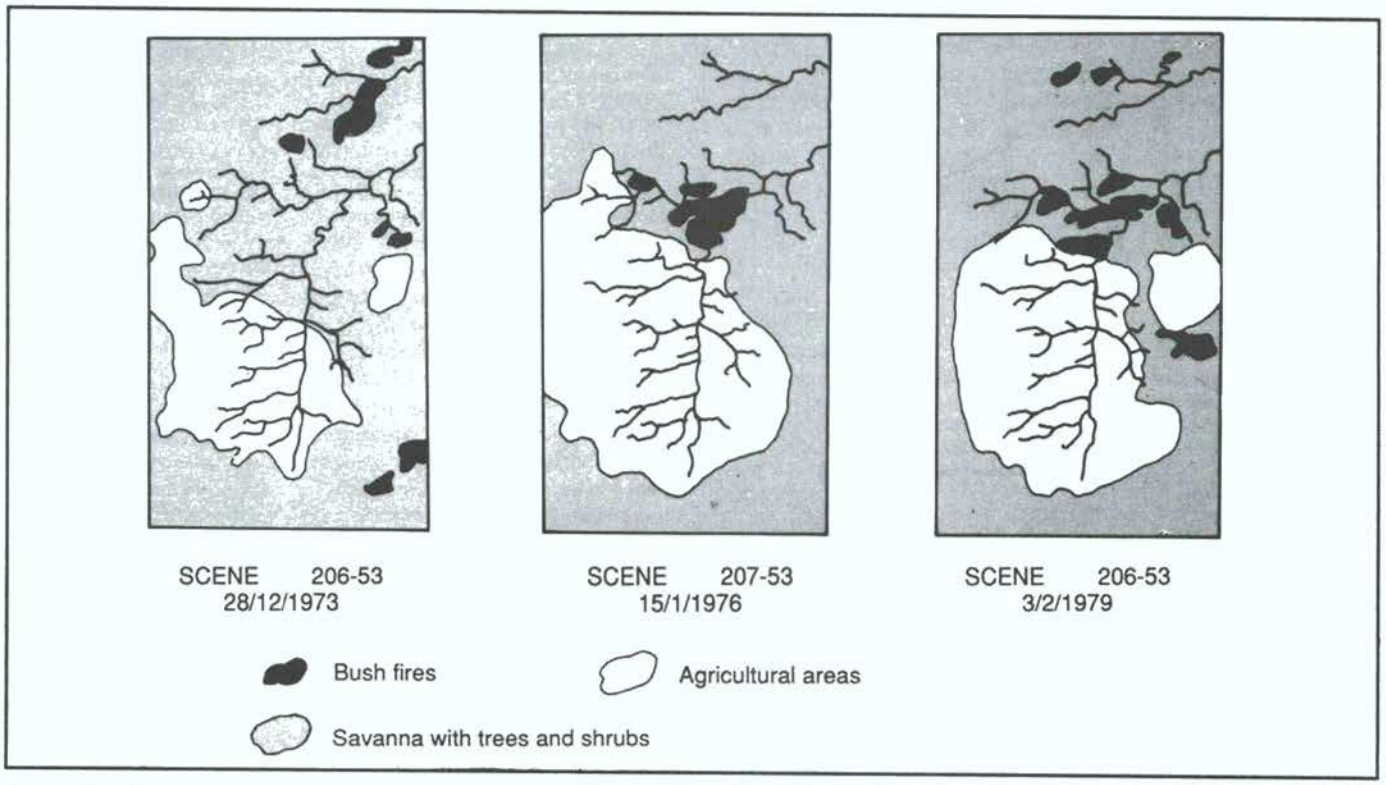


Figure 3: Time-series study of Landsat images on 1:100,000 showing the changing areas affected by agriculture and bush fires in the savanna (upper course of the Alibori, Benin) taken from Girard and Nagele (1984)

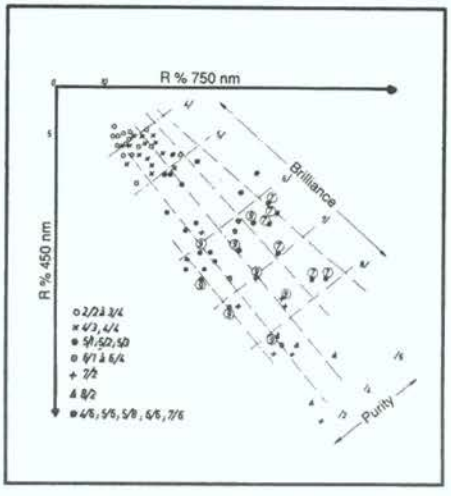


Figure 4: Relationship between the Munsell colours of samples of surface soil conditions and their reflectance at 450 nm and 750 nm. The samples were air-dried and sifted. All the uncircled points are on colour chart 10YR, the others correspond to the following codes: 7:7.5YR, 9:2.5YR, 2/, 4/, 6/, ..., Munsell brilliance; /2, /3, /6, ...; Munsell purity (chroma)

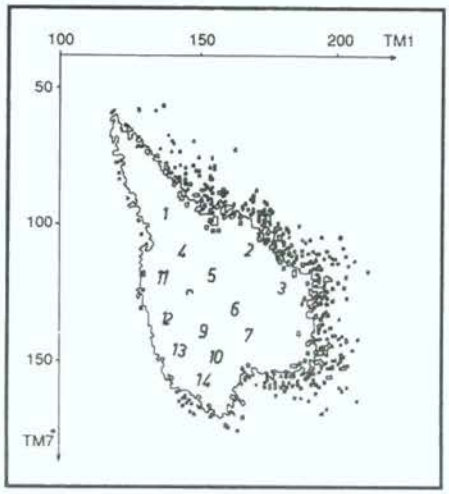


Fig 5: Two-dimensional histogram on channels 1 and 7 of Thematic Mapper (Escadafal, 1989). It is possible to distinguish shadows (1) and gypseous (2, 3), carbonaceous (4, 5, 6, 7), sandy and calcareous alluvial (8, 9, 10, 11) and quartzous (11, 12, 13, 14) surface conditions

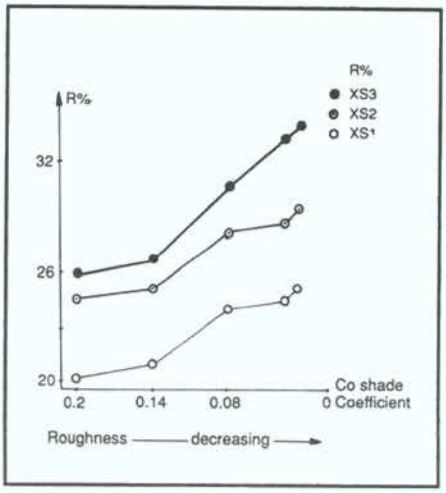


Fig 6: Relationship between reflectance and roughness of ground surface (Courault, 1989). Roughness is measured by the shadow coefficient (Co) for a transect. Co = length in shadow seen by sensor/(total length - length hidden from sensor). Each point represents the average value of 30 measurements made over the entire plot. Standard deviations are not indicated as they are very small. Reflectance in the green spectral band (○), the red spectral band (●) and the near infra-red spectral band (●)

Remote sensing over a period of time

One of the problems involved in studying arid and semi-arid regions is the extreme variability of the phenomena over time. Geostationary satellites such as NOAA or Meteosat or the combination of geosynchronous satellites in the Landsat series or SPOT series (the last two providing a return every 3 or 4 days depending on the angles of view) can provide the information necessary for time-series studies.

Remote sensing extending over large areas

As certain phenomena are transient it is very important to obtain images of vast areas taken at specific points in time. The images provided by geostationary satellites meet this need, as do those of the Landsat series.

High-resolution remote sensing

Detailed images with good resolution are essential to analyse human impact and anti-erosion measures or to identify the passage of herds. Aerial photography (at various altitudes) could certainly be used, but SPOT images represent a perfect compromise between aerial photographs (good resolution, small instantaneous coverage, analogue signal) and NOAA satellite images or those of the Landsat series (poor resolution, large instantaneous coverage, digital signal) as they provide good resolution (10 or 20 m), average instantaneous coverage (36,000 km²) and an analogue signal. They can be used to monitor the movements of herds and to identify villages.

Remote sensing and relief

SPOT images can be used to compile a topographical map with an elevation accuracy of 5 to 10 m. This facilitates the study of relief patterns and is particularly valuable in respect of arid and semi-arid regions, for which accurate topographical maps are seldom available.

Discussion

Remote sensing now provides useful information for the study of arid and semi-arid regions, but it needs to be supplemented as it provides an insufficient basis for every type of study.

A multi-level approach is essential. The information provided by remote sensing must be combined with field observation and measurement. It is essential, for instance, to understand fully the significance of any boundaries discovered on processing satellite data. In order to do so it is useful to study transects between the spatial units identified on the images, in an attempt to understand the determining factors and analyse the changes that occur from one unit to another. Obviously such studies are the job of the national services concerned, as has been pointed out by Isavwa (1989). Courses in the development of methods for operational applications are required.

The countries concerned need technical equipment (hardware and software), in so far as they are capable of maintaining the hardware for the studies. The software must be directly applicable.

The descriptions of the regions under study are based on a whole array of data. Geographical information systems to identify the relevant variables for the projected studies must therefore be developed. Some such systems were described in the papers presented to the symposium by Gonzalez et al., (1989). They are, however, a means rather than an end in themselves.

The approach adopted by Babaev and Kharin (1989) is interesting in that it attempts to establish various levels of desertification on the basis of a variety of data: satellite images, aerial photographs of various scales and field observations and surveys. By correlating data on the environment (soil, plant communities, etc.) and human and related activities (population pressure and the impact of domestic animals) it is possible to prepare risk charts for desertification.

In order to reach conclusions that will be useful to the countries concerned it is essential not to concentrate exclusively on environmental data. Agronomic, economic and sociological information appropriate to the aims of the exercise must be added. Surveys must therefore be conducted in parallel with the environmental studies.

Lastly, and most importantly, as such studies are quite a major undertaking it is a good idea to define the aims quite clearly. The description of operational agrobiological units, the calculation of the dynamics of the desertification process, the battle against erosion and the search for grazing land are examples of goals that are not based on the same concerns. It follows that the methods to be employed will not be the same; and the use made of remote sensing data will also be different.

Conclusion

Remote sensing has proved to be a tool that can be put to good use in the study of arid and semi-arid regions. But it is not the only tool for the task: geographical information systems constitute another. It is essential first of all to define clearly the aim of the exercise, whether it be agricultural improvement, sensible management of arid and semi-arid regions or the study of desertification; and secondly to identify

the relevant indicators of the phenomena to be detected and analysed. This can be done only through a combination of basic and applied studies.

(Taken from *Nature & Resources*, Vol. 26, No. 1, 1990 - a UNESCO/ Parthenon publication)

References

ALAILY, F. and POHLMANN, J. (1989). Eine Flächenhafte erfassung von Bodengesellschaften arider Gebiete mit Hilfe von Landsat-Multispektral-laufnahmen. *Berliner geowiss. Abh.* (A) 47, pp 49-61

ALAILY, F., BORNKAMM, R., KHEL, H. and RENGER, M. (1987). Evaluation of land in SW-Egypt. *Berliner geowiss. Abh.*, (A) 75, pp 517-44

ALAILY, F. (1989). Visual interpretation and supervised classification of satellite images for identifying soils in arid regions. *Proceedings of the International Symposium on the State of the Art of Remote Sensing Technologies for Biosphere Studies*, Moscow, USSR, 18-22 September, 1989

BABAEV, A.G. and KHARIN, N.G. (1989). Soviet experience on application of remote sensing to study the process of desertification. *Proceedings of the International Symposium on the State of the Art of Remote Sensing Technologies for Biosphere Studies*, Moscow, USSR, 18-22 September, 1989, p. 11

BOYADIEV, T.G. (1977). Interprétation des images satellites et caractéristique des unités de paysages de la vallée du fleuve Sénégal. *Proceedings of the lst Symposium of Pedology and Remote Sensing*, Paris, pp. 173-82

CERVELLE, B., CHOROWICZ, J., RUDANT, J-P., TALMAIN, G. and ALEM, E-M. (1988). Caractérisation des roches par spectroradiométrie à haute résolution spectrale visible et infra-rouge proche. *Proceedings of the 4th International Symposium "Spectral Signatures in Remote Sensing"*, pp. 319-22

COURAULT, D. (1989) *Etude de la dégradation des états de surface du sol, par télédétection*. University thesis, Paris 6. pp. 214.

COURAULT, D. and GIRARD, M.C (1988). Relationships between the soils composition and their spectral signatures. *Proceedings of the 5th Symposium of Working Group on Remote Sensing of ISSS*, Budapest, pp. 178-85

COUREL, M-F. (1985). *Etude de l'évolution récente des milieux sahéliens à partir des mesures fournies par les satellites*. University thesis, Paris l, p. 407

ESCADAFAL, R. (1989). *Caractérisation de la surface des sols arides par observation de terrain et par télédétection*. Thesis, University of Paris 6, p. 317

ESCADAFAL, R., GIRARD, M-C. and COURAULT, D. (1989). Modeling the relationships between Munsell soil color and soil spectral properties. *Int. Agrophys., 4*. pp. 249-61

GIRARD, C.M. (1987). Caractérisation des prairies permanentes par leur physionomie saisonnière et leur comportement spectral: application à l'évaluation de la biomasse. *Oecol. Plant*, vol. 8 (22), no. 4, pp. 345-58

GIRARD, C.M. and NAGELE (1984). *Méthodologie et cadre du développement agropastoral au Bénin*. Mission report, TCP/BEN/2308. FAO Rome, p. 83

GIRARD, M.C. and GIRARD, C.M. (1989). *Télédétection appliquée. Zones Tempérées et Intertropicales*, p. 260 (Paris: Masson)

GONZALES LOYARTE, M.M., ZAND RODRIGUEZ, B. and LEGUIZAMON, S. (1989). Determination of potential soil erosion using geographical information system technology in a piedmont of Mendoza, Argentina. *Proceedings of the International Symposium on the State of the Art of Remote Sensing Technologies for Biosphere Studies*, Moscow, USSR, 18-22 September 1989

HIELKEMA, J.U. (1988). Satellite environmental monitoring for global food security and desert locust surveillance at FAO. *Proceedings of the 5th Symposium of Working Group on Remote Sensing of ISSS*. Budapest. pp. 95-103

ISAVWA, L.A. (1989). Remote-sensing technology transfer in eastern and southern Africa subregion. *Proceedings of the International Symposium on the State of the Art of Remote Sensing Technologies for Biosphere Studies*, Moscow, USSR, 18-22 September 1989

KHARIN, N.G. (1974). Spectral reflectance of desert vegetation and remote sensing. *Proceedings of Symposium on Remote Sensing Photo-interpretation*. Banff, Alberta, Canada, pp. 493-500

KING, C. (1979) *Contribution à l'utilisation des microondes dans l'étude des sols*. Doctoral thesis, Engineering INA PG, p. 122

M'BAYE, M. (1989). Application of geographical information systems in order to evaluate the impact of water availability on land use in northern Senegal. *Proceedings of the International Symposium on the State of the Art of Remote Sensing Technologies for Biosphere Studies*, Moscow, USSR, 18-22 September, 1989

MULDERS, M.A. (1987) Remote sensing in soil science. *Developments in Soil Science*, Vol. 15, pp. 379 (Amsterdam: Elsevier)

POUGET, M., LORTIC, B., SOUISSI, A., ESCADAFAL, R. and MTIMET A. (1984). Apport des données MSS Landsat pour la cartographie des ressources en sols des régions arides (Tunisie). *Proceedings of the 18th Symposium Observation of the Earth*. CNESERIM, Paris, p. 14

SEGUIN, B., ASSAD, E. and FRETEAU, J-P (1987). Water-balance monitoring in Sahelian regions with thermal IR and vegetation index data from meteorological satellites. *Proceedings International ERIM Symposium*, Nairobi, Kenya

TUCKER, C.J. (1987). Red and photographic infra-red linear combinations for monitoring vegetation. *Remote Sensing of Environment*, 8, pp. 127-50

NEWS FROM UNEP

DC/PAC Personnel

Mr Robert N'Daw from Mali left UNEP in October 1989 after working for four and a half years as Director of DC/PAC to take up the position of Regional Director of the UN Food and Agriculture Organisation (FAO) in Ghana.

As Director of DC/PAC Mr N'Daw demonstrated dedicated concern for the people directly affected by desertification. He led DC/PAC in implementing the Plan of Action to Combat Desertification after its first general assessment (GAP I) in 1984. Apart from direct assistance to governments, the major programme activities included AMCEN pilot villages, pilot projects on appropriate technology, desertification assessment and monitoring and the establishment of DESIS.

Before joining UNEP he worked for the Mali Government where, among other positions, he was Minister of Planning and Transport, Minister of Industrial Development and Tourism and Minister of Energy and Mines. In 1978-79 Mr N'Daw was the representative for the government of Mali of a joint United Nations Development Programme (UNDP)/UN Food and Agriculture Organisation (FAO) project for the economic development of liberated zones. He has also worked for the governments of Mauritania, Guinea and Senegal.

Mr N'Daw was educated in France where he obtained his Licence des Sciences in Mines and Industrial Minerals and his Diplome Ingénieur ENSG from the Ecole de Géologie in Nancy.

Mr Till Darnhofer from Austria joined UNEP as Deputy Director of the Desertification Control Programme Activity Centre in July 1989. He holds a PhD in meteorology from the University of Vienna.

Mr Darnhofer started his professional career in Africa in 1971 as a bio-climatologist in an United Nations Food and Agricultural Organization (FAO) research project on the malagasy migratory locust. In a similar research programme he continued in Mali and the Lake Chad Basin until 1976.

Subsequently he worked for six years with the World Meteorological Organisation (WMO) as expert in charge of the national projects of the programme for strengthening the agrometeorological and hydrological services of the Sahelian countries (AGRHYMET) in Chad and Niger.

In 1982 Mr Darnhofer took up an appointment as senior research scientist with the International Council for Research in Agroforestry (ICRAF) covering the micro and macro-climatological research aspects of this sustainable agricultural land-use approach.

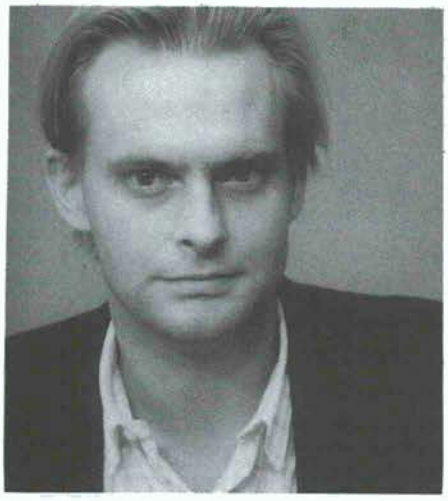
Mr Darnhofer is married with two children.

Mr Timo Paavali Maukonen from Finland joined DC/PAC as a senior programme officer in March 1990. He is an expert in pasture and range land husbandry and in farm system development.

Mr Maukonen, who has an MSc degree in agronomy/plant husbandry from Helsinki University, Finland, and a diploma in general agriculture from the University of Minnesota, USA, was previously seconded to DC/PAC as a senior programme officer by the Finnish government from December 1986 - December 1989. He has also worked for the UN Food and Agriculture Organisation (FAO) as an agricultural officer involved in education and training between 1973-75.

Mr Maukonen spent many years in south-east Asia working for an agricultural and industrial chemical company as fertilizer specialist and, at the beginning of the 80s, as an agricultural and agro-industrial consultant in Finland.

He is a member of the Scientific Agricultural Society of Finland and of the Association of Finnish Agricultural Engineers. Since 1967, he has also been a small-holder farmer in Finland (now by correspondence). He is married with five children.



Mr Per Mogstad, a Junior Professional Officer from Norway, was seconded to DC/PAC by the Norwegian Government to deal with desertification problems in member countries of the Southern African Development Co-ordination Conference (SADCC).

Mr Mogstad has a MSc degree from the University of Agriculture in Norway and has also studied social anthropology and tropical agriculture. Before joining DC/PAC he worked for one and a half years in a Norwegian non-governmental solidarity and aid organisation and for two years as a lecturer at an agriculture school.

Mr Mauro Mendoza Chacaltana from Peru joined DC/PAC in January 1990 as Project Co-ordinator of UNEP's Global Assessment of Desertification. He was previously Facilities Manager with UNEP's Global Environment Monitoring System (GEMS)/Global Resources Information Database (GRID).

Before joining UNEP, Mr Mendoza worked in Peru as director of the computer centre for the Oficina Nacional de Evaluacion de Recursos Naturales, where he previously held positions as chief of project and natural resource specialist. In the 1970s he was a lecturer with the Peruvian Ministry of Agriculture.

Mr Mendoza has participated in various Geographic Information Systems projects, including the 1986-7 ONERN-GRID development plan for livestock, reforestation and Andenes in Chumbivilcas, the 1987 integrated plan for moving the capital of Peru and a drought simulation project in the Puno microregion.

He has published several papers on GIS and Remote Sensing systems and is a member of the Peruvian Association of Applied Technology.

Governing Council 15th session

The desertification problem is far better recognized today as an environmental issue than it was in 1977 on the eve of the United Nations Conference on Desertification. However, isolated sectoral anti-desertification projects and their lack of integration with national development plans have led to limited success. Consequently, the main thrust of the subprogramme, Aridlands and Desertification, was technical assistance to developing countries in the preparation of national plans for combating desertification and the establishment of mechanisms to implement them.

The session on desertification at the fifteenth session of UNEP's Governing Council focussed, amongst others, on the now familiar issues of financing desertification control activities and the preparation for the second General Assessment of Progress (GAP II) in the implementation of the Plan of Action to Combat Desertification (PACD) which will coincide with the 1992 United Nations Conference on the Environment and Development (UNCED).

Financing desertification control

Intensive discussions were held with regard to policy guidance on the role of the Consultative Group for Desertification Control (DESCON), the United Nations Special Account to finance the implementation of the Plan of Action to Combat Desertification (Special Account) and the feasibility of adopting a new realistic approach to financing the implementation of the PACD, as requested by the GA resolution 42/189 C.

Some, with strong reservations about DESCON and the Special Account, requested that both be abolished. They stated that both mechanisms had lacked support, had not lived up to expectations and had not been able to fulfill their task of funding desertification control.

Others, largely from affected developing countries, maintained that DESCON still had a function as a forum for exchanging experiences. They suggested some corrective measures, such as strengthening DESCON at national level and defining more clearly the terms of reference. Others acknowledged that DESCON is the only world-wide mechanism for mobilizing financial resources for desertification control but expressed their concern at the numerous regional and sub-regional organisations involved and called for their greater co-ordination and collaboration.

The link between debt and desertification was mentioned with regard to formulating a new realistic approach to financing. The Secretariat's proposal to create new financial institutions was opposed by those arguing against the further proliferation of institutions and bureaucracies. In their view, existing multilateral development banks and bilateral funding arrangements were sufficient for channelling funds on concessionary terms.

There was general concern that desertification control might be relegated to second place as an environmental action programme, despite the ever-increasing expansion of the problem and the large numbers of people affected. They asserted that it should be a core programme of environmental management as desertification contributes to other environmental problems, such as climate change. Concern was also expressed at the degradation of resources, including soil and water, and a call was made for managing them so as to ensure sustainable development.

The integration of action plans to combat desertification with national development plans, with emphasis on popular participation, still remains an important task. UNEP's role in desertification control was seen as a catalyst in studies on long-term desertification problems and their possible solutions, rather than to implement projects where the major task is to evaluate desertification control programmes or to assess desertification.

Other suggestions called for UNEP's assistance in projects on pastoral nomadism in the form of a pilot project on environmental management; and in combating the spread of the Kalahari Desert.

GAP II

The project budget document for 1990/91 approved by GC 15 reflects the emphasis laid on the assessment and evaluation of desertification within UNEP's desertification control programme. However, since this exercise is very costly, a supplementary programme fund of US$ 400,000 was allocated for the relevant studies in 1990. The GAP II reports will account for the fifteen year period since the 1977 UNCOD and recommend future actions to be taken with regard to the control of desertification/land degradation.

General Assembly's view on GC decisions

GC's recommendation to close the Special Account was approved by the General Assembly. However, General Assembly rejected the UNEP GC's recommendation that DESCON be a forum to review PACD implementation and exchange scientific information, and reaffirmed the mandate of resolutions GA 32/172 and GA 39/168 that DESCON meet annually until the 1992 UNCED and every two years afterwards. New means of financing and promoting PACD and National PACD (NPACD) are to be drawn up in consultation with UNEP and submitted to the 1992 UNCED through the Preparatory Committee.

General Assembly reinforced GC'srequest for an **external evaluation of the PACD** to be conducted and further invited UNEP Governing Council to undertake a general evaluation of progress in implementing the PACD and to present this as its contribution to the 1992 UNCED. The evaluation will be a composite report containing as its main components chapters devoted to 1) **a global assessment of the status of desertification;** 2) **evaluation of the PACD;** 3) **progress in implementing PACD itself;** 4) **financing anti-desertification programmes; and** 5) **recommendations: PACD to the year 2010.**

These reports will be prepared with the assistance of several groups of international experts and in full co-operation with national governments, FAO, United Nations Educational, Scientific and Cultural Organization (UNESCO), scientific institutions and major non-governmental organisations. It is anticipated that these reports will be ready by early 1992.

The progress on the evaluation of the PACD will be reported to the 16th session of UNEP GC in 1991 as well as to the Preparatory Committee for the 1992 UNCED.

Governing Council Decision 15/23 - Desertification

A. Implementation of the Plan of Action to Combat Desertification

Recalling General Assembly resolutions 32/169 and 32/172 of 19 December 1977, 33/89 of 15 December 1978, 34/184 of 18 December 1979, 35/73 of 5 December 1980, 37/147 and 37/218 of December of 1982, 38/160 of 9 December 1983, 39/168 A of 17 December 1984, 40/198 A of 17 December 1985, S-13/2 of 1 June 1986 and 42/189 A of 11 December 1987,

Recalling also its decision 9/22 A and B of 26 May 1981, section VII of decision 10/14 of 31 May 1982, section VII of its decision 11/7 of 24 May 1983, and decisions 12/10 of 28 May 1984 and 14/15 A of 18 June 1987,

Having considered the report of the Executive Director on the implementation in 1987 and 1988 of the Plan of Action to Combat Desertification,

Having also considered those parts of the 1987 and 1988 reports of the Administrative Committee on Co-ordination dealing with the co-ordination and follow-up of the implementation of the Plan of Action to Combat Desertification,

Convinced that combating desertification at the national level involves integrated measures that require nation-wide mobilization of institutional, human and financial resources,

Noting with great concern that desertification remains unabated with its menacing impacts on food-producing capacity, and international efforts to halt its spread as envisaged by the United Nations Plan of Action to Combat Desertification endorsed by General Assembly in 1977 remain inadequate, particularly as a result of the insufficiency of financial resources,

1. *Takes note* of the report of the Executive Director on the implementation in 1987 and 1988 of the Plan of Action to Combat Desertification;

2. *Invites* Governments of countries prone to desertification to consider according priority in their national development programmes to anti-desertification activities such as:

(a) Preparing a national programme to combat desertification within the framework of national plans for development of natural resources and rehabilitation of impaired ecosystems;

(b) Ensuring that the national programme to combat desertification is ecologically sound, technically feasible and socially acceptable;

(c) Appropriating, within the resources available for implementation of national plans for development, resources needed for the implementation of the programme for combating desertification;

(d) Establishing, or strengthening if they already exist, centrally-placed national machineries capable of mobilizing national institutional resources needed for implementation of the national programme for combating desertification and of monitoring progress in executing related activities;

3. *Also invites* donor Governments, intergovernmental bodies including aid agencies and non-governmental organisations to accord high priority in their bilateral and multilateral assistance activities to national programmes for combating desertification and for the rehabilitation of degraded land resources and to take into account the promotion of long-term ecological and social rehabilitation programmes in areas prone to desertification;

4. *Commends* the Inter-Agency Working Group on Desertification for its positive role in ensuring that activities related to arid lands and desertification are included within the programmes of its member organisations;

5. *Requests* that the Inter-Agency Working Group on Desertification implement the following measures to enhance its work:

(a) Include in the agenda of its regular meetings reporting on activities of member organisations relevant to implementation of the Plan of Action to Combat Desertification, a review of the activities of other structures concerned with implementation of the Plan of Action, such as the Consultative Group for Desertification Control and regional bodies, such as the Permanent Inter-State Committee on Drought Control in the Sahel, the Southern African Development Co-ordination Conference, the Intergovernmental Authority on Drought and Development and the Dakar Ministerial Conference on Desertification and review the overall status of the implementation of the Plan of Action;

(b) Institute as a permanent feature of its functioning that its ad hoc meetings be devoted to thematic joint programming;

(c) Undertake joint inter-agency action to mobilize technical and financial resources to assist national programme to combat desertification;

(d) Collaborate with the Inter-Agency Working Group of the African Ministerial Conference on the Environment, with special reference to the work of African Deserts and Arid Lands Committee;

6. *Requests* the Executive Director of UNEP to assist, within available financial resources, countries prone to desertification, at

Strategy of UNEP's Arid Land and Desertification Subprogramme

(a) Legislative authority: UNEP MTP 1990-1995, paragraphs 40-44

UNEP target for 1995: Provision of assistance to 15 countries affected by soil degradation and desertification in the development and implementation of their plans and programmes to control desertification and halt soil degradation.

(b) Programme elements:

Activities and outputs (status)	Allocation from the Environment Fund (thousands US $)
1 Co-ordination of UNEP Desertification Control Programme	1 400 (C)
2 Development of DC-PAC internal Desertification Control Data Base towards a centre of excellence in query-answer capability on major desertification topics	1 000 (C)
3 Global Assessment of Desertification	1 000 (C)
4 Assistance to five countries for the implementation of National Plans or Programmes of Action to Combat Desertification: one in Africa, two in Asia, two in Latin America. Identification, dissemination and application of appropriate technologies for rehabilitation of arid and semi-arid lands	500 (C)
5 Assistance to intergovernmental bodies in (i) strengthening of North African Green Belt (ii) formulation of programmes for renewable resource conservation in Southern Africa	250 (C)
6 Assistance to 3-4 countries in establishment of village level projects involving popular participation for rational exploitation of natural resources, sustainable production of food, fodder and fuel in semi-arid and sub-humid conditions	650 (C)
7 Support to the development of regional networks for exchange of information, training and research, afforestation and sand-dune stabilization in Latin America, Africa, Asia/Pacific and West Asia	300 (C)
8 Training Programme: 400 persons trained in desertification control techniques. Two to four guidelines and handbooks published	350 (C)
9 Desertification control information activity: *Desertification Control Bulletin*; preparation and dissemination of other information materials	5 600 (C)

their request, in developing programmes for combating desertification within their development plans;

7. *Also requests* the Executive Director of the United Nations Environment Programme to include in the proposed programme budget of the United Nations Environment Programme for the biennium 1990-1991 activities on pastoral nomadism, under the subprogramme 3 "Arid lands and desertification" with a view to assisting two or three countries in Asia and Africa implement pilot projects to provide environmental support for pastoral nomads demonstrating the efficiency of nomadism as an ecologically sound way of life for the utilization of marginal resources and to invite other United Nations agencies and donor countries to support the activities on pastoral nomadism;

8. *Further requests* the Executive Director to arrange for an external evaluation of the Plan of Action to Combat Desertification to be conducted and for the results to be presented well in time for the proposed United Nations Conference on Environment and Development in 1992, but not later than the sixteenth regular session of the Governing Council.

B. Financing and other measures in support of the plan of Action to Combat Desertification

Recalling General Assembly resolutions 34/184 of 18 December 1979, 36/191 of 17 December 1981, 37/220 of 20 December 1982 and 42/189 C of 11 December 1987,

Recalling also its decisions 13/30 A of 23 May 1985 and 14/15 D of 18 June 1987,

Having considered the report of the Executive Director on the United Nations Special Account to finance the implementation of the Plan of Action to Combat Desertification and additional ways and means of financing the Plan of Action to Combat Desertification,

1. *Recommends* to the United Nations General Assembly that the United Nations Special Account to finance the implementation of the Plan of Action to Combat Desertification be abolished;

2. *Recommends* that the Consultative Group for Desertification Control should hold sessions every two years (in even-numbered years starting from 1990), to review the status of the Plan of Action to Combat Desertification and to exchange information on scientific research in this field, on national programmes and on the implementation of the Plan of Action to Combat Desertification and to advise on further action against desertification;

3. *Invites* the international community to pledge voluntary contributions to local, national and regional mechanisms for financing the implementation of the Plan of Action to Combat Desertification;

4. *Further invites* the international community to create the necessary economic and financial conditions that would enable countries prone to desertification to appropriate part of their resources to combat desertification.

Landmark Year for the Environment

1992 promises to be an important year. The UN Conference on Human Environment which was the precursor of UNEP will celebrate its twentieth anniversary by holding a conference in Brazil: the UN Conference on the Environment and Development (UNCED).

The overall aim of UNCED, designed to coincide with World Environment Day on 5 June, will be to find ways of halting and reversing worldwide environmental degradation, with particular emphasis on protecting the atmosphere, fresh water, seas and land resources (including measures against deforestation, desertification and drought), conservation of biological diversity, control of biotechnology, sound management of wastes and improvement of human health.

It will review actions being taken to protect and enhance the environment and the UN's role and responsibilities in this. Having looked at the way environmental concerns have been incorporated into economic and social policies and planning, the conference will define future global and national strategies and guidelines to ensure that environmental issues continue to be given priority.

Ways to facilitate transfer of information on environmentally-sound technologies and management to developing countries will be identified and the conference will emphasize that accurate, reliable data on environmental issues should be made globally available.

Co-operation between nations will be discussed and specific agreements and commitments by neighbouring governments will be encouraged. The role of the UN in solving environmental disputes will be examined. Environmental education, especially for the younger generation, will be promoted.

Recommendations will be made aimed at combating poverty and improving the quality of life in all countries through sustained, environmentally-sound development and economic growth.

The conference will identify the necessary additional financial resources needed to realise its decisions. It will take into account the abnormal burden placed upon developing countries due to their lack of financial, technical and human resources.

The blueprint for the conference was drawn up in resolution 15, adopted by the 44th session of UN General Assembly. A Special Meeting of Permanent Representatives to UNEP met in January 1990 to establish a Preparatory Committee (PREPCOM) for the conference made up of the General Assembly and open to all UN Member States and specialised agencies. The first organisational session met in New York for two weeks in March 1990 and elected a chairperson, vice-chairpersons and other committee members, and decided that future meetings would be held in Nairobi (6-31 August 1990) and later in Geneva.

Preparations and the conference itself will be funded by the existing UN budget, which will also make finance available to enable developing countries to participate fully and effectively.

Implementing Sustainable Development

Two General Assembly resolutions 42/186 and 42/187 adopted the *Environmental Perspectives to the Year 2000 and Beyond* report and the World Commission of Environment and Development's report published worldwide as *Our Common Future* as guides for implementing the sustainable development concept.

The *perspective* document recommended annual reporting be made on the status of the progress made in achieving the objectives of sustainable development. By the 15th session of UNEP's Governing Council, 24 March 1989, twenty-two governments and the European Community had responded to UNEP's request for information. A full picture of how far sustainable development policies have been implemented has not yet emerged largely due to the complexity of the task and shortage of time.

Although the replies so far received show greater political will towards its implementation, it was evident that in addition to the emerging environmental problems, governments felt confronted with many long-standing environmental issues. GC noted that a preventative approach is needed to address the sources of environmental degradation and matters of overall national policy. Existing strategies and programmes and existing mechanisms for implementing them should be reviewed and modified as appropriate, depending on the needs and priorities of each country.

Most UN organisations have already adopted sustainable development policies into their programmes and have adjusted their existing priorities and programme budgets. A number of governments have worked to put the recommendations of the reports into effect at a high level. Furthermore, a number of NGOs have worked to put the concept of sustainable development into effect at local, national and international levels.

Sustainable Development*

The Governing Council believes that sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs and does not imply in any way encroachment upon national sovereignty. The Governing Council considers that the achievement of sustainable development involves co-operation within and across national boundaries. It implies progress towards national and international equity, including assistance to developing countries in accordance with their national development plans, priorities and objectives. It implies, further, the existence of a supportive international economic environment that would result in sustained economic growth and development in all countries, particularly in developing countries, which is of major importance for sound management of the environment. It also implies the maintenance, rational use and enhancement of the natural resource base that underpins ecological resilience and economic growth. Sustainable development further implies incorporation of environmental concerns and considerations in development planning and policies and does not represent a new form of conditionality in aid or development financing.

*From the GC decision 15/2 adopted May 1989.

Global Assessment of Land Degradation/ Desertification - GAP II

Second General Assesssment of Progress in Implementation of the PACD

UNEP's Desertification Control Programme Activity Centre (DC/PAC) is entrusted by the international community with catalyzing and co-ordinating the implementation of the United Nations Plan of Action to Combat Desertification (PACD) which was adopted in 1977 at the UN Conference on Desertification (UNCOD).

This mandate calls on DC/PAC to promote a better understanding of the processes of desertification, its status and underlying causes, and to create an awareness of the problem in order to mobilise resources and actions to control it.

The first attempt to portray the global extent of desertification - the UNESCO/UNEP World Map of Desertification - was prepared for

the 1977 UNCOD. This map had the great merit of compelling the world to recognise the vast scale of the natural resource degradation that was taking place in the earth's sub-humid, semi-arid and arid climatic zones. However its scale of 1:25,000,000 was too large to be of any real use in assessing the extent and degree of desertification in specific locations. Moreover, the map was based on existing geographical data which was not precise enough to assist future action in planning and guiding anti-desertification activities either at a national or international level.

One of the immediate actions called for by the PACD was to establish a common scientific methodology for assessing desertification globally, the results of which could then be used to produce detailed maps at larger scales, particularly at national andregional levels. In 1984, as part of the General Assessment of Progress (GAP I) in implementation of the PACD, an Experimental Map of Desertification Hazards for Africa based on the FAO/UNEP Provisional Methodology for Assessment and Mapping of Desertification was published.

However, although this methodology was revised following field tests in nine countries, it was criticized for being impractical to apply. Lack of sufficient data, even in developed countries, was a major handicap and the cost of acquiring such detailed data through extensive field studies would have been excessive.

In view of these criticisms, an vexpert meeting held in Nairobi in March 1985 recommended that the FAO/UNEP methodology be re-evaluated in terms of its applicability and a simpler, refined methodology that could be used for assessing and mapping desertification at local, national and regional levels be developed and tested. Kenya agreed to carry out the pilot study in Baringo and Marsabit districts\

UNEP Governing Council had pointed out in 1984 that desertification cannot adequately be shown on a single map but should rather be an atlas containing a series of thematic maps on desertification (see report below). It also decided that the second GAP (GAP II) should be carried out in 1992.

Preparatory activities for GAP II

In order to assess progress on the global assessment to be presented in 1992, UNEP held in-house consultation meetings in February and May 1989, chaired by Prof. M. El-Kassas, senior advisor.

The aim of the meetings was to review progress and plans for the second global desertification assessment (GAP II) and to draw up a work-plan for 1989, 1990 and 1991, as required by UNEP Governing Council decision 12/10.

In its discussions, preliminary results of the following on-going UNEP assessment projects were presented and reviewed:

a) Desertification assessment and mapping pilot study (Kenya) presented by Kenya's Department of Remote Sensing and Resource Survey (DRSRS);

b) Global Assessment of Soil Degradation (GLASOD) by ISRIC;

c) Mali experience on application of modified FAO/UNEP Methodology by UNEPCOM;

d) Assessment of the Evolution of the Sahelian Environment 1952-1987 by IGN/ORSTOM.

The meeting also discussed the work plan for preparation of the *World Atlas of Thematic Indicators of Desertification*, and the agenda of actions towards preparation for the 1992 GAP II.

The World Atlas of Thematic Indicators of Desertification was considered with regard to the general principles concerning scales, audiences, purposes and themes of maps which were agreed upon at the Expert Meeting on Desertification held in March 1985. On-going projects and possible subject areas were reviewed as potential sources of appropriate themes for a World Atlas covering arid, semi-arid and sub-humid areas.

As a result of the consultations, it was agreed that Soil Degradation Maps being prepared under the on-going Global Assessment of Soil Degradation Project (GLASOD), and a map of climatic vulnerability under preparation by GEMS/GRID represented some of the thematic areas suitable for maps in the World Atlas on Desertification.

In this regard it was decided that GEMS-GRID, would examine the concept of an Atlas, considering alternative means of using stored data for application at national, regional and global levels;that UNEP in-house consultations with GEMS/GRID, DC/PAC, Soils and other units should be initiated to explore the suitable scales, indicators and parameters to be used in the preparation of a climatic map related to desertification risks and the process by which such a map could be produced, including the cost of the project;that steps should also be taken to involve participation of other organisations likely to be interested in contributing technically and financially to this project; that a full-time co-ordinator should be des-ignated to co-ordinate/convene the required activities, and that an inter-national workshop on the sub-ject should be held in February 1990.

Ad-hoc consultation meeting assessment of global desertification: status and methodologies

The ad-hoc consultation held from 15 to 17 February 1990, organised by UNEP in Nairobi, was attended by experts from Argentina, Australia, Colombia, Egypt, France, Ghana, Hungary, India, Iran, Israel, Japan, Kenya, Nigeria, Syria, Tanzania, Trinidad & Tobago, Tunisia, Uganda, UK, USA, USSR, and representatives from FAO, UNESCO, UNSO, and UNEP. The aim of the meeting was to review methodologies currently available for desertification assessment and to propose a scientifically acceptable and feasible method to evaluate the global status and trends of desertification. The meeting also drew up guidelines regarding the contents of the report on GAP II due for 1992 and the proposed World Atlas of Thematic Indicators of Desertification.

The following reports were presented and discussed at the meeting:

Overviews:

- Current status of desertification; Prof. B. Rozanov (USSR)
- Methodologies for desertification assessment; Prof. B. Rozanov (USSR)
- Review of the desertification concept; Prof. R. Odingo (Kenya)

Assessment Methodologies:

- Desertification assessment and control: IADIZA activities, Argentina; Dr. V. Roig (Argentina)
- Desertification assessment methodologies: North America; Prof. H. Dregne (USA)
- Desertification assessment methodologies: Australia; Prof. R. Perry (Australia)
- Geographical belts and zonal types of landscape; Dr. E. Milanova (USSR)

World Atlas of Thematic Maps on Desertification:

- Regional assessment: USSR/Asia - Mongolia, USSR, Mali, Afghanistan; Prof. N. Kharin (UNEP)
- Local assessment: the Kenya pilot study; D. Andere, W. Ottichilo, J. Grunblatt (Kenya)
- Assessment and monitoring of desertification in Sahelian and Sudanian regions; Mr L. Guyot (France)
- Background/overview and objectives; Dr M. Norton-Griffiths (UNEP)
- Global Assessment of Desertification - World Atlas of Thematic Indicators of Desertification: Project Approach;Mr M. Mendoza (UNEP)

A special discussion session following the presentations was chaired by Dr M.K. Tolba, UNEP's Executive Director. In this session, the participants provided advise on the following topics:

Assessment of the Status of Desertification:

The preliminary evaluation of desertification conducted in 1975/76 preparatory to the UNCOD 1977 came up with the figure of 6 million ha of land lost annually to desertification; the general assessment in 1983/84 confirmed the figure but also added that 21 million ha of land were reduced to zero or negative productivity annually. Regarding the forthcoming assessment, it is possible to validate scientifically the credibility of these figures by, for example, taking one continent - eg Africa - to compare the 1977 situation with that of 1984 and extrapolate for the remainder of the period.

The highest degree of **credibility** will have to be established with regard to the data used for the assessment. As there is no adequate quantitative data available on desertification, and given the constraints of limited time, it may be advisable to focus on a pilot area on a regional frame, like North Africa, Sudano-Sahelian region, China, USSR or Australia, for which some basic data exists. Data from such pilot areas should be compiled from aerial studies complemented by ground-surveying, reports/literature, opinions of scientists on the spot and mapping.

It was also mentioned that there is a need to emphasize areas where it is probable that desertification will occur, rather than categorically stating that "21 million ha of land were lost to zero productivity" as discussed previously. It will be necessary to include **human aspects** of desertification in the Global Asessment of Ssoil Degradation (GLASOD) to underline the concept of credibility.

The **constraints of limited data and time** can be minimized by using available materials at suitable scale and in this regard GLASOD would be ideal. The scale 1:10 million could be used for the regional (global) assessment while the scale 1:500,000 could be used for country level assessment. GLASOD data can be complemented with Population Maps, Climatology Maps and other data derived from remote sensing.

It was pointed out that **collaboration between UNEP, UNSO, FAO, UNESCO, WMO,** etc will be crucial. This is expected to involve multidisciplinary work on soils, forestry, grazing and arable land, water supplies, agroclimate,population, social indicators and related

proposal of the thematic areas for the atlas would focus such efforts). Its functions would be multiple: to serve as a basis for global or regional policy development as well as a global analytical tool. With the advent of geographic information systems it has become more feasible that a thematic atlas of desertification can be compiled. FAO noted that GLASOD's results mean they are now less doubtful about the practical possibilities of assessing the status of desertification than they were a few years ago.

It was stressed that the objective of the assessment exercise was not merely to produce desertification maps but, of more crucial value, to provide the world with the best judgement or measurement of the status of desertification since the PACD launch 15 years ago. **Credibility and probability** are necessary but **not sufficient** for governments which need information and data indicating the effect of desertification in **concrete terms,** such as in the case of ozone depletion where its effect on cancer was clearly shown.

Evaluation of PACD and Progress in Implementing PACD:

Concerning the **evaluation,** the question being asked is how far have the concepts on which the PACD was based been applicable to-date, given current development in the major environmental issues with a bearing on desertification, such as climate change, which are now prominent on the agenda of environmental concerns. Is the main thrust of the PACD outmoded in the light of the new developments? GAP II is intended to assess how far the present PACD has been implemented - starting from the 1984 assessment and looking into which factors led to progress or lack of progress.

It will be essential to obtain information from affected countries on the development since 1977. For this purpose, a structured set of guidelines will have to be devised for use by consultants or teams of experts who conduct the assessment. It was noted that the recent Australian assessment, reported at the consultation, could be adopted as a model and modified for this purpose. It was noted that "Assessment of Desertification in the Sudano-Sahelian Region 1978-1984", prepared by UNSO for the first GAP, formed a good baseline for a second assessment of that region.

GAP II is a long, complex and difficult task which involves many researchers collecting data from various sources using a wide range of methods. A suggestion was made that FAO could be asked to assess the impact of the several desertification control projects it has executed with funding from UNSO, UNDP, World Bank, etc.

It was underlined that GAP II reports would have to show clearly which of the recommendations of the PACD had been carried out and with what impact, or why in some cases the actions taken did not result in meaningful impact.

Financial Aspects of Anti-Desertification Programmes:

At the request of the General Assembly, expert studies on financing the PACD were prepared in 1978 and 1981, highlighting in particular additional measures, means and modalities. However, GA made no clear decisions and asked for further expert studies to be conducted on financing anti-desertification programmes. The immediate question as we approach these studies is in what context the financial resources should be sought, ie: a) specifically (exclusively) for desertification control programmes; b) for integrated development programmes in which desertification control is included; or c) environmental protection programmes including issues like climate change in which a certain percentage is for desertification.

Anti-desertification programmes are regarded by many not to be financially viable by current standards. Furthermore, countries facing desertification problems generally do not give priority to this sector because of the pressing needs for education, transport, etc. hence the need arises for additional resources for desertification control in order to assist the countries threatened by it. However, it is important to recognize the reality that both recipient and donor governments will not accord priority to desertification control as long as it is focussed on a long term return.

There is need to place emphasis on integrating desertification control with development programmes and to fund it in the frame of broader plans. Experience with field soil conservation programmes show that these have been successful when put in the frame of programmes directed at the farmers' concern with food. At the global level, desertification control should be featured with the major global environmental problems and ought to be funded in this framework.

It was underlined that it is important to emphasize that funding is required specifically for stopping land degradation. Funding should be directed at the protection of land threatened by desertification/land degradation and at arresting land degradation occurring in areas which presently support the population, not at rehabilitation of lost land.

Thematic Atlas:

The format of the atlas was proposed to be at A3 sheet size, approximately at the scale of 1:80 million, accompanied by wall charts at the scale of 1:10 million showing selected thematic indicators at the global level. The meeting called for technical and scientific co-operation between UNEP, other UN bodies and agencies to be strengthened, especially regarding sources of data, information and expertise which can be incorporated into the assessment and the atlas.

A Working Concept of Desertification for the Purpose of its Assessment

As one of the significant conclusions reached by the consultation group, it was agreed that the term "desertification" should be used side-by-side with the term "land degradation". Furthermore, a working concept of desertification/land degradation for the purpose of its assessment was adopted (see box).

Desertification/land degradation in the context of assessment is land degradation in arid, semi-arid and dry sub-humid areas resulting from adverse human impact.

LAND in this concept includes soil and local water resources, land surface and vegetation or crops.

DEGRADATION implies reduction of resource potential by one or a combination of processes acting on the land.

These processes include water erosion, wind erosion and sedimentation by these agents, long-term reduction in amount or diversity of natural vegetation where relevant, and salinization and sodication.

Assessment should provide measures or estimates for the effects of these processes, eg: in the form of status or severity of water erosion, based on explicit criteria.

The information on the status for each process should form part of the assessment, which should not merely present an aggregate severity class for undifferentiated desertification/land degradation.

Approved by ad-hoc consultation meeting assessment of global desertification: Status and Methodologies UNEP, Nairobi, Kenya 16 February 1990

Pilot Study to Evaluate FAO/UNEP Provisional Methodology for Assessing and Mapping Desertification

A pilot study to evaluate the FAO/UNEP provisional methodology for the assessment and mapping of desertification (1984) and to propose a simplified methodology was undertaken at a pilot level in two study areas located in Baringo and Marsabit districts of Kenya.

Project activities started in March 1988 following the signing of the memorandum of understanding between UNEP and the Government of Kenya in 1987. The report of the study was published in January 1990.

The objective of the project was to choose appropriate desertification indicators and to identify methods that could be used for data collection and analysis in a rapid and cost effective manner.

Initial evaluation of the FAO/UNEP methodology showed that most of the indicators and methods proposed could only be used in assessment and mapping of desertification at a local or pilot level. Since most countries do not have detailed data to the level proposed in the methodology, it would be very expensive and time consuming to use most of the proposed indicators and methods for assessment and mapping of desertification at regional or national level.

It was also noted that data from the recent past (eg 50 years), which was required to determine the rate of desertification, is lacking. It was further noted that socio-economic data needed to be added to the methodology since desertification processes are largely induced by human activities.

The project team collected detailed data on selected desertification indicators using remote sensing techniques and field surveys. This detailed data was then evaluated for use at local level. Selected data elements and other ancillary data were used in the geographic information system (GIS) to develop generalized models that could be used in the assessment and mapping of desertification at regional or national level.

The principle behind the pilot study's attempt to find a simplified method of assessment was to collect detailed data at local level and then select from it generalized data elements which were then analyzed. During analysis it became apparent that some indicators could be used for assessing desertification at a pilot or local level only. However, some of the indicators were found to have wider application and could be successfully used in developing desertification assessment and mapping models that could also be used at a national level, where they can be easily verified through field observation. In all, five were selected for assessing desertification status.

1 **Water Erosion Status**: Slope Erosivity factors, Vegetation cover (%), Rockiness factor (%),
2 **Wind Erosion Status**: Vegetation cover (%), Rockiness factor (%), Wind erosivity index,
3 **Vegetation Degradation Status**: Actual herb production , potential herb production: Annual Rainfall, RUE Rockiness factor
4 **Range Carrying Capacity Status**: Available herb biomass - predicted livestock

consumption where available
herb biomass = field data

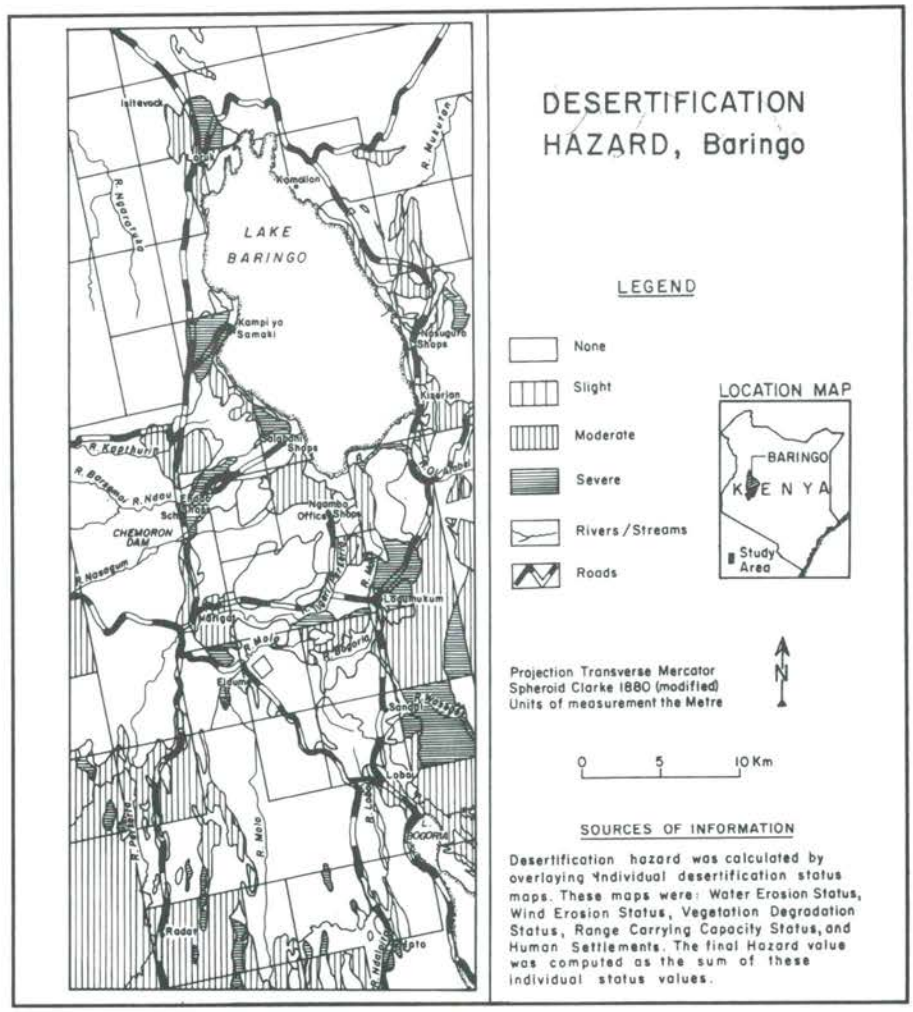
5 **Human population density status:** (from Systematic Reconnaisance Flight (SRF) data)

The report proposed that these models be used in assessment of desertification at a national level using basic data on climate, landform, soil, vegetation, animal numbers and human population.

Based on the experience gained from this study, it was recommended that in areas where the basic data required for the models do not exist, systematic reconnaissance flights can be used instead of remote sensing techniques - particularly satellite imagery - to gather data for the baseline resource inventory for the long-term monitoring and assessment of desertification.

A detailed report on the modelling exercise, currently under preparation, is due to be ready by late 1990.

UNEP is now assisting the Kenyan Government in expanding this project throughout the country in order to test the applicability of this revised methodology on a national level.



Desertification Hazard Map, Baringo

World Map of Present Status of Human-Induced Soil Degradation

UNEP and the International Soils Reference and Information Centre (ISRIC) in the Netherlands published a world map of the present status of human-induced soil degradation (GLASOD) in July 1990.

The map (see front cover), which is made up of three wall sheets at the scale of 1:10 million, is intended to create awareness among policy and decision-makers of the seriousness of the problem of global and continental soil degradation. It was compiled with expert knowledge and existing material following general methodology guidelines for the assessment of human-induced soil degradation.

Two hundred and fifty soil and environmental scientists all over the world participated in compiling the data. Twenty-one regional correlators prepared draft regional maps in consultation with the respective experts who collected the data. The final draft global map was compiled by ISRIC and was sent to national soil institutions throughout the world for their final comments and acceptance. The response from a large cross-section of countries gave project management sufficient confidence about the quality of the data.

The GLASOD map and its explanatory notes are expected to be endorsed by the Fourteenth International Congress of the Society of Soil Science at Kyoto, Japan in August 1990. Some of the most important information shown in the map includes the type, degree, extent, severity and major causes of degradation and speed at which degradation processes took place in the last 5 to 10 years.

Digitized GLASOD data are now available at UNEP's Global Environment Monitoring System (GEMS)/Global Resource Information Database (GRID) for ease of accessibility. The digitized GLASOD data will also be a major input in the preparation by UNEP of the Global Assessment of Desertification/Land Degradation - World Atlas.

UNSO

United Nations Sudano-Sahelian Office

Established by the Secretary-General in 1974, the United Nations Trust Fund for Sudano-Sahelian Activities serves as a repository of funds with which the United Nations Sudano-Sahelian Office (UNSO) carries out its programming and operational responsibilities.

These responsibilities cover two major areas:

- the implementation of the medium-term and long-term recovery and rehabilitation programme of the nine drought-stricken Sahelian countries which are members of the Permanent Inter-State Committee on Drought Control in the Sahel (CILSS) - Burkina Faso, Cape Verde, Chad, the Gambia, Guinea-Bissau, Mali, Mauritania, the Niger and Senegal; and of the six East African Sahelian countries which are members of the Intergovernmental Authority on Drought and Development (IGADD) - Djibouti, Ethiopia, Kenya, Somalia, Sudan and Uganda; and
- the implementation of the Plan of Action to Combat Desertification in 22 Sudano-Sahelian countries which include those listed above in the CILSS and IGADD regions, as well as 7 additional countries of the adjacent subregions - Benin, Cameroon, Guinea, Nigeria, Togo and the United Republic of Tanzania.

The resources of the Fund are used for providing assistance to governments in planning and co-ordination of activities for the protection of natural productive resources, for project and programme financing and, where possible, to promote various forms of complementary, joint or parallel financing, combining as appropriate, the elements of capital investment and technical co-operation required to fund viable projects. Thus, programmes and projects of crucial importance for the recovery and rehabilitation of the Sahel and for combating desertification in the Sudano-Sahelian region are formulated in a manner capable of attracting and stimulating the flow of additional financial and material support, along both bilateral and multilateral channels.

The total flow of financial resources from UNSO to the Sudano-Sahelian countries during the period 1974-1989 exceeded US$ 220 million with the focus on afforestation and reforestation activities, fuelwood conservation and utilization of alternative sources of energy, rangeland management, soil protection and sand dune fixation, integrated land management, construction and maintenance of feeder roads, and assistance to governments in planning and programming for the protection of natural productive resources and the fight against desertification.

In 1989, the total amount of resources mobilized by UNSO through the UNSO Trust Fund was US$ 37.5 million, an increase of over 37 per cent over the resource mobilized in 1988. As in the past, the bulk of the resources mobilized, US$ 22.5 million, was in the form of contributions earmarked for specific projects under trust fund arrangements, identified and formulated jointly by recipient governments, UNSO and donor agencies. The 1989 figure represented an increase of almost 14 per cent over the earmarked project resources mobilized in 1988.

Pledges for 1989 to UNSO general resources totaled US$ 6.7 million. During this period, funding amounting to US$ 8.2 million was also obtained under Management Service Agreements.

Following the recommendations of an in-house study in 1988, it was decided to strengthen the technical profile of UNSO headquarters in New York which now co-ordinates specific projects and programmes. At the field level, UNSO's field office in Burkina Faso was mandated to co-ordinate the implementation of the PACD in West Africa and a new regional office was opened in Nairobi in February 1990 to co-ordinate the implementation of the PACD in East Africa. For more information on the new Nairobi field office please contact:

Mr Dennis Seiner, Chief of the Office, Room A-125, UNSO regional headquarters, Block A, United Nations Complex, PO Box 30552, Nairobi, KENYA; Tel: 333930 or 520600 ext. 6908/6909. The Administrative and Financial Assistant of the Office is Mrs Marie-Lucie Pinchinat. Both Ougadougou and Nairobi offices co-ordinate UNSO's regional and sub-regional programmes.

In July 1989 UNEP Governing Council 15 commended UNSO on its activities to date and called on it to find additional resources to ensure continued support for its programmes and regional organisations, in particular for IGADD and CILSS.

GC 15 also called on UNSO to co-operate with the Southern African Development Co-ordination Conference (SADCC), Economic Community of West African States (ECOWAS), Ministerial Conference on Desertification (COMIDES) and CILSS in finding a joint policy to combat desertification in the affected Sudano-Sahelian countries of Africa.

GC 15 agreed to allocate $US 2 million for the 1990-91 biennium towards the institutional and programme support costs.

The Definition of Desertification: Its Programmatic Consequences for UNEP and the International Community

Prof. Richard S. Odingo
Department of Geography
University of Nairobi,
Kenya

The following article on the definition of desertification arose out of a request I received from the United Nations Environment Programme (UNEP) last year to examine their conceptional and programmatic definition of desertification since the United Nations Conference on Desertification (UNCOD). The aim was to look for consistency among the scientists who have over the years tried to contribute to the better understanding of this important topic. Owing to time and space constraints, the critique presented may not be adequate and readers are invited to contribute further to this debate with a view to bringing out a clear-cut definition which can assist with natural and international fund-raising to ameliorate the conditions of areas and countries suffering from this scourge. The explanation is simple: with a fuzzy definition funders will remain reluctant to produce the money to help developing countries overcome this problem; with a clear-cut and programme-oriented definition funds may begin to flow. So readers and all others affected are asked to start thinking about this problem and to help in finding solutions.

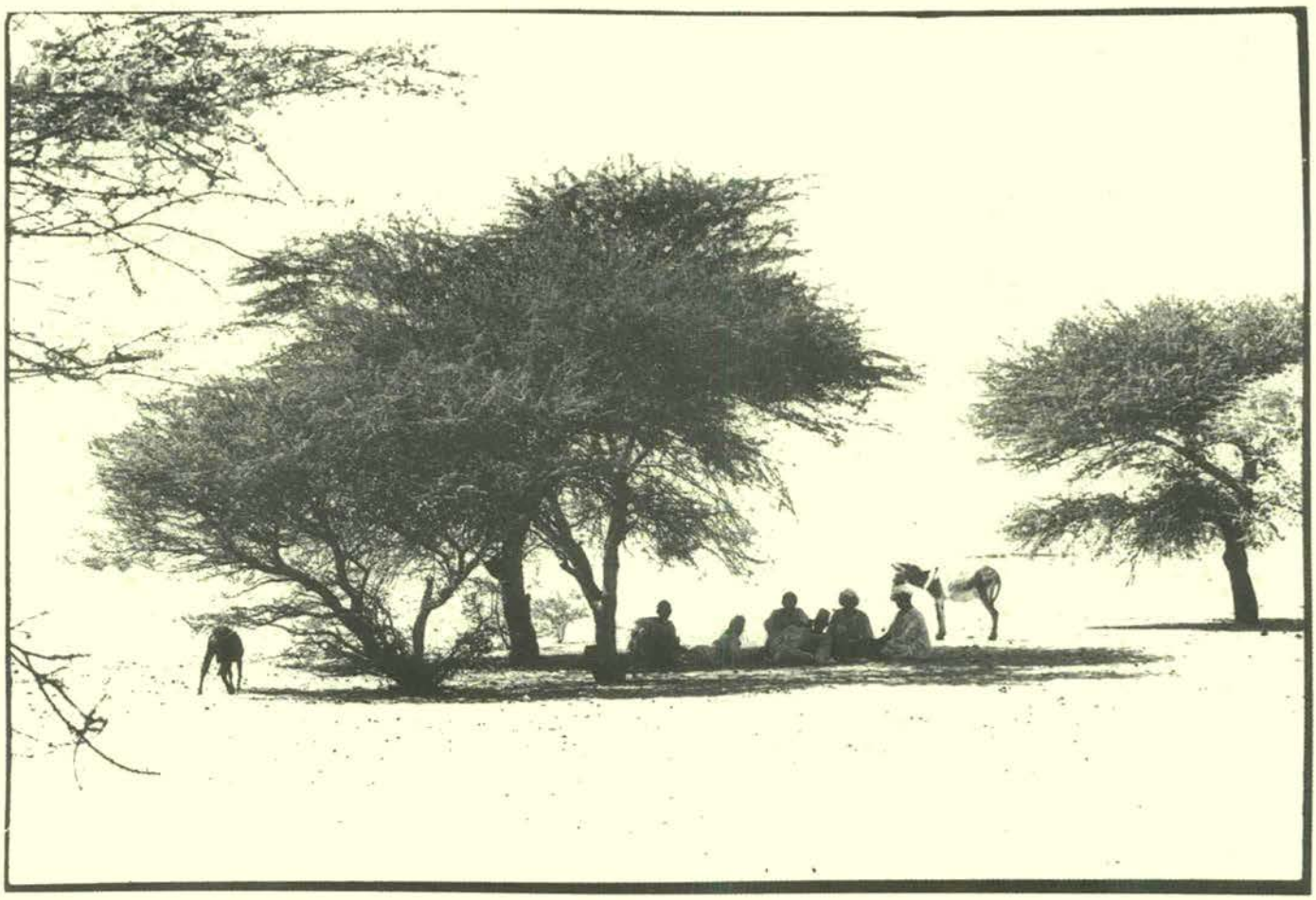
Introduction

Desertification as a human environmental issue was first raised at Stockholm in 1972 in a very generalized way and it was only later that it forced its way up the UNEP agenda.

At Stockholm "desertification" received very little attention and it was lumped together with many other environmental problems which, it was optimistically felt, could be "tackled" and even "got rid of" by the application of already available scientific and technical knowledge. At this time environmental problems were simplified to such an extent that what was thought to be required was to "identify" them, and then spell out appropriate "corrective activities". Many of the proposed activities were guided by the false assumption that technology had the answer to all the problems being addressed. Over the years, this assumption influenced the language used which was clearly unrealistic, words such as to "combat", to "stop" and to "reverse", and so on. This also led to some unrealistic deadlines, such as halting and reversing desertification by the year 2000. This "technological superiority approach" has tended in some cases to mar the processes being studied and led to false assumptions and false hopes that solutions to the problems being addressed were just around the corner, if only the massive funds required could be raised from the international community.

At its first session in June 1973, the Governing Council of UNEP was quick to spell out policy objectives, and among these were the obvious "concern for the need to prevent the loss of productive soil through erosion, 'salination' or contamination; to arrest the process of 'desertification' and to restore the productivity of desiccated soil." (UNEP 1978, p. 53)[1] Unfortunately these clear-cut strategies for dealing with desertification were not accompanied by any serious attempt to define and dissect this perceived environmental problem, or even to conceptualize it better for the benefit of decision-makers at the grass-roots levels. In spite of these uncertainties, the Executive Director of UNEP was requested by the Governing Council (Ibid)[1] to mount a concerted programme to "arrest" the spread of deserts and to "initiate national and international efforts for efficient drought forecasting and help countries in mitigating the consequences of drought." (Ibid)[1]

In December of that same year (1973), the UN General Assembly, by its Resolution 3054 (XXVIII), noted with interest "the recommendations and resolutions of the heads of state of the drought-stricken countries including the medium-term and long-term action programme, and the establishment of the Permanent Inter-State Committee on Drought Control in the Sahel, to co-ordinate national and regional action". Thus apart from desertification there was the problem of severe drought in the Sahel in West



Shade is a vital amenity around villages. The Saharan fringes, Kordofan province, Sudan. (Photo: Earthscan/Mark Edwards)

Africa, which commanded even more urgent attention and which inevitably led to a certain amount of confusion in setting priorities for long-term measures to deal with desertification and short-term measures for dealing with droughts, especially prolonged drought.

To a large extent the "desertification movement" acquired its own momentum as a result of the initial concern for the occurrence of widespread and debilitating droughts, in particular the Great Sahelian Drought (1968-1973), and the series of almost contemporaneous droughts which were at that time being experienced in several other parts of the world. Up to then, droughts had been regarded as a "normal" aspect of climatic variability and climatic fluctuations. But now it was noticed that the droughts were also associated with more permanent ecological damage to the land resource base, or *land degradation*, which was termed "desertification", to such an extent that it was of more global concern and deserved detailed international attention, both at the level of UNEP, and at the level of the UN General Assembly. In this paper an attempt will be made to trace the origins of the word "desertification", its employment within UNEP circles, including a brief look at the programmatic activities that have been and are still being established under the leadership of UNEP. In addition, other approaches to arid lands studies and the "desertification problem" by the scientific community will be examined briefly to establish to what extent there is a unanimity of views, both at the scientific and technological levels to guide UNEP's programmes and activities.

Arid lands research and desertification movement

Prior to Stockholm there were decades of scientific and technological research carried out both at national and international level on problems of arid and semi-arid lands. Aridity naturally afflicts many developed and developing countries with large tracts of their territory found to be either true desert or semi-desert. Consequently, over the years there have emerged numerous viable scientific and technical research programmes in Australia, West Asia, China, Africa, North and South America, aimed at finding both immediate and long-term solutions to the challenges put forward by the need to understand the ecology, as well as to manage rationally the natural resources of

these lands. Within the UN system, the United Nations Educational, Scientific and Cultural Organization (UNESCO) had pioneered a viable arid lands research programme from as far back as 1951, such that by 1958 this was one of its largest research projects. However, the term "desertification" was not being used at this stage. An Advisory Committee on Arid Zone. Research had been created in 1951 and this was quickly expanded into a global research programme primarily dedicated to the study of deserts, though later it extended its activities into the semi-arid belts of the world (UNESCO 1963)[2].

The catalogue of research areas covered by the UNESCO programme was long and included arid zone hydrology, utilization of saline water, plant ecology, wind and solar energy, human and animal ecology, climatology, salinity problems in the arid zones, plant-water relationships, land use and nomads and nomadism. In its programme, UNESCO established a history of co-operation with other UN agencies such as the Food and Agriculture Organization of the United Nations (FAO), World Meteorological Organization (WMO), as well as other national and international organisations. When UNEP was established in 1973, UNESCO offered its assistance and experience in many areas of knowledge, including that of Arid Lands.

Apart from UNESCO, WMO and FAO had also mounted viable research programmes on arid lands specific to their areas of expertise. FAO for example studied desertification from the point of view of soils and at Stockholm it was requested to prepare a World Map of Soil Degradation which came quite close to a World Map of Desertification.

Thus when the topic "desertification" was pushed to the center stage of the "Environmental Movement" there was already a wealth of scientific and technical knowledge to provide a back-stopping for any proposed activities by the international community. There was a general assumption that this knowledge was adequate as well as appropriate. The first such test programme with the international spot-light focussed on it was mounted to deal with the disastrous and crippling drought that struck the Sahelian lands of West Africa between 1968-1973. Using existing knowledge, and bringing together expertise from international organisations like UNESCO, WMO, FAO and several bilateral and multilateral donors, the Comité Permanent Inter-états de Lutte Contre la Sècheresse dans le Sahel (CILSS) - (Permanent Inter-State Committee on Drought Control in the Sahel) - was quickly established in 1973. The aim of CILSS was to conduct a viable drought control programme, thereby attempting to alleviate human suffering due to drought, bringing science and technology to "fight" drought and to rehabilitate drought-damaged land in the Sahel. It was the Sahelian Drought that succeeded in galvanizing world opinion to "fight" desertification, and that led to an outcry for a fully-fledged United Nations Conference to bring political weight to bear upon the problems faced by arid and semi-arid lands globally. The way CILSS was conceptualized reveals assumptions of scientific and technical "superiority" over environmental problems like drought, by suggesting that all the "armaments" were available for the "war" against drought, and that what was now important was to work out a "battle" plan.

This unmistakable "military" approach to problems of the environment was later to be found in international efforts to tackle desertification, even when it was realized that desertification was a more deadly enemy than drought, because it threatens the whole ecological basis of production in the affected lands. Drought naturally led to prolonged *land degradation* and over a longer period it was shown that man-induced *land degradation* deserved a more appropriate terminology to describe it, hence the use of the word "*desertification*".

Scientific origins of the term "desertification"

The word "desertification" had quietly crept into scientific literature such that by the Stockholm Conference it could be used in the deliberations without creating any doubt or consternation! One of the earliest scientists to use the term "desertification" was Aubreville (1949)[3] who is associated with originating it. Aubreville was referring to conditions in semi-arid and sub-humid zones with annual rainfall totals ranging from 700-1,500 mm per annum. He was emphasizing the process of *land degradation* that was taking place in these zones, largely as a result of human activities. His now famous quote in French was as follows: *"ce sont des déserts qui naissent aujourd'hui, sous nos yeux, dans des pays où il tombe cependant annuellement de 700 à plus de 1,500 mm de pluies."*[3]

The definition of desertification most commonly used by UNEP can be assumed to come close to this original Aubreville definition which, on second thoughts, was an expression of horror by Aubreville of the extent to which vegetation was being destroyed in the semi-arid and sub-humid regions that he was writing about. This assertion can be gleaned from the English translation of Aubrevilles' comment as follows: *"These are deserts that are being born today, under our very eyes, in regions where the annual rainfall is from 700 to 1,500 mm"*.

Having crept into the vocabulary, and being used by the scientific

community throughout the world, the word "desertification" has over the years acquired different meanings, according to the emphasis being made by the individual or group of scientists, depending on their training and their disciplinary backgrounds.

By the time of the Stockholm Conference the word "desertification" was being liberally used by most scientists to mean a phenomenon representing some environmental and even developmental symptoms that were characterized by *land degradation* in general and *soil and vegetation degradation* in particular. These early records show a lack of specificity in terms of areas affected because the usage was indiscriminately applied to all lands, from the desert proper to the semi-arid and sub-humid belts. For example, one encounters the use of the term "desertification" in relation to land degradation in some Saharan oases. (cf. Despois, J. (1973): The crisis of the Saharan Oases in D.H. Amiran et al (Eds) *Coastal Deserts*, Tucson, pp. 167-169[4]; Echallier J.C. (1972): *Villages déserts et structures agraires anciennes du Tonat - Gourara (Sahara algérien)*, Paris, p. 122[5]; Meckelein, W. (1976): Desertification caused by land reclamation in deserts: The example of the new valley, Egypt, *Pre-Congress Symp.* K26 of XXIII Int. Geog. Congress, Working Group on Desertification in and around Arid Lands, Ashkabad, USSR, 1976, pp. 151-153[6]; Meckelein, W. (1980): *Desertification in Extremely Arid Environments*, Stuttgarter Geographische Studien, Band 95; I.G.U. Working Group on Desertification in and around Arid Lands - Sub-group Extremely Arid Environments[7]; Evenari, M., Shanan, L. and Tadmor, N.H. (1971): *The Negev: The Challenge of a desert*, Cambridge Mass., Harvard University Press, p. 345[8]; Novikoff, G. et al (1975): *The desertification of rangelands and cereal cultivated lands in pre-Saharan Tunisia*, Tunisian pre-Saharan Project Times[9]).

For a time the French-speaking scientific community showed a preference for the term "desertization" instead of "desertification". To these groups, "desertization" (to mean desertification, or desert encroachment) was defined as the spread of desert-like conditions in arid or semi-arid lands (Rapp, A., Le Houerou, H.N. and Lundholm, B. (Eds) *Can Desert Encroachment be stopped?* SIES, Stockholm, (1976)[10]. Anders Rapp and his colleagues (op. cit.) tried to rationalize the use of the alternative terminology by specifying the conditions under which desertification occurs as due to:

- severe prolonged drought; and
- man's over-exploitation of vegetation and soil in dry lands.

But the International Geographical Union pre-empted further discussion and set the standard when in 1972 they set up a *Working Group on Desertification in and Around Arid Lands*, rather along UNESCO lines which focussed more on the deserts. Since then most of the scientific community seem to have agreed to the use of the term "desertification" instead of "desertization". At the beginning, a large majority of the scientific contributions approached "desertification" from the desert margins into the semi-arid and sub-humid lands. This tended to colour their thinking such that they came to view the process as one in which the deserts were *encroaching* on the margins of semi-arid and sub-humid lands, rather than the kind of *land degradation* that can, and does, take place within and outside these two zones as a result of mismanagement by human populations.

As already shown, world opinion "to do something about desertification" was galvanized by the Sahelian Drought and by the realization of the global scientific community that there were significant "teleconnections" between drought occurring in one part of the world and another. Thus after the Governing Council of UNEP in March 1974, the pace of activities began to quicken. In discussing activities to be pursued in respect of *Land, Water and Desertification*, the Governing Council directed that first priority "should be given to the establishment of integrated research programmes on arid and semi-arid lands" (UNEP GC 1974)[11]. Even more important was the decision to pay particular attention to the Sudano-Sahelian region. Following the General Assembly Resolution 3054 (XXVIII) of 17 October 1973, and because of the urgent need for immediate intervention, the Executive Director of UNEP was requested to treat this region afflicted by droughts as a priority area of concentration within the programme and activities planned for 1974 (UNEP 1978, p. 93)[1]. The General Assembly's 29th session at the end of that year went even further than the UNEP Governing Council. Prior to this session the United Nations Development Programme (UNDP) Governing Council had called for the need to undertake in-depth studies on the extent of the drought in Africa and to draw up corresponding action programmes. The General Assembly (29th session) now emphasized the need to ensure that all available knowledge in the area was fully utilized, in particular the experience available from all the relevant UN agencies and the Economic and Social Council (ECOSOC). It went even further by deciding to initiate concerted international action to "combat" desertification and to convene the 1977 UNCOD to give impetus to international action to combat desertification (UNEP 1978, p. 124)[1]. The General Assembly instructed further that the Inter-Agency Task Force should undertake as one of its first functions the preparation of a World Map of areas affected and areas likely to be

affected by the process of desertification. The General Assembly was reacting to a bad sub-regional drought and there was a real risk that the drought would be confused with the much more complicated phenomenon known as "desertification". But all proceeded as if "desertification" was well understood and needed no definition.

Prior to UNCOD many of the developing and newly independent African countries had had little previous experience in coping on a large scale with a major drought of several years duration. Due to lack of scientific and technological preparation, the drought(s) proved to be devastating and in some cases succeeded in completely paralyzing these countries' economies, to the extent that in their minds and even in the literature emanating from these countries, they tended to treat drought and desertification inter-changeably, thereby complicating any future serious efforts at definition of either phenomenon. For the purpose of this article though, drought will be treated as a natural hazard, to be classified together with floods, earthquakes and similar "climatic accidents". Unfortunately this does not make it any easier to comprehend the prolonged droughts which should be better termed "desiccation" (see F. Kenneth Hare (1987): Drought and Desiccation: Twin Hazards of a variable climate, *Planning for Drought; towards a reduction of societal vulnerability*, Wilhite, D.A., W.E. Easterling, and D.A. Wood (Eds), Boulder and London, Westview Press)[12]. "Desiccation," according to Kenneth Hare, is a "prolonged period in which drought slowly and intermittently intensifies. Even natural ecosystems may be confounded by two or three decades of decreasing rainfall." He classifies the Sahelian Drought which triggered the "Desertification Movement" as a process of "desiccation". Now it is a well-known fact that the Great Sahelian Drought of 1968-73 was "a much more prolonged and profound disturbance of rainfall over much of Africa." (Hare op. cit.)[12] One should therefore be prepared to forgive those in Africa to whom drought was a greater reality than desertification.

In efforts to define "desertification" attempts have been made to underline its more permanent nature as compared to drought. However, Wilhite and Glantz (1987)[13], in their recent analysis of drought definitions, have endeavoured to point out that drought impacts can be equally long lasting, at times lingering for years, and that human and social factors often aggravate the effects of drought. These statements come rather close to certain definitions of "desertification" which emphasize that it is a *man-made* rather than *natural* phenomenon. In the same way as one struggling to find a workable definition of desertification, Wilhite and Glantz (op. cit.)[13] have the following to say in respect of a prolonged drought:

"The inadequate understanding of the concept of drought and the lack of appreciation of its physical and social impacts by the scientific community and governments has serious world-wide implications for the future as the difference between food production and food consumption narrows." (Wilhite and Glantz, 1987, p. 24)[13]

Preparations for the UN Conference on Desertification (UNCOD)

The decision by the UN General Assembly to hold a conference on desertification was a momentous one and it called upon the UN agencies to tap all the available knowledge, both in-house and among the scientific community at large. The decision was a political one, and it now needed the science and technology to make it a reality. At the international level the results of the arid-zone research previously sponsored by UNESCO, and more specialized work by the FAO on soils and many other aspects of agriculture such as dry farming, rangeland development and forestry in arid lands, would now be made available to the proposed conference on desertification. The WMO was charged with the preparation of papers on the link between climate and drought, and climate and desertification. Some of the overview papers were expected to have clearly pointed objectives. For example the climatological studies had to try and answer some of the following questions:

"Was the Sahelian Drought evidence of larger changes in the global climate? Was the Sahara expanding south? What implications did this have for the countries directly involved? For their neighbours? For the international community? Most important, what could be done to cushion the impact of, or prevent disastrous changes?" (UNCOD (1977): Round Up, Plan of Action and Resolutions, p. 1)[14]

The whole of the scientific community was expected to address itself to the above questions and others as well. On the basis of the massive research on arid lands which had so far been carried out by UNESCO, FAO, WMO, International Council of Scientific Unions (ICSU) and the International Union for the Conservation of Nature (IUCN), there was a general feeling that scientific knowledge on how to handle the arid lands existed and what was now required was the application of this scientific and technological knowledge to the solution of problems associated with desertification.

It is surprising that many of the

scientific groups which had worked on arid lands knew the symptoms of desertification and yet only a few were prepared to define it clearly and openly. According to Per Brink (1976)[15], a lot of the basic scientific research findings were not in a ready form to be applied, and this included the many years of arid-zone research pioneered by UNESCO and the more recent programme, "Man and the Biosphere" (MAB), by the same agency which fell into the same category. However, now that they were challenged by the UN General Assembly, these agencies and organisations had to find ways of applying the accumulated knowledge and, in particular, of incorporating socio-economic considerations into their equations. The Swedish National Science Research Council, in a book entitled *Can Desert Encroachment be stopped?* (1976)[10] prepared for UNCOD and authored by several known experts on arid lands, was among the first to put forward a definition of desertification although they called it "desertization" and defined it as follows:

"Desertization or the degradation of arid and semi-arid ecosystems is a stepwise decomposition of the plant and animal communities. Initially, there is a reduction of production of part of the species within the amplitude - that is the limits of variations - of the ecosystem. In terrestrial ecosystems the process usually occurs through soil deterioration via loss of primary species and invasion by new specific material. When the density of vegetation decreases, certain conditions of soil and climate may also induce desertization... The loss of species indicates an incipient irreversible evolution which transmutes the system."
(Rapp A. et al, 1976)[10]

This definition, though close to the one which was finally accepted at UNCOD, was not sufficiently unequivocal in spelling out what is and what is not desertification. In any case, the authors were using the word "desertization" instead of the now more generally accepted "desertification".

The actual preparations for UNCOD were a massive exercise and several distinguished groups of scientists were asked to prepare background papers on key aspects, such as Climate and Desertification, Ecological Change and Desertification, Population, Society and Desertification, and Technology and Desertification. A quick summary of the key papers should indicate the thinking at the time.

The Climate paper was detailed and the evidence it amassed tended to point a finger towards human activities as causing desertification, and to re-emphasize that droughts will continue to come and go. (Climate and Desertification A/CONF.74/5)[16]

The report on Ecological Change and Desertification (A/CONF.74/7)[17] showed the indicators marking the progressive stages leading finally to desertification. It showed that perceptions of what constitutes desertification will vary depending on the culture of a people in question, and went ahead to suggest methods of rehabilitating desertified land using sound ecological principles.

The background document on Population, Society and Desertification (A/CONF.74/6)[18] associated the process of desertification with, apart from climatic fluctuations, two major aspects of human population changes as follows:

- That both the growth and decline of population appear to cause desertification;
- Three types of social change also contribute to desertification:

integration into wider socio-economic systems which alters the dynamics of local livelihood systems; the invasion of new and the retreat of old technologies which truncates the evolution of indigenous expertise; and the fluctuating strength and effectiveness of governments which drastically affects stability and survival in the dry margins.

The study was not in favour of the definition of desertification as "the spread or intensification of desert-like conditions" (ibid)[30]. It insisted that human societies are not merely passive recipients of the harmful effects of desertification and that all societies have coping strategies to deal with desertification. In other words desertification is very much a human-induced process caused by man's constant efforts to adjust to difficult environmental conditions associated with the occurrence of prolonged droughts.

The background document on Technology and Desertification (A/CONF.74/6)[19] went even further in endeavouring to clarify issues surrounding first drought and then desertification. It commented on the Sahelian Drought as follows:

"Drought is something to be expected in the earth's drylands and it has been experienced many times in places with a severity sometimes even greater than the recent disaster in the Sahel. Yet this century's great improvements in communications brought the Sahel drought forcibly to the world's attention and served to remind mankind of one of its most serious and enduring problems - the advance of desert-like conditions on to once-productive land."

The Document also attempted in its own way to define desertification as follows:

"Desertification is the impoverishment of arid, semi-arid and some sub-humid ecosystems by the impact of man's activities. It is the process of change in these ecosystems that leads to reduced productivity of desirable plants, alterations in the biomass and in the diversity of life forms, accelerated soil degradation, and increased hazards for human occupancy. Desertification is the result of land abuse."
(A/CONF.74/6)[19]

UNCOD would also provide an

opportunity for all those from different parts of the world to exchange notes on the phenomenon which had proved to be sufficiently worrying to bring them all to Nairobi to deliberate on it, and to suggest solutions at the various levels of human society. All these papers had been prepared at the request of the Executive Director of UNEP upon whom the General Assembly, by its resolution 3337 (XXIX), had delegated the responsibility of preparing for the Conference. It is important to note that the four major scientific reviews prepared for the UNCOD were not unanimous in defining desertification, with each disciplinary group trying to emphasize its own angle of the problem. Nevertheless, for UNEP's purposes, there was a certain amount of agreement about the fact that desertification, however described, was caused by man in his effort to seek sustenance from his environment. Looking at the Overview Document prepared for the Conference (A/CONF.74/I/Rev.1)[20], there is a clear sense of caution that not all the science was in the right place, and that more scientific and technical research was needed to be sure that all aspects of this complicated problem were understood. In particular, understanding of the role of climate was still extremely tentative.

The Overview Document was very explicit in pointing out where the desertification problem was most rampant and should have received more attention. It summarised the position thus:

"Deserts themselves are not the sources from which desertification springs. Except for hot winds, the deserts themselves supply none of the essential impetus for the processes described. Desertification breaks out, usually at times of drought stress, in areas of naturally vulnerable land subject to pressures of land use" and:

"These extreme deserts do not concern us, they are not subject to further desertification and they remain unclassified on the World Desertification Map." (Overview Document p. 24)[20]

It was therefore unfortunate that too many of the case studies and associated case studies (nos. 38-41) tended to be from true desert situations where reclamation measures were being undertaken. Most of the case studies tried to show what was being done in the country concerned to "stop" desertification or to reduce affected areas. None of them was sure how to define desertification. One exception was the case study on Chad, prepared under the supervision of LeHouerou, which did define desertification in some detail.

The United Nations Conference on Desertification definitions

Apart from the General Debate, the main business of the Conference was to discuss in detail "Processes and Causes of Desertification" and the "Plan of Action to Combat Desertification". The scientific community had done its work in spelling out in detail what in their view could be regarded as the processes and indicators of desertification and what corrective measures were called for to make a concerted effort to start dealing with desertification. Now it was the turn of the policy and decision makers to agree on a course of action, which was largely political. All the Conference Papers which have been discussed above and many others were made available to the participants for discussion and action. These included the Draft Plan of Action to Combat Desertification. Out of UNCOD the following definition of desertification, which has guided UNEP's programmatic activities, was arrived at:

"Desertification is the diminution or destruction of the biological potential of the land, and can lead ultimately to desert-like conditions. It is an aspect of the widespread deterioration of ecosystems and has diminished or destroyed the biological potential, ie, the plant and animal production, for multiple use purposes at a time when increased productivity is needed to support growing populations in quest of development."

As is now well-known, the UNCOD produced the Plan of Action to "Combat" Desertification (PACD), a carefully-crafted document which put forward the scientific case and the action needed at each stage "to combat" desertification. This deliberate use of military language was clearly based on the premise that there was already sufficient scientific and technical knowledge to "combat" and, if necessary, to reverse the process of desertification.

The six official feasibility studies which had been presented at UNCOD had been intended to guide UNEP in its future programmatic activities on desertification control by demonstrating practical ways to achieve transnational co-operation to combat desertification. It could even be said that the conference over-emphasized the ecological aspects and the transnational aspects of the problem at the expense of the "national level", which is where desertification is to be found. Conference participants were encouraged to accept that existing knowledge was adequate for making the Plan of Action to Combat Desertification realistic. What was needed was the political will to go ahead and combat desertification and the line of action was carefully spelled out in the 28 recommendations in the PACD, and a target date (the year 2000) was set for bringing the "war" to an end.

Looking back now, it is clear that there was a certain amount of

optimism that the desired goals could be achieved in what was then perceived as a simple environmental problem, but which subsequent years have proved to be much more complex. There was a belief that the experience already gained from the Sahel, put together with the suggestions contained in the case studies, would be sufficient. To quote from the UNCOD Document, the Plan of Action was to be guided by certain basic principles which was characterized by a central theme as follows:

"A central theme will be the immediate adaptation and application of existing knowledge, particularly in the implementation of urgent corrective measures against desertification, in educating the people and the affected communities to an awareness of the problem, and instituting training programmes in collaboration with international organisations such as the CILSS, UNESCO, through its Man and the Biosphere Programme (MAB), and FAO through its programme on Ecological Management of Arid and Semi-Arid Rangelands (EMASAR)."

The recommendations of UNCOD, however, did not necessarily conflict with the definition of desertification. If anything they provided practical steps for dealing at the national, regional and international levels with the scourge.

One of the most important recommendations from the conference was that which pointed at the grass-roots levels and the need to integrate anti-desertification programmes into comprehensive national development plans. It was spelled out as follows:

"Programmes to combat desertification should be formulated, whenever possible, in accordance with the guidelines of comprehensive development plans at the national level."

In order to avoid a sectoral approach to anti-desertification activities the notion of incorporating them into national development planning processes was extremely important. It was only later to be realized that this is where most of the emphasis should have been placed because, in the final analysis, desertification is a development problem with important environmental implications, and it is not always easy at the national level to separate environmental issues from overall national resource management, which is easier to provide for in a comprehensive national development plan.

Brian Spooner (1982)[21], in a book entitled *Desertification and Development*, argues that the outcome of UNCOD should be seen at two levels, viz. 1) that of ecological resource management, and 2) that of the political levels of management (p. 5). He states that while all the delegates accepted the ecological explanations of desertification (cf. evidence of this in the definition which was being discussed) and the technical solutions proposed, many were more concerned with causation at another level: that of the economic and political conditions that generate land use decisions (Ibid)[21]. He asserts that the campaign to organise for the purpose of conserving resources can never entirely free itself from the campaign to reorganise the distribution of resources and calls for a correct appreciation of the perceptions and values of pastoralist populations.

So far this paper has avoided comment on financing anti-desertification programmes following the convening of UNCOD and approving of the Plan of Action to Combat Desertification (PACD), because it is fair to assume that if the problem was correctly defined and the action plan appropriately designed, the financing of the various activities emanating from the conference would almost be mechanistic. Unfortunately this has not been the case because, in the process of implementing the PACD, many obstacles have arisen which must point back at desertification as it was defined at UNCOD, and all the programmatic activities which have been built around that definition and the accompanying PACD. Desertification as an issue is essentially a problem of *land degradation* arising from human misuse of the land and any meaningful programmes to "combat" it call for action(s) on a very broad front, so broad that it can even be called ambitious! Thus efforts to finance such a broad programme, if desertification is left so broadly defined, are likely to meet donor resistance, whether one is attempting to deal with the problem at the national, sub-regional or regional levels. Arising from the UNCOD definition of desertification, the mandate given to UNEP, albeit operating in collaboration with the whole of the UN System and other inter-governmental and non-governmental organisations, was to produce an action programme in keeping with the PACD.

Looking back, it is surprising that the PACD was not analyzed critically by UNEP's own Governing Council, neither was it given a critical review by UNCOD which passed it, because the declared immediate goal of the PACD was in retrospect rather ambitious; the immediate goal of PACD was stated to be "to prevent and arrest the advance of desertification and, where possible, to reclaim desertified land for productive use."

Post-UNCOD definitions of desertification

The period between 1978 and 1982 was taken up by the establishment within UNEP of the Desertification Branch and later the Desertification Programme Activity Center (DC/PAC), the convening of Consultative Group for Desertification

Chir pine seedlings at Danday nursery, 1 km from Thakot. (WWP photo by F.Mattioli,FAO)

Control (DESCON) meetings, and meetings of the Inter-Agency Working Group on Desertification (IAWGD). The PACD was approved by the UN General Assembly in resolution 32/172 of 19 December 1977, and it was that resolution which authorized the establishment of the Desertification Control Branch (and later on DC/PAC), DESCON and the IAWGD. The newly created Desertification Unit was asked to provide a Secretariat for IAWGD and for DESCON.

During this time, the United Nations Sudano-Sahelian Office (UNSO), a joint UNEP/UNDP organisation handling anti-desertification activities in the Sahel, was strengthened and its mandate extended to include assistance in the implementation of the PACD among the Sudano-Sahelian countries. However, there is no evidence of a questioning of the definition of desertification as had been accepted during UNCOD. In any case, as the drought menace was still very much around, any anti-desertification activities would continue to be justified without question. UNEP brought together all activities connected with arid and semi-arid lands ecosystems and the combat of desertification in line with the PACD.

Soon after it was formed, IAWGD concentrated its attention on co-ordinating UN activities on desertification control in keeping with the PACD, and saw its job as that of implementor rather than a refiner of the concept of desertification. Consequently, there is no evidence that the IAWGD ever tried to re-define desertification.

Similarly, DESCON at its first and subsequent meetings confined its attention to discussing its own modes of operation and concentrated on the six transnational projects which had been proposed at UNCOD. In other words, it provided a forum for evaluating proposed

projects and, where possible, suggesting possible sources of funding.

In approving the PACD, the UN General Assembly left some room for UNEP to re-assess the definition of desertification should this be necessary. This is evident in the recommendation to the UN Secretary-General "to involve the whole of the UN System, as well as scientific institutions outside the system, to assist with further research for the development and refinement of data pertaining to desert-ification, to close any existing gaps in scientific knowledge and technology and for the involvement of inter-governmental and non-governmental organisations in efforts to realize success for the implementation of PACD." (UN General Assembly, December 1977)

One of UNCOD's recommendations for projects to be undertaken after the conference was the preparation of a World Desertification Map. Unfortunately, the idea of the map was not finally approved by UNEP Governing Council until its Twelfth Session in 1982. The project aimed at developing a common methodology for the assessment of desertification. In the process of its execution it became a project jointly sponsored by UNEP, FAO, UNESCO and WMO. What transpired was that a Desertification Hazards Map was produced instead. But even more important was that in the process of preparing the maps, FAO and UNEP made an effort to agree on at least a "Provisional Methodology for Assessment and Mapping of Desertification". This too provided an opportunity for a new attempt at the re-definition of desertification. This was now given as follows:

"In the context of the FAO/UNEP Desertification Assessment and Mapping Project, desertification is defined as a comprehensive expression of economic and social processes as well as those natural or induced ones which destroy the equilibrium of soil, vegetation, air and water, in the areas subject to edaphic and/or climatic aridity. Continued deterioration leads to a decrease in, or destruction of, the biological potential of the land, deterioration of living conditions and an increase of desert landscapes." and:

"Desertification is a continuous process going through several stages before reaching the final one, which is an irreversible change. Natural threshold changes exist - historical events as well as current geo-socio-economic changes - which either provoke or keep constant the intensity of desertification processes. Desertification is therefore the result of natural processes and of processes due to human and animal pressures, but only through man's activity can it be slowed down or stopped." (FAO/UNEP (1982) *Provisional Methodology for Assessment and Mapping of Desertification*)[22]

This definition presented to UNEP in 1982 was to a marked extent different from the previous UNCOD definition which had guided the programmes on desertification control so far. In the first instance there was now a deliberate effort to emphasize less ecological considerations and more "economic and social processes". Secondly, there was now an admission that "natural" processes were equally important in understanding desertification. The emphasis on the biological potential was now given a back seat! And now there was a clear reference to the fact that, at some stages, desertification could be reversible, although there was always a point of no return beyond which the processes would be irreversible. In the closing parts the new definition now clearly specified that desertification is "the result of natural processes and of processes due to human and animal pressures, but only through man's activity can it be slowed down and stopped."

To a certain extent the FAO/UNEP methodology developed was biased in the direction of climate as explaining the process of desertification. On the basis of their divisions they produced a series of maps of vulnerability of land to desertification, but the small scale at which these maps were produced (1:5 million) made them rather limited in usefulness. There is no indication of UNEP's reactions to this new tentative definition which would have been a departure from the UNCOD definition, and when the assessment of desertification came in 1982/83 for presentation to the UNEP Governing Council in 1984, there was more or less a reconfirmation of the UNCOD definition of desertification.

During the first major review or assessment of desertification on a global basis, UNEP decided to keep the UNCOD definition despite indications to the contrary. This assessment period was an important one and the opportunity should have been taken to re-examine the scientific merits of the basic assumptions under which the anti-desertification programmes had been arrived at. It is true that since 1977 the programme was being propelled by the "political steam" that had been generated at UNCOD. But now it seemed that the "steam" was running out, and it would have been very appropriate to re-examine the 1977 definition. As long as the definition remained the same, all the conceptions about and around desertification would rely on the earlier basic assumptions, and the whole of the international community would still wait for guidance from UNEP.

The scientists preparing the assessment also decided to keep the UNCOD definition, largely because they felt conditions had not changed. It is also true that 1984 marked the peak of the several years of a new drought which was still raging in many parts of Sahelian Africa, and the general feeling even at UNEP

Governing Council in February that year was that desertification accompanied by drought should still remain high on the global development agenda. But this was not an excuse for the scientific failure to make a thorough re-evaluation of earlier basic assumptions and, if need be, to put new emphasis by changing the definition of desertification.

A look at the list of projects which had so far been funded globally up to 1984 as part of anti-desertification programmes includes; assessment, land use planning, public awareness, industrialization/urbanization effects, water, range improvement, rain-fed croplands, irrigated lands, vegetation improvement, conservation of flora and fauna, ecological monitoring, socio-economic evaluation, population health care, human settlements, monitoring the human condition, drought contingency, national science and technology, energy sources, information, national machineries, national desertification programmes, climate studies and shared water resources. The inevitable conclusion one arrives at is that if desertification was to be treated sectorally then it clearly lacked specificity, and that even if it had sufficient specificity, then it must be treated as part and parcel of national development planning, to guard against its being given a low priority. If indeed, according to the adopted definition, desertification was a process that led to irrevocable loss of biological productivity, such diffuse financing as suggested by the numerous projects listed above would have very little impact on the problem because it could easily be lost in the welter of other projects trying to solve other aspects of the development problematique.

The question immediately raised is that, in the face of clear difficulty with definition of desertification and even greater difficulties in quantifying the problem on a small, let alone global scale, was it really possible to cost accurately the presumed losses so as to work out a cost-benefit position? Somehow or other this is where the problem has started, and it is instructive even now to go back to the scientists to see if they are agreed on a water-tight definition of desertification, and hence of desertification assessment methodology, which can be used to support such a stand. Only then can UNEP's position be secured when it is looking for massive funds to "wage the war" against desertification. In the meantime it is fair to say that, however defined, if they remain sectoral, anti-desertification control measures are unlikely to be attractive to donors because they do not easily translate into cost-benefit figures.

The popularization of the desertification cause

In the process of popularisation of the desertification cause there have been several oversimplifications and even a distortion of the scientific basis of the problem. The origins of the notion of the encroaching deserts, particularly the Sahara, go back to E.W. Bovrill and E.P. Stebbing (1935 and 1938)[23/24] who first made the allegations of an encroaching desert (quoted in H.E. Dregne and C.J. Tucker (1988) Desert Encroachment, *Desertification Control Bulletin* No. 16)[25], and in 1975 in Hugh Lamprey's report on the desert encroachment reconnaissance in northern Sudan (21 October to 10 November 1975, UNESCO/UNEP)[26] which provided the now much-quoted data about rates of the encroachment of the Sahara (90-100 km between 1958 and 1975), all of which have recently been severely challenged. It is important to emphasize that a lot of the irresponsible statements have looked at desertification from the "desert end of the stick", rather than from the sub-humid and semi-arid ends of the spectrum. To the extent that these banners have been taken by the press and the media, they have denied UNEP the initiative of defining desertification in a cool and calculated scientific manner, so that corrective measures can be discussed meaningfully. In the same vein, one of the popular publications produced by UNEP as recently as 1987 entitled *Rolling back the Desert: Ten Years after UNCOD*[27], had an unfortunate connotation in suggesting that desertification is such a simple process that it can be made light work of. A more appropriate title would have concentrated on protecting the arid and semi-arid environments at the edge of the true deserts from *land degradation*.

The aim here is not to criticize what has proved to be a very successful public education campaign about desertification, but to show that in its success it has created difficulties for UNEP and for the definition of desertification by always focussing it on the true deserts rather than on the semi-arid and sub-humid areas where the real problem is. If it is possible to "roll back the desert" as suggested by the popular publication, why should one stop on reaching the boundaries of the Sahara, the Gobi Desert, or for that matter the Australian Desert? Put this way it can be seen that such suggestions of technological superiority and what money can do if UNEP had it, do make it very difficult to define desertification correctly and to concentrate on areas where efforts to halt, control or contain land degradation are likely to yield real fruits. As long as the issue remains politicized, donors will be reluctant to continue funding it or to increase funding.

A review of concepts and definitions of desertification outside UNEP

Definitions as well as conceptualization of desertification by individual scientists are always value-loaded, with some emphasizing climate, and in particular prolonged droughts or "desiccation" as an essential element, others more concerned with the partial or total loss of biological productivity, others seeing good prospects of recovery provided climate co-operates, while others, especially those who work in desert research institutes, hold out no hope for recovery. These divisions of opinion have always existed even prior to UNCOD, but some scientists appear to have hardened their stand at and since UNCOD, probably to keep the political case for anti-desertification programmes strong. But it is important for UNEP to be aware of all the varying shades of opinion even if it wants to take the political line for fund-raising purposes.

An early and unbiased indication of thinking by scientists can be seen from the work of Le Houerou who, in 1959[28], from his work in Southern Tunisia, came to the following conclusion:

"In the case of Southern Tunisia it is man who has made the desert, climate is only a favorable circumstance."

This view was confirmed at a National Seminar on Desertification held in Tunisia in 1972 when the participants concluded that:

"Desertization (or desertification) is a man-induced phenomenon; there is no evidence of increased climatic aridity during the period of instrumental record"; and:

"Desertization (or desertification) is a result of high 'demographic pressure' which results in generalized overgrazing, clearing of natural pastures for cereal production and over-cultivation of sandy soils, destruction of woody species for fuel and extension of mechanized farming"; and:

"These cumulative causes result in accelerated soil erosion (both water and aeolian) which in many cases leads to new desert landscapes."

The above-quoted observations have been typical of the "desertification debate" where scientists and decision makers try to define desertification by defining the symptoms and falling prey to impressionism. Also typical of this Tunisian definition under the leadership of Le Houerou was the ever-present attempt to play down or underplay the impact of climate, a feature reminiscent of many other conceptualizations and definitions of desertification. This is unfortunate because inevitably a climatic turn for the better, even if it comes after 30 years of "desiccation", may sooner or later start a process of recovery.

Professor Kenneth Hare, one of the most outstanding climatologists in the world, emphasizes that at the end of each period of prolonged drought(s) or "desiccation" there is always the chance of recovery but he emphasizes that such recovery can take decades, as can be seen from the following quotation:

"In a drought the losses can be made good, but not so in a true desiccation. Woody vegetation and organic content in soil disappear and do not return for decades. Desiccation means a loss of capital stock, a writing off of assets, perhaps also permanent impoverishment."
(Hare,K., 1988)[12]

It is the feeling of this paper that many of the definitions of desertification that have been reported in the Sahel, in other parts of Africa and even in Asia, North and South America, have been closer to Kenneth Hare's "desiccation" because they are definitions derived from symptoms which have ignored the time-scale of a desiccation. But where permanent impoverishment is reached, be that in Africa or Australia (if it were not for the drought insurance schemes), the word desertification can be equated with "desiccation".

Professor Dregne defined desertification in 1977 as:

"the impoverishment of arid, semi-arid and the sub-humid ecosystems by the combined impact of man's activities and drought. It is the process of change in these ecosystems that can be measured by the reduced productivity of desirable plants, alteration in the biomass and the diversity of the micro and macro fauna and flora, accelerated soil deterioration, and increased hazards for human occupancy."
(Dregne, H.E., 1977 Desertification of Arid Lands *Economic Geography 53* (4) pp. 322 - 333)[29]

But he was quick to add that extreme cases of irreversible desertification were few. In his view: "there are not many large areas where economically irreversible desertification has occurred". (Dregne, op. cit. p. 329)[29]

This view expressed in 1977 was overridden by the 1984 UNEP Assessment of Desertification without adequate ground research, and makes it wise to revisit it twelve years later. In short, Dregne did not want to support those who insisted on irreversibility being one of the essential elements of desertification.

The lack of consistency among the scientists in defining and/or conceptualizing the desertification problem is clearly brought out in a collection of studies put together by Professor Wolfgang Meckelein of the University of Stuttgart in West Germany, entitled *Desertification in Extremely Arid Environments* (Meckelein 1980)[7]. He has the following to say about the problem:

"The term 'desertification' is not well defined scientifically. In most cases it means the process of desert encroachment, especially caused by man interfering with an unstable

ecological equilibrium in semi-arid lands."

However, in spite of the above emphasis on the semi-arid lands, he also refers to land degradation within desert oases as a kind of desertification which he defines as follows:

"Desertification in this case means the process of deterioration of cultivated lands, which had already been wrested by man from the desert."

He ends his contribution by offering a more generalized definition of desertification as follows:

"Desertification means natural and cultural processes leading to an encroachment or intensification of desert conditions in arid lands and their marginal zones."

In the same publication Professor M. Mainguet (1980)[30] offers a valid comment to clarify the apparent confusion in terminology and concept-ualization of desertification by giving the following comment:

"Blowing sand-dunes are more linked to winds from true deserts than necessarily to a process of desertification."

Other scientists tend to prefer conceptualizing desertification as a general process of land degradation in which case it does not have to be restricted only to marginal semi-arid areas. Desertification as a term in this case would be used for resource mismanagement, and especially land degradation, in a multiplicity of environments, including areas within the deserts where localized agriculture is practiced.

Prof. Horst Mensching of the University of Hamburg, who spent many years studying arid lands in Sahelian countries like Niger, Burkina Faso, Mali and Sudan, feels it is wrong to ignore the impact of secular climatic changes as being closely linked to the process of desertification. He emphasizes that due to lack of adequate data, the scientific community as a whole does not really understand long-term climatic trends. This, according to him, applies equally to the historical period and forecasts for future centuries. However, according to him, the term desertification "should be restricted to processes whereby the ecological potential is seriously damaged or even destroyed by human exploitation..." He ends by cautioning those who would accept the idea of rapid desert encroachment and wild generalizations about the pace of world-wide desertification which is based on too limited and not always supportable evidence. (Mensching H. (1986) *Is the desert spreading? Desertification in the Sahel Zone of Africa in Applied Geography and Development*, Vol. 27, pp. 7-18)[31]

In a recent article re-visiting the "desertification debate", Professor Harold Dregne, one of the leading scientists who has steered the desertification cause along with Professors Mohamed Kassas and Jack Mabbutt, has clearly urged caution in defining and conceptualizing desertification. He has emphasized that even at UNCOD the scientists gathered agreed that desertification was a complex process, having many causes and effects. He regrets that even scientists are now repeating falsehoods about desertification in very reputable scientific journals (H. Dregne and C.J. Tucker, 1988, pp. 16-19)[25].

Professor Kassas, the first person to use the term "desertification" in an English publication in 1970 in an article entitled "Desertification versus potential for recovery in circum-saharan territories" (Dregne H. (Ed) 1970, *Arid Lands in Transition*)[32], was one of the first scientists to raise the issue of "reversibility" and "irreversibility" of the process. In the earlier stages he thought at least some of the processes were reversible. He was particularly concerned at the possibility of permanent shifts in the boundaries of vegetation zones in the arid and semi-arid lands close to the true deserts, but was prepared to wait for definitive research to settle the question. In a recent publication entitled *Ecology and Management of Desertification* (M.A.F. Kassas, Earth 1988: Changing Geographic Perspectives)[33], he has called for a clear distinction between drought and desertification. He believes that drought is a natural hazard which can be contained by proper planning.

But as far as desertification and drought are concerned he asserts that though related, they should not be confused. He defines desertification as:

"primarily a man-made ecological degradation... by which bio-productivity potential (in economic terms) of land is reduced. This is often a gradual process that operates through systems of land use that overtax inherent bio-productive capacity. Excessive reduction of plant growth destroys its ability to regenerate and deprives the soil of its protective plant cover thereby exposing it to erosion. This deterioration is exacerbated by the inherent fragility of the ecosystems in arid, semi-arid and sub-humid regions of the world. One causative of this fragility is recurrent drought."

Kassas introduces new ideas in the desertification debate, such as the observation that it can be caused just as much by the lack of population as by overpopulation.

The main area of disagreement among scientists is whether ecological boundaries are shifting because of desertification. Herein too lies the strength of the anti-desertification calls. The proponents state categorically that the work of man is destroying the semi-arid and the dry sub-humid lands so fast that there is a permanent movement of ecological boundaries, in other words, desert encroachment is winning on the outlying areas. The opponents of this argument state that apart from many but localized areas of severe ecological (especially vegetation) degradation, there are no permanent shifts in ecological boundaries and

that such shifts if they were to occur would be linked to observed, and observable, climatic change. Le Houerou and Rapp (1977)[34] were some of the earliest scientists to emphasize that the "desert boundary zone is not static but can shift over periods of years. In periods of extremely low or ill-distributed rainfall (such as the Sahelian Drought years of 1968-1973), the desert boundary can shift into surrounding lands. In other periods of favourable rainfall and low pressure of (human) exploitation, the desert boundary may shift back again, provided the degradation of vegetation and soil has not been irreversible."

Joel Schecter (1977)[35], writing about desertification in the Negev (Israel), observes that the processes associated with desertification of the Negev have been in progress for many millennia. He joins the group of scientists who consider that there has been no ecologically significant climatic change since 7000 BC or possibly even 8000 BC. He suggests caution about attributing any increase in the desert area to man alone, and points out the evidence from the Negev areas which receive 150-400 mm of rainfall per annum. In such areas he asserts, "even seemingly insignificant fluctuations in precipitation create an ecological response causing the northern border of aridity to fluctuate and the desert to expand or contract."

R.W. Dennell, in an article entitled *Archaeology and the Study of Desertification* (Spooner (Ed) 1983)[36], also calls for a longer timeview in conceptualizing desertification. He asserts that investigations into the causes, processes and even diagnosis of desertification are frequently hampered by the lack of a long timescale, and that "given the vulnerability of dry lands to the effects of minor climatic oscillations, historical climatology clearly becomes far more than a mere academic exercise with no relevance to the contemporary world."

In his view, our knowledge about the environmental changes that have occurred in drylands since the last ice age is inadequate because of poor data. We cannot speak with scientific confidence about environmental change over the last 5000 years and, according to him, an unfortunate consequence of these uncertainties is that our understanding of the long-term causes of desertification are weakened "if we do not know the extent to which present desert environments are a climatic or human product."

Ulf Hellden (1984) from Lund University in Sweden, basing his work on an analysis of a combination of old and new aerial photographs (1961 and 1979) as well as Landsat satellite imageries of the same region that Hugh Lamprey had studied in 1975 and used to claim the southward movement of the Saharan boundary of 6 km per year between 1958 and 1975, challenged Lamprey's assertions of relentless southward creep of the Sahara Desert[37]. Dregne and Tucker (1988)[25] have recently questioned Hellden's methodology offering counter-evidence based on NOAA Advanced Very High Resolution Radiometer (AVHRR) satellite data. However, since the AVHRR satellite data was based on averaged observations over a period of one year only, they too are worthless when dealing conceptually with a phenomenon which should be traced over a 30-40 year period.

In the same breath it is important to point out that the use of satellite imagery for desertification monitoring will be worthless unless it can cover periods of up to 20 years. Dregne himself admits that to study a permanent vegetation shift of 5-6 km per year as alleged by Lamprey "would require perhaps 30 to 40 years of observation by meteorological satellites and ground studies before it would be possible to conclude that the shift was, indeed, permanent."

The truth of the matter is that even within the scientific community there is a lot of loose talk and lack of precision about defining desertification and it is strongly felt that if UNEP, with all its political weight and with all its easy access, cannot get the scientists to agree, its own programmes on "combating" desertification should be more carefully worked out to prevent it from "going against nature", and trying to propose solutions to problems which are difficult to solve because even scientists are not fully agreed on how they should be tackled.

Recently the World Bank, and the International Institute for Environment and Development (IIED) have "entered the affray" by challenging UNEP's definitions of desertification and proposing alternative definitions which are more "fundable" because they can be reduced more readily into cost-benefit ratios. In an in-house paper of the newly established Environment Department of the World Bank, entitled *Dryland Management: The "Desertification" Problem*, (Working Paper No. 8, (1988)[38]. Ridley Nelson has tried to tackle the "desertification issue" and to challenge many of the basic assumptions presented at UNCOD in 1977 and subsequent programmes of action guided by the PACD. This paper severely criticizes UNEP's attitude and approach to desertification by suggesting that UNEP has over-simplified the problem in all respects.

In their view UNEP has tended to take the hard political line in the hope of raising sufficient funds to enable it to mount a sufficiently viable, and environmentally meaningful programme of anti-desertification. The World Bank Paper has offered the following alternative definitions of desertification:

"Desertification is a process of sustained land (soil and vegetation) degradation in arid, semi-arid and dry sub-humid areas, caused at least partly by man. It reduces productive potential to an extent which can neither be readily reversed by removing the cause nor easily reclaimed without substantial investment."

This definition lays more emphasis on *land degradation* and confines it to the arid, semi-arid, and dry sub-humid areas of the world, and is coined in the traditional language of the banker. But apart from removing the excesses which have been associated with the desertification debate and conceptualizing the problem, it remains essentially the same as the concerns which have been voiced by the scientific and technical communities. While laying a lot of emphasis on the real and general process of land degradation in the affected parts of the world the paper has the following to say:

"The prevention strategy of halting the desertification problem seems to have diverted attention from the more promising strategy of simply developing profitable land management systems in dry areas, and this prevention strategy seem in turn to have diverted attention from profitability. Past studies and experience have shown that farmers' and pastoralists' responses are rather well explained by perceptions of profitability and worst-year outcomes."

The question the World Bank paper does not answer is: "Where in the world, particularly in marginal areas, are successful and sustainable agricultural or pastoral pursuits found without much subsidy from governments to protect them from the effects of prolonged droughts and general land degradation?"

Nevertheless it is gratifying to see that at the end of a fairly comprehensive analysis of the problem, the World Bank paper concluded that the Bank should "probably somewhat increase its lending in dryland areas over the pre-1987 level because of the possibly very high costs of inaction." And the paper admits in conclusion that for the Bank and its borrowers: "improved dryland management must be addressed, over the next five years, as one of the major and most intractable global development issues".

The position held by the IIED is inclined towards equating desertification with *land degradation* which interferes with its continued availability as a basic natural resource. They show a preference for the definition of desertification in its most unambiguous form as follows:

"Desertification is the notion that the extent of deserts - dry areas with few plants - is increasing, usually into the semi-arid lands."[39]

Thus defined it conveys the original meaning which Aubreville in 1949 had intended.[3]

According to the IIED paper prepared by Andrew Warren and Clive Agnew (1988)[38], there has emerged an unacceptably loose use of the term "desertification" globally, to include all forms of land degradation including those in humid areas. According to the paper, most reports about desertification base their arguments on a litany of statistics, themselves derived from conflicting definitions. They are in favour of separating the climatic true deserts from the semi-arid lands and warn against efforts to measure the advance of the deserts' edge because of the lack of accurate data and because of scientific disagreements about definition.

Since most scientists believe in the loss of vegetation as a primary indicator of desert-ification, they examine the available evidence and come to the conclusion that from Aubreville's time in 1949, "acute devegetation has been shown repeatedly to affect only small parts of the semi-arid landscapes."[39] The report accepts progressive decline in productivity as a more appropriate way to conceptualize desertification, and for this they would prefer the use of the term *land degradation* rather than "desertification".

In the final analysis the paper is against the use of desertification as an "institutional fact" for fund raising purposes if it is not sufficiently supported or supportable by science. They end by proposing their own array of solutions to the *land degradation* problems which, in fairness, must be measured against other solutions and especially the very comprehensive ones which had been proposed in the PACD.

With the recent new advances in the study of climatic impacts and possible climatic change, a group of scientists who prefer to take a longer view of natural processes, as appropriate, has raised the question as to whether in conceptualizing desertification we are not missing the point by not linking it to global climate change and to warming (especially greenhouse warming). In a recent article entitled *Global Prospects for the Prediction of Drought: a Meteorological Perspective*, Eugene M. Rassmusson (1988)[40] has classified desertification, deforestation and greenhouse warming together as anthropogenic effects of the climatic change saga. In his view they together are more closely related to questions of climate change than climate variability.

Thus, before concluding, it is fair to say that there is now a strong global mood for re-assessment of earlier definitions and earlier basic assumptions about the process of desertification. Opinion is swinging in the direction of seeing desertification as a slow and insidious process of *land degradation*, which is on the one hand exacerbated by prolonged droughts and, on the other, by carelessness in resource use by human populations. The dramatization of the processes in the form of "desert encroachment" is quietly moving

out of favour and UNEP, in planning its future strategies for anti-desertification activities, should take note of that. The new mood is aptly summarized by the recent contribution to UNEP's *Desertification Control Bulletin* · (1988, No. 16, pp. 16-19)[25] by Harold E. Dregne and C.J. Tucker in the following manner:

"Desertification is a term that evokes visions of an expanding Sahara destroying villages, water supplies and fields in its path while sand dunes move inexorably forward like waves on the ocean. In fact, desertification does bring destruction to peoples' livelihoods and land resources, but usually in a stealthy and insidious fashion which is usually less dramatic than burying a village under moving dunes."

It is to this slower and more insidious process of land degradation that the World Bank and the IIED subscribe and call for research and a better understanding and new conceptualization to make any new proposed anti-desertification programmes more meaningful.

A similar word of caution has come from a scientist and practicing ecologist of many years experience in Africa and the dry parts of the United States, Allan Savory, who has the following to say:

"Politicians more than those in any other profession, have most difficulty in overcoming the temptation to ignore cause and effect... The worldwide response to desertification shows how people may fall into the same trap without the slightest trace of cynicism"; and:

"When leaders face a problem and have money, they come under great pressure to act somehow, anyhow." (*Holistic Resource Management*, 1988, pp. 294)[41]

In his view there is probably now an adequate understanding of the symptoms of desertification, but in order to find a true solution to the problem there is need to understand better the process and if possible to be able to modify it. Such a modification must be preceded by a new definition and a re-assessment of what technology can and cannot do.

Programmatic implications of the definition problem

Following UNCOD and the PACD, UNEP, as the UN agency charged with co-ordinating the global anti-desertification programme, was expected to interpret the PACD in such a way as to begin to realize the following four objectives, among others:

- To *prevent* and arrest the advance of desertification;
- Where possible to work towards the reclamation on a global basis of desertified land for productive use; to sustain and promote, within ecological limits, the productivity of arid, semi-arid, sub-humid and other areas vulnerable to desertification with the view to improving the quality of life of their inhabitants;
- To help prevent deforestation — especially in so far as it affected semi-arid and sub-humid lands; and:
- To help halt declining availability of groundwater and surface water - as a result of human activities.

The value of this standardization of indicators was to make it possible to compare progress in anti-desertification strategies from one part of the globe to the next, but it is legitimate to ask whether this approach did not in fact tend to oversimplify a problem which had proved particularly difficult to conceptualize.

"Ecological messages" and even more generally what can be called "environmental messages" are not always easy to put across to governments throughout the world, largely because in the initial stages no one wants to feel particularly responsible for the environment until public opinion has been so aroused that something has to be done. But in this case the question to be asked is: "Is the desertification constituency outside the normal development constituency?" If UNEP adopted the former, it would insist on the creation in each country of a Desertification Control Unit, and a National Plan of Action to Combat Desertification. If on the other hand it adopted the latter "constituency", then UNEP would work towards the development of strong multi-disciplinary teams within each country and the incorporation, as well as the full integration, of anti-desertification measures within the normal national development planning processes.

The second programmatic consideration linked to the definition of desertification refers to the time-scale over which intervention is envisaged and whether such intervention is carried out separately or as part and parcel of national development programmes. Defined ecologically, corrective measures to "control" or even to "combat" desertification must be viewed over a 15-30 year period and, if the complications brought about by climatic variations are added to the equation, it may even be necessary to think in terms of 30-50 years for recovery to take place. It is not clear if UNEP ever gave serious enough thought to the time-frames implicit in the definitions adopted for desertification.

The Action Plan in a way oversimplified the required activities for UNEP by suggesting that they could be divided out as follows:

- Those activities primarily aimed at "arresting" desertification;

- Activities aimed at establishing sound and ecologically sustainable land use systems; and:
- Activities aimed at ultimately bringing about the social and economic advancement of the communities previously affected by desertification.

It is sufficient to emphasize that none of the above activities is amenable to a "crash programme".

In the period between major assessments, such as now, it pays to re-visit earlier definitions and to prepare for future programmatic changes, if these are considered necessary. Critics of UNEP and, in particular, of its anti-desertification strategy have suggested that "with the wrong problem planted in the minds of decision makers, some of the policies adopted to fight the loss of sand have been 'futile and even damaging'. This can affect the lives of millions of people since land degradation is a major ingredient in the recipe for famine." (Bill Forse, *New Scientist*, 4 February 1989 p. 32)[42]

In response to this it must be pointed out that UNEP has rightly concentrated most of its anti-desertification activities at the national level with supporting activities, particularly new institutions and training, being sponsored at the sub-regional and regional levels. To that extent there was a tendency to insist on the need for the formulation of National Plans of Action to Combat Desertification (NPACD).

However, on realizing that most nations, especially the developing nations in Africa, Asia and Latin America either found it difficult or inappropriate to establish separate anti-desertification units in their own countries, it has proved possible to shift the emphasis in such a way as to promote anti-desertification programmes which are part and parcel of national development planning. From the point of view of fund raising this should also prove more acceptable, especially since bilateral and even multi-lateral funding agencies have indicated their preference for dealing with individual countries. In dealing with individual countries, UNEP can in fact begin to introduce the changing views about the conceptualization of desertification while encouraging them to produce comprehensive anti-desertification programmes to be incorporated in national development plans. This should be in keeping with national aspirations as each country will tend to prioritize its anti-desertification activities in such a way as to prevent internal conflict.

In view of the continuing disagreement among scientists on how best to define desertification, UNEP should continue to emphasize the part played by man in bringing about *land degradation* in particular and his responsibility for rehabilitating degraded natural resources in the interest of sustainability for future generations.

The word "desertification" has now acquired an inexactitude and a notoriety which in some respects prevent it from serving mankind in a more focussed way. Short of holding another UNCOD, it would be difficult to prevent its misuse by the various groups, including some scientific circles. Nevertheless efforts should be made by UNEP to focus much more on the *land degradation* aspect and desertification strategies at all levels, in particular at the national and grass roots levels. The guidelines contained in the PACD are still largely valid as an indicator of what should be done at all the various levels to stop deterioration and severe land degradation.

Finally, it appears that for fund raising purposes UNEP has tended to underplay the role of climate and especially of desiccation in helping to explain desertification. If indeed climate is changing through a combination of factors, including human activities, then there is likely to be an increase in the occurrence of severe droughts which reflect directly in land use, particularly in the lands located in the semi-arid and sub-humid climatic zones of the world. It is in these zones where the impact of droughts is immediately felt in the field of food production, thereby striking at the roots of the societies which inhabit these lands.

A global drop in food production is bound to be felt at all levels of human society, hence the need to keep desertification as an important global issue on the United Nations agenda. In so far as UNEP has been entrusted with providing leadership at the world level in finding solutions to these problems, it should continue with efforts to understand better the problem, even if this will mean a complete re-definition of the word "desertification" and more emphasis put on *land degradation*. This may mean less emphasis on the impact of desertification on environmental quality and more emphasis on the socio-economic as well as the political impacts of this phenomenon.

In that respect the following is offered as a possible compromise definition which should satisfy the scientific as well as the development communities: "*Desertification* or *land degradation*, is the process of *land degradation* characteristic of the arid, semi-arid and sub-humid areas of the world. The process, which is largely human-induced, is normally exacerbated by adverse climatic conditions such as prolonged drought or desiccation, which enable it to strike at the land resource base by weakening the physical, biological and economic potential of the land, thereby severely reducing or curtailing overall productivity."

So far this paper has concentrated on the scientific aspects of the desertification problem, including the various definitions and how they have been interpreted by UNEP for programmatic purposes. In the final analysis however, what is achieved at the national, sub-regional, regional and international levels depends on collective political will to get things moving, even in the

Goats attempt to graze on the sparse shoots of grass that push up through the rocky soil. (Photo: Nina Darnton)

absence of complete information.

It would be erroneous to give the impression that UNEP has over the last 12 years achieved nothing or little. The truth is that even in the absence of complete information, UNEP has developed a viable and consistent approach to the problem of *land degradation/desertification* and has made clear-cut programmes to achieve its objectives. Since 1978 UNEP has been able to give a clear-cut international leadership in working towards the consolidation of international efforts to "combat" desertification. In this worthy task it has asked for and received support from the Environment Co-ordination Board, DESCON and regional and national efforts to "combat" desertification on the lines spelled out in the PACD.

Among the success stories was the creation of an enlarged United Nations Sudano-Sahelian Office (UNSO) as a joint responsibility of UNEP and UNDP. Even if it is now being suggested that the action programmes were inadequate and even "misguided", UNSO has been able to realize tangible international financing for anti-desertification programmes in at least 18 countries, first in Western Africa and recently in Eastern Africa. UNSO was created to provide on the spot and close supervision of activities and programmes in the region as well as at the national level. If it were not for donor resistance, the UNSO module should have been replicated in other regions such as south-west Asia and Latin America which are equally affected by *land degradation* or *desertification*. Granted that more than 75 percent of UNSO projects have fallen within agriculture, forestry, range management

and energy, but indirectly they have enabled the countries and the region concerned to make a start in addressing the problem.

The activities of UNEP, working in close collaboration with DESCON, IAWGD, the Environment Co-ordination Board as well as national institutions, many of them newly created, has led to the development of programmes and strategies which have directly addressed the problem.

The other main area of achievement already mentioned has been in the field of public awareness. This has had the very welcome effect of generating national, bilateral as well as multi-lateral programmes to "combat" desertification which would not have existed in the absence of UNEP's leadership. And now that there is a clearly-stated donor preference for national as well as regional anti-desertification projects, this should be given every encouragement with UNEP coming in to assist in the formulation of viable national action programmes incorporated within national development plans. If it is also true that donors would prefer the term *land degradation* instead of *desertification* there will be no strong scientific argument to counter this.

In conclusion the position of the ACC must be reiterated, that desertification, however defined, is a vast field and UNEP cannot be expected to go it alone. It is at once a developmental, as well as an environmental problem. Action to "combat" desertification must be long-term, which is not always politically popular because the results may not be realized within a five year period, the normal time-frame for political decisions followed by functioning agencies. For UNEP it may be best to sharpen the definition of desertification to enable it to do what it can do best with limited funding. One such area is in the field of creating global awareness for understanding the process, even if it is called *land degradation*; such global awareness should be aimed at stimulating action at the national and grass roots levels where it matters most.

The second area of concentration should be to continue to give leadership to other UN agencies which have the capacity to carry out programmes which complement those of UNEP in dealing with desertification. If it can continue to harmonize activities in the two main areas, it will be able to build a basis for the long-term application of programmes designed eventually to address those aspects of desertification which can respond to corrective measures.

References

1 UNEP (1978) *Compendium of Legislative Authority* 1972 - 1977, Nairobi, UNEP

2 UNESCO (1963) Changes of Climate. *Proceedings of the Lomé Symposium*, Paris, UNESCO

3 AUBREVILLE, A. (1949) *Climats, forêts et désertification de l'Afrique tropicale*, Société d'Editions Géographiques et coloniales, Paris

4 DESPOIS, J. (1973) The crisis of the Saharan oases in D.H. Amiran, et al (Eds) *Coastal Deserts*, Tucson

5 ECHALLIER, J.C. (1972) *Villages, déserts et structures agraires anciennes du Tonat - Gourara (Sahara algérien)*, Paris, p. 122

6 MECKELEIN, W. (1976) Desertification caused by land reclamation in deserts: the example of the New Valley in Egypt. *Pre-Congress Symposium K 26, of XXIII Int. Geog. Congress*, Working Group on Desertification in and around arid lands, Ashkabad, U.S.S.R.

7 MECKELEIN, W. (1980) *Desertification in Extremely Arid Environments*, Stuttgarter Geographische Studien, Band 95; I.G.U. Working Group on Desertification in and around Arid Lands - Sub-group Extremely Arid Environments

8 EVENAYORI, M. et al (1971) *The Negev: The challenge of a Desert*, Cambridge, Mass., Harvard University Press

9 NOVIKOFF, G. et al (Eds) (1975) *The desertification of rangelands and cereal cultivated lands in pre-Saharan Tunisia*, Tunisian pre-Saharan Project Times

10 RAPP, A., LE HOUEROU, H.N. and LUNDHOLM, B. (Eds) (1976) *Can Desert encroachment be stopped?* Stockholm, SIES

11 UNEP Governing Council (1974) Report of the UNEP Governing Council

12 HARE, K. (1987) Drought and Desiccation, twin hazards of a variable climate in WILHITE, D.A. et al (Eds.) (1987) *Planning for Droughts; towards a reduction of societal vulnerability*, Boulder and London, Westview Press

13 WILHITE, D.A and GLANTZ, M. (1987) Definitions of Droughts in Wilhite, D.A. et al (Eds) op. cit.

14 UN (1977) *Round-up Plan of Action and Resolutions*, United Nations Conference on Desertification

15 BRINK, Per (1976) Present knowledge of arid ecosystems - in Rapp et al, op. cit. (see ref. 10)

16 UNCOD (1977) *Climate and Desertification* (A/CONF.74/5)

17 UNCOD (1977) *Ecological Change and Desertification* (A/CONF.74/7)

18 UNCOD (1977) *Population, Society and Desertification* (A/CONF.74/6)

19 UNCOD (1977) *Technology and Desertification* (A/CONF.74/6)

20 UNCOD (1977) *Overview Document of UNCOD* (A/CONF.74/1/Rev.1)

21 SPOONER, B. and MANN, H.S. (Eds) (1982) *Desertification and Development*, London, New York, Academic Press

22 FAO/UNEP (1982) *Provisional Methodology for Assessment and Mapping of Desertification*, Rome, FAO/UNEP

23 STEBBING, E.P. (1935) The encroaching Sahara: the threat to Western colonies, *The Geographical Journal* No. 85: pp. 506-204

24 STEBBING, E.P. (1938) The advance of the Sahara: *The Geographical Journal* No. 91: pp. 356-359

25 DREGNE, H.E. and C.J. TUCKER (1988) Desert encroachment in *Desertification Control Bulletin* No. 16, pp. 16-19

26 LAMPREY, H. (1975) *Report on the desert encroachment reconnaissance in Northern Sudan, 21 October to 10 November 1975*, UNESCO/UNEP, Paris, Nairobi p. 16

27 UNEP (1987) *Rolling back the desert: Ten years after UNCOD*, UNEP, Nairobi

28 LE HOUEROU, H.N. (1972) In National Seminar on Desertification, Tunis

29 DREGNE, H.E. (1977) Desertification of Arid Lands, *Economic Geography 53* (4), pp. 322-331

30 MAINGUET, M. (1980) In Meckelein 1980 (see ref. 7)

31 MENSCHING, H. (1986) Is the desert spreading? Desertification in the Sahel Zone of Africa, *Applied Geography and Development*, Vol. 27, pp. 7-18

32 KASSAS, M. (1970) Desertification versus potential recovery in circum-Saharan territories - in DREGNE, H.E. (1970) *Arid Lands in Transition*

33 KASSAS, M. (1988) Ecology and management of desertification, *Earth 1988: Changing Geographic Perspectives*

34 LE HOUEROU, RAPP et al (1977) *Sahelian Drought Years of 1968-1973*

35 SCHECTER, J. (1977) *Israel Case Study* (UNCOD A/CONF./74/20)

36 DENNELL, R.W. (1983) Archaeology and the study of desertification in Spooner (1983), op. cit. (see ref. 21)

37 HELLDEN, U. (1984) *Drought impact monitoring*, Lunds Universites Naturgeografiska Institution, Lund, Sweden

38 WORLD BANK (1988) *Dryland management: the desertification problem* by Ridley, Nelson - Working Paper No. 8

39 WARREN, A. and C. AGNEW (1988) *An assessment of desertification and land degradation in arid and semi-arid areas*, IIED Paper No. 2, November 1988

40 RASSMUSSON, E.M. (1988) Global Prospects for the Prediction of Drought; a Meteorological Perspective

41 SAVORY, A. (1988) *Holistic resource management*, Washington D.C., Island Press

42 FORSE, B. (1989) *New Scientist*, February 1989, p. 32

Sahara and Sahel Regional Observatory

UNEP was invited to an international colloquium organised by the French Government in June 1990 to launch their Sahara and Sahel Observatory (OSS) programme.

The aim of OSS is to give new impetus to the fight against drought and desertification by supplementing and strengthening the existing structures for drought and desertification in twenty countries of North, East and West Africa.

OSS' preliminary programme is made up of three components:

Component one - to reinforce the structures for the observation and continual monitoring of the physical and biological parameters of the desertification process with the ultimate aim of setting up co-ordinated systems of information among North, West and East Africa.

Component two - to develop scientific research on different types of vegetation and its fitness for drought conditions; on water resources and their use; on soil and methods of controlling fertility and erosion; and on socio-economic aspects.

Component three - to test, disseminate and promote methods of prevention and correction of desertification and to analyse existing agricultural and pastoral production systems and their reactions to drought.

OSS also aims to promote North-South and South-South co-operation and information exchange between scientists and to promote good relations between southern scientists and the major international environmental programmes. OSS will co-ordinate collaboration at all levels between existing bodies, including the Interstate Committee for the Fight Against Drought in the Sahel (CILSS), the Intergovernmental Authority on Drought and Development (IGADD), the International Centre for Mediterranean Higher Agricultural Studies (CIHEAM) and numerous regional and international organisations already involved in this field.

OSS obtained political support from the seven major industrialized nations at their July 1989 economic summit in Paris and will also involve other industrialised countries which have signed agreements with the African states involved and multilateral organisations such as the European Community, the World Bank and UN agencies, particularly the United Nations Sudano-Sahelian Office (UNSO).

UNEP and OSS

UNEP is working with OSS in a joint project implemented by UNEP-DC/PAC, the French Institut Géographique Nationale (IGN) and Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM), which aims to develop a new methodology to assess ecological changes in the Sahelian Zone of West Africa (see report below).

The French government has made $US 10 million available to OSS for the first year which will be used to co-ordinate activities.

OSS and UNSO

UNSO is co-operating with the development and implementation of the OSS programme, in particular with the first two components to evaluate and strengthen the observation system and carry out research projects.

Observation system: For 18 weeks between March and July 1990 an UNSO mission of three experts, covering the principal fields relating to the observation of drought and desertification phenomena, visited the region to take stock of the present situation and to make proposals for action. Their task was to establish a file of existing international, regional and national experts, institutions, agencies, programmes and projects, specifying their objectives and activities and the staff and type of equipment available to them. This inventory will concern all agencies and programmes working in the field of agro-meteorological and ecological monitoring and natural-resources cartography based on remote sensing. The mission also defined the respective roles of national and sub-regional institutions with a view to optimising their resources and improving co-ordination and co-operation.

The UNSO mission also aimed to identify constraints and problems and to point out the strengths and weaknesses of existing institutions and current programmes. Their objective was to make relevant recommendations for achieving OSS' goals, including preliminary proposals for a subsequent study of ways and means of harmonizing data-collecting and data-processing procedures and techniques and improving channels of communication.

A report is currently being compiled at UNSO headquarters in New York and will be studied at a series of regional workshops to be held in North, West and East Africa in early 1991. The list of participants and the agenda for these workshops will be proposed by the UNSO mission.

Current state of research: The aim of OSS' research component is to develop interdisciplinary scientific research on production systems that are viable ecologically, economically and socially.

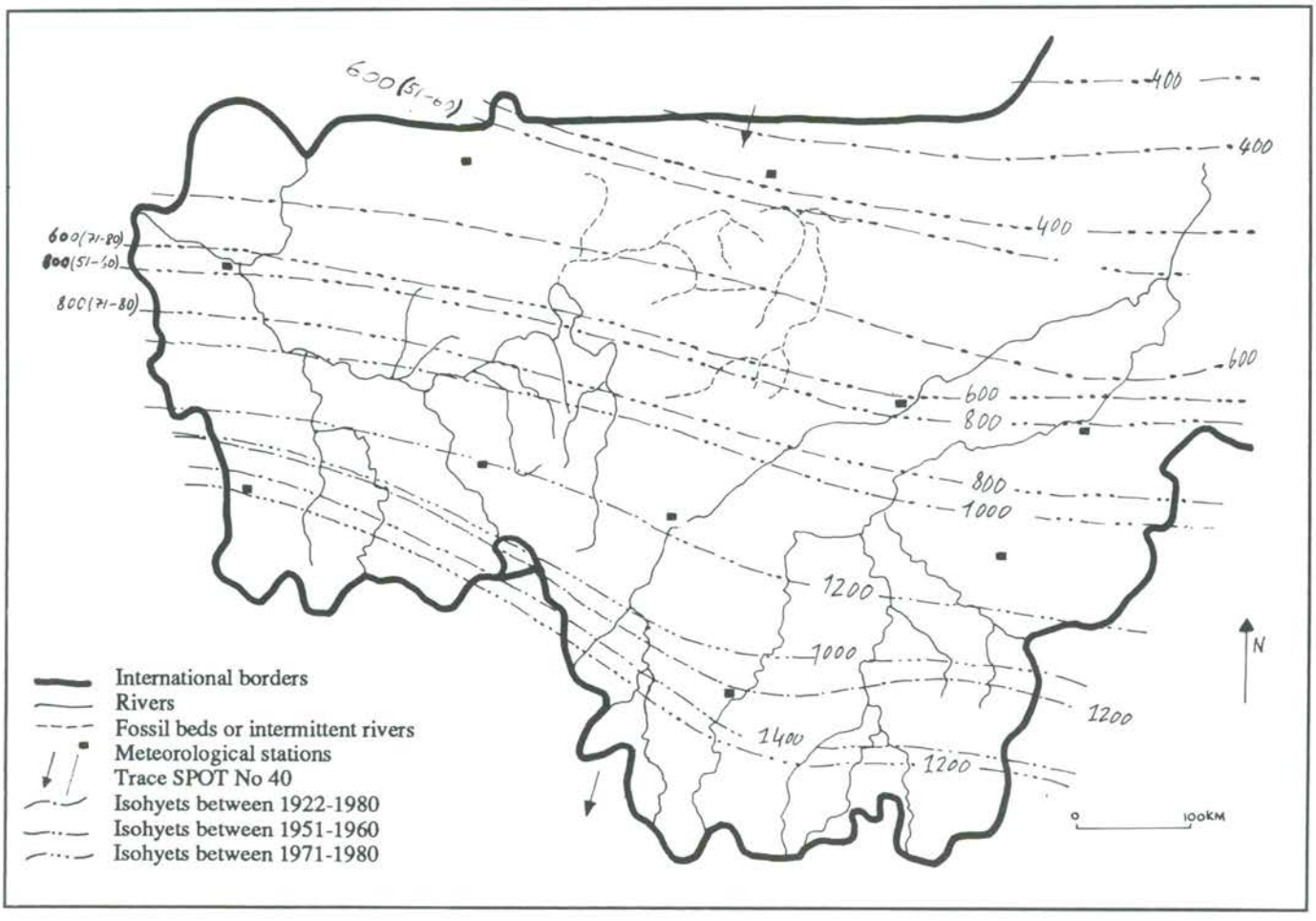
An UNSO mission made up of two teams of three expert consultants covering the principal research fields relating to the fight against ecological degradation and

desertification visited the OSS region from June-October 1990. The object of the mission was to establish a file of existing national and regional institutions, agencies, programmes and projects that conduct scientific research connected with the management of natural resources, to specify their strengths and weaknesses, objectives and activities, and the staff and type of equipment available to them.

The mission also studied proposed research programmes awaiting financing, identified gaps in present research and made preliminary proposals concerning the necessary measures to be taken to enable research organisations to establish coherent programmes. The UNSO consultants also evaluated the possibilities of strengthening the exchange of experience among countries covered by the OSS programme with a view to improving co-operation.

The mission drafted its report in Paris in October and proposed an agenda and list of participants who will study the finalised mission report at a series of regional workshops to be held in North, West and East Africa in early 1991.

Assessment of Desertification in the Sahel



The areas most affected by land degradation are between the 600-800mm isohyets. The main reason is thought to be population pressure.

As part of its Sahara and Sahel Observatory (OSS) programme, France is co-operating with UNEP's DC/PAC to develop a methodology for assessment of desertification in the southern Sahara's arid, semi-arid and sub-humid ecozones.

The methodology grew out of DC/PAC field experience in the Sahelian region in 1985. The pilot study in implementing the new methodology is now being carried out in the Western Sahel by the Institut Géographique Nationale from France. It is financed jointly by UNEP and the French Government.

The pilot study is a systematic attempt to find a method for assessing desertification which is precise enough to translate easily into field action and, at the same time, is general enough to allow for it to be adapted at reasonable cost for implementation in the wide-range of

areas involved. It measures objectively the evolution of ecosystems by combining direct ground observations with detailed comparative photo interpretation from 1:50,000 scale aerial photographs taken in the 1950s and in 1987, under technical conditions as similar as possible to the old ones. These interpretations are supported by SPOT satellite images which allow cartographic adjustments of the aerial photographs.

For the pilot study it was decided to limit the exercise initially to two transects, roughly perpendicular to the boundaries between ecological zones. Detailed analysis was made in three test areas of approximately 60,000 hectares in each of these zones, ie arid, semi-arid and sub-humid regions.

The number of features studied are limited to those which are well defined and can be well distinguished from each other in both sets of aerial photographs. To avoid any possible misinterpretation, as a first step, any element which cannot be observed in the aerial photograph and on the ground was eliminated. A report on the results obtained from the analysis of three test areas in West Mali demonstrated successfully that 18 land-use patterns could be distinguished and respective changes over the last 30 years quantified.

Based on these encouraging results, the project has been extended with proposed additional funds to be provided equally by UNEP and France. The object of this extension is to test the possibility of using high resolution satellite imagery instead of a second set of expensive aerial photographs for the quantification of ecological changes in the Sahel. To support the same objective, statistical methods using the initial approach of comparative photo-interpretation are included in the research programme.

The end result of this project is expected to provide a reliable and cost effective method for qualitative and quantitative assessment of desertification throughout the sahelian zone of Africa and similar ecozones elsewhere. However, more research is needed before scientists can fully identify the potential of remote sensing for the various applications.

Possible future co-operation between UNEP and France under the OSS programme will focus on environmental monitoring in desertification prone countries using geographical information systems (GIS) and the establishment of a desertification database system.

Cairo Programme for African Co-operation (AMCEN)

Delegates to the third session of the African Ministerial Conference on the Environment (AMCEN), held in Nairobi in May 1989, were addressed by the Executive Director of UNEP, Dr Mostafa K. Tolba, who was concerned by their governments' lack of action in response to the Cairo Programme for African Co-operation.

The Cairo Programme for economic recovery for Africa was conceived and approved by African governments for implementation, basically by the African people themselves. It anticipated the declaration made by the African Group at the 1986 UN Special Session which said that "Africa has taken the main responsibility for its own development".

The Cairo plan was designed to cope with complexity, emphasizing effective co-ordination and inexpensive projects that rely on Africa's abundant local enterprise and initiative. It is dedicated to bolstering self-reliance and co-operation, leaving donor nations to assist in a subordinate role and was designed to be immune to policy shifts imposed from outside.

Pilot projects implemented under the Cairo programme were to be financed by a five per cent levy on United Nations Development Programme (UNDP)/Indicative Planning Figure (IPF) allocations, to be earmarked by the governments involved, which would have brought in an average of US$ 440,000 per country over a five year period. UNDP regional budgets were also to be tapped to support the networks and other regional components. UNEP and the AMCEN bureau were committed to raising additional funds from other sources, but most importantly, African governments were expected to mobilize indigenous resources and expertise.

Their inability to do this, and their failure to make the Cairo Programme a priority in national development plans were the main concerns expressed by Dr Tolba. He said that the apparent lack of commitment by governments concerned was the main reason that AMCEN's Inter Agency Working Group (IAWG) has not, so far, provided fully-fledged technical and financial support. The donor community will only give first priority to AMCEN activities when African governments demonstrate their willingness to implement them.

Dr Tolba also commented that some countries had asked UNEP to formulate and design their projects, instead of using local experts, and had also been unwilling to cover the costs of their experts' and institutes' participation in meetings relating to AMCEN.

He suggested that governments critically review the commitments they made in Cairo to the pilot projects, networks and committees and should agree on concrete measures to speed up progress. If necessary, targets and timetables should be amended and solemn undertakings made to stick to the new programme.

Dr Tolba also recommended that governments radically re-examine the role of UNDP/IPF and the financial arrangements for all the components of the Cairo Programme, including the establishment of a separate Secretariat financed by a Trust Fund. He said they should also consider what type of concrete support they should provide to their experts and institutions participating in network activities and what specific support they should provide to governments hosting the Regional Co-ordination Network units and the secretariats of the individual committees.

However, despite his critical assessment of slow progress to date, Dr Tolba said that some success has been achieved. He pointed out that six of the priority networks are in the process of formulating programmes, and in a few cases implementation has begun. He said that under the committees, an encouraging start has been made, especially in the case of arid lands and river and lake basins and that 21 countries have prepared village and stock-raising projects, indicating that with some effort the original aims of the Cairo Programme could still be realised.

"Given the nature of the projects results may be slow in coming, but we can be confident that their benefits will last for the well-being of this and future generations," said Dr Tolba.

But he reiterated that the Cairo Programme is an African Programme and, ultimately, its success or failure will be decided by the collective will of African governments.

AMCEN Projects in Southern Africa

The aim of AMCEN pilot villages is to achieve self-sufficiency in food and energy by using the traditional skills and expertise of the villagers in economically feasible, environmentally sound and socially acceptable development.

However, the implementation of AMCEN village pilot projects in Tanzania, Mozambique, Zimbabwe and Zambia is not as impressive as it could be, according to DC/PAC's Senior Programme Officer, Mr Stanislaw Sangweni, who visited these countries in February-March 1990.

The projects are at a standstill because of lack of funding (apart from Zimbabwe) and because they are not considered a priority by any of the countries' Ministries of Finance/Planning. In their view the AMCEN projects are little different from the traditional rural development programmes that have been carried out in their countries over the last twenty years.

However, since there is every evidence that the AMCEN projects are technically and substantively different from the traditional approach towards rural development, officials from environment agencies in all four countries were keen to attend UNEP's proposed training/workshop, based on the Chinese approach to sustainable food and energy production, to be held in China later in 1990 (see report below). They saw the ecologically-sound practices employed by the Chinese as clearly what the AMCEN pilot projects purport to demonstrate and stressed that villagers themselves, as well as government agencies and officials concerned with funding should be invited to participate.

Mozambique

A memorandum of understanding was signed between UNEP and the Government of Mozambique in 1979. As a result of this, it was agreed that DC/PAC would assist the National Institute of Physical Planning (INPF) with formulating a proposal for a food and energy production project at Chinhambuzi village in Manica Province. A UNEP consultant visited the area in May/June 1990 and carried out quantitative and qualitative assessments of soil conditions, topographic aspects, water resources, drainage systems, grazing capacity, land-use potential, fuel and energy requirements and surveyed crop variety suitability for the project area. The aim was to determine the form of later advisory assistance on dry and marginal lands. A 2-3 month English language training course is to be organised with the Zimbabwe government to prepare Mozambiquan participants for the Chinese eco-village workshop.

Zimbabwe

Zimbabwe received DC/PAC assistance in the preparation of four pilot villages and one stock-raising zone development programme in 1988.

The Ngulube-Sansukwe grazing and wildlife development programme in Bulimia-Mwange district, South Matabeleland is partly funded under the United Nations Development Programme (UNDP)'s Africa 2000 programme, which has also indicated its willingness to finance parts of the Kusena project, Mitare District, Manicaland.

The Mukarakate pilot project on sustainable resource management is being implemented through funding from the Canadian International Development Agency (CIDA) and the Jotshole grazing and wildlife development programme is expected to receive funding from the

Norwegian Agency for Development (NORAD).

The Kawanzaruwa village project in Mashonaland Central has not attracted funding yet but has been sent to the Government of the Federal Republic of Germany for consideration. However lack of funds has not deterred villagers from implementing some of the project's original components themselves. Homes have been built for families resettled from grazing lands to permanent villages and pastures have been fenced in to separate them from cultivated land.

Zambia

In Zambia the three project villages in Eastern, Southern and Western provinces nominated by the government have not yet received funding from donors. However, in Eastern and Southern provinces there are plans for consultancy assistance in preparation of rangeland management plans.

The Liangati village and stock-raising pilot project that was prepared in 1988 has not yet been funded, probably because of its large scale. There are now plans to try to implement it component by component. However, because of Zambia's good prospects for applying ecologically sustainable farming techniques, this project has been earmarked for participation in the Chinese workshop (see separate article). The National Research Council has developed viable biogas digester technology and installed a prototype model at Kasisi Mission Station near Lusaka airport and an agro-forestry pilot project, also near Lusaka, offers complimentary ecologically-based techniques that can be incorporated into sustainable food and energy production at village level.

Tanzania

Four proposed AMCEN integrated development programmes for Bahi division in Dodoma rural region, Namanyere and Ulemo villages in Singida region and Maswa district in Shinyanga region in Tanzania are being considered for funding by DANIDA and NORAD respectively. However, government officials sense some reluctance from donors who find the projects too large. Tanzania's National Environmental Management Council is determined to secure funding for these programmes and to go ahead with rural women-based integration projects in Ruvuma region (see below).

Government officials in Tanzania, Mozambique, Zambia and Zimbabwe have been requested to name people, in particular villagers, to participate in the Chinese workshop. All four countries are looking for bilateral funding from the Chinese government.

Representatives of AMCEN Secretariat visit Dawa village, Ghana in February 1990

Lesotho

In Lesotho the three pilot villages which were originally nominated to be developed under the Cairo concept - Mekaling in Mohale's Hoek district and Makhoaba and Hermon in Mafeteng district - have been given low priority by the government.

The integrated project of arid lands for the drought-struck southern districts of Lesotho, which was drawn up in consultancy with DC/PAC in 1988, is being implemented by UN Educational, Scientific and Cultural Organisation (UNESCO) with support from the Federal Republic of Germany.

It was recommended that immediate arrangements be made with the Chinese government to hold a workshop in August/September 1990 for SADCC countries and others, including Uganda, Kenya, Ghana, Egypt and Sudan. Chinese experts are to be asked to develop teaching materials and other workshop support measures in consultation with UNEP (see article below).

Sharing the Experience: UNEP Tour of Ecological Farms/Villages in China

Chinese ecological villages could be suitable as a model for developing pilot villages under the African Ministerial Conference on the Environment (AMCEN) Cairo programme (see article above). This was the conclusion of a UNEP mission which visited China in October 1989.

The mission, hosted by the Foreign Affairs Office of the National Environmental Protection Agency (NEPA) and the Nanjing Research Institute of Environmental Science, looked at eight sites in Beijing, Lingxia Hui, Nanjing, Anhui and Hangzhou provinces. Here, Chinese villagers are recycling organic matter as feed, biogas and for increasing soil fertility, using biomass and solar energy for fuel and light, and intensifying and diversifying their farming (see Chinese Eco-villages in News of Interest). The villages effectively show how sustainable agricultural production can lead to self-sufficiency in food, fodder and fuel and protect the environment.

Signing the Memorandum of Understanding (Photo: UNEP)

The visit to China followed discussions in 1987 between Director of UNEP, Dr M. K. Tolba and Mr Qu Geping, Administrator of the Chinese National Environmental Protection Agency, when it was agreed that a number of case studies on ecological farming practices would be identified and prepared for dissemination outside China as well as for application in Africa. Furthermore, UNEP Governing Council's 15th session noted that insufficient attention was being given to the environmental impact of agricultural policies and practices, which was resulting in loss of land productivity, genetic erosion and increased vulnerability of crops to diseases and pests. Consequently, Governing Council decided to organise a joint UN Food and Agriculture Organisation (FAO)/UNEP meeting to review methods for integrating agricultural production and environmental policies world-wide. The aim of the FAO/UNEP collaboration is to draw up ecologically sustainable agricultural policies which will improve the quality of life for rural people throughout the world. Chinese ecological farms and villages are a practical example of how this can be achieved.

Following the UNEP visit, it was proposed to hold a workshop in China for Anglophone Africa during September/October 1990. A Chinese consultant, Mr Li Zhengfang, visited UNEP headquarters in Nairobi in July/August to advise UNEP in drawing up a memorandum of understanding between UNEP and NEPA who will host the "Training Workshop on Eco-farming Villages". The memorandum was signed on 16 August 1990 by Mr Xia Kunbao, deputy director of the foreign affairs office of NEPA, and Mr A. Al-Futaih, chief of UNEP's Fund Programme Management Branch.

Mr Zhengfang, from the Nanjing Research Institute of Environmental Science, will also assist in designing a schedule and timetable for the workshop which will last approximately 6 weeks, and in preparation of training materials with particular reference to sound food, fodder and energy production. Audio-video aids, slides, wall-charts, background papers and texts on the theoretical principles behind eco-farming will be used in the workshop and will later be developed as manuals for use in the field. Mr Zhengfang will identify institutions and lecturers in China to be involved in the training and demonstration of eco-farming practices and their application in concrete situations in China. He will also identify suitably located eco-villages/farms to be toured by participants and prepare background case-studies.

It is recommended that a second workshop for Francophone Africa is organised in China for September 1991. The Chinese authorities have agreed to extend assistance to UNEP and African governments both in organising the workshops and later to offer technical assistance in implementing the projects. The workshops will be funded by UNEP's DC/PAC and Regional Office for Africa (ROA).

Some videos and written materials in English and Chinese were collected at the sites visited by the mission and these may be translated and disseminated in order to popularise the idea of eco-villages among African governments.

DC/PAC in Southern Africa

In Southern Africa DC/PAC is collaborating with member governments of the Southern African Development Co-ordination Conference (SADCC), which include Malawi, Tanzania, Zambia, Zimbabwe, Mozambique, Swaziland, Botswana, Angola and Lesotho, both nationally and through SADCC's Soil and Water Conservation and Land Utilization Unit (SWCLU). This is in accordance with UN General Assembly resolutions and UNEP Governing Council resolution 13/30 which calls on DC/PAC to assist SADCC countries in making desertification control activities an integral part of national development plans.

DC/PAC activities in Southern African countries include initiating and providing consultancy services for preparing National Plans of Action to Combat Desertification (NPACD), developing and co-ordinating sub-regional desertification control plans and activities, training in desertification control, experimentation and dissemination of appropriate technologies and developing pilot village projects in line with the African Ministerial Conference on the Environment (AMCEN) Cairo programme.

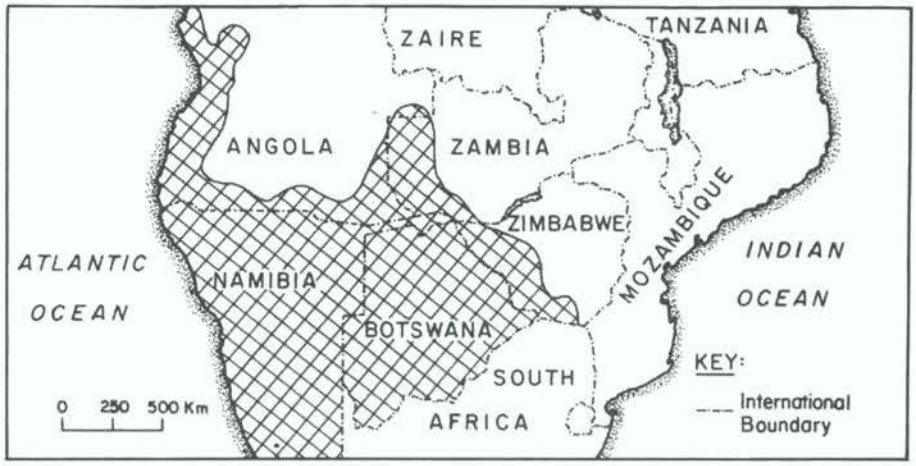
Plan of Action for the Kalahari-Namib Region

The Plan of Action for the Kalahari-Namib Region is a sub-regional action plan which reciprocates AMCEN's Arid and Desert Lands Committee (ADALCO) programme. It was initiated in response to a request by SADCC member governments to UNEP Governing Council and to the Inter-Agency Working Group on Desertification (IAWGD) to check and reverse the degradation of natural resources in the area affected by the Kalahari and Namib deserts.

The draft "Plan of Action" for the Kalahari-Namib affected areas was developed in collaboration between DC/PAC and SADCC's Soil and Water Conservation and Land Utilization (SWCLU) unit. It was approved as a priority programme by the SADCC Committee of Ministers of Agriculture and Natural Resources who met in Maseru, Lesotho, in November 1989.

Desertification in the Kalahari-Namib affected areas has received scant international attention, partly because of the relatively sparse human population in the sub-region.

The fragile arid and semi-arid ecosystems that surround the desert zone can carry only a limited number of human and animal populations and can support only minimal exploitation by man. A drought in the 1970s devastated this area and, in particular, the livestock industry was acutely affected. Now the sustainability of this sub-region and destruction of resources are reaching crisis point.



Kalahari/Namib region

The "Plan of Action" is a long-term programme for land use planning, monitoring, development and rehabilitation of natural resources and will be implemented in several phases. The aim is to set up pilot projects specifically adapted to the individual situations in each participating country and to monitor them using a methodology common to them all.

UNEP/the USSR Commission to UNEP (UNEPCOM) funded a multi-disciplinary mission, including a consultant from the region and three experts from USSR, which visited Zambia, Zimbabwe and Botswana in April-May 1990. As a result of the mission, they drew up an overall draft project document and individual national plans which were discussed at a project formulation workshop for technical officers in charge of implementing the Plan, organised by DC/PAC, UNEPCOM and SADCC and held in Bulawayo, Zimbabwe in June 1990. The aim of the workshop was to elaborate a detailed workplan for project implementation. It was attended by DC/PAC's Mr Per Mogstad, representatives from SWCLU, UNEPCOM, ADALCO, experts from USSR, and government officials from Zimbabwe, Botswana, Tanzania, Swaziland, Lesotho and Zambia.

Namibia felt that it would take some months before they are ready to participate fully in SADCC activities and did not take part in the workshop. However, government officials have expressed interest for the "Plan of Action" to SWCLU. Angola has also expressed interest

and was represented at the workshop by an Embassy official in Harare.

The workshop discussed matters related to land-use planning, natural resource management, establishment of natural resource monitoring transects running through the Kalahari-Namib, development of pilot livestock raising areas along the transects, monitoring exercises and establishment/reinforcement of the national resource monitoring institutions.

The "Plan of Action" is co-ordinated by SWCLU. UNEP's DC/PAC is funding some of the joint activities in the preparatory phase but resources for implementing the plan itself will be mobilized by SWCLU, which will also be responsible for the technical organisation of training courses, meetings and evaluation.

A training course with participants from SADCC countries directly involved in the Plan of Action will be held in the USSR in September/October 1990. A second training course for the Kalahari-Namib region will be held in Zimbabwe in June 1991. SWCLU is responsible for the election of trainees. Implementation of the projects is expected to begin in late 1991.

The Kalahari Namib Region

Bio-climatically, the Kalahari-Namib Region is composed of semi-arid areas although some sub-humid patches can be found. The climatic pattern is influenced by the South-East monsoon and, to a lesser extent, the North-East monsoon; by the cool South-West Atlantic air mass, which influences the climatic pattern in Zambia, Zimbabwe and Botswana; by the cold Benguela current and the cold water upwelling along the coast under the influence of South-Easterly trade winds, which provoke extreme aridity over the coastal areas (with mean annual rainfall of 125 mm in Angola, falling to less than 25 mm along the Namibian coast); and by the Inter-Tropical Convergence Zone (ITCZ) which has a particularly marked influence on Zambia, Zimbabwe and Botswana.

A single rainy season and cold and hot dry seasons characterise the region. An important climatic feature is the unreliability of rainfall, particularly in Botswana and Western Zimbabwe. The region is prone to drought: in Botswana there is at least one severe drought every 5 to 7 years, droughts have been particularly serious during the past 10 years. This pattern not only influences agricultural production but also contributes to the degradation of natural resources.

The Namib is a true desert with clearly identified boundaries on the North and South; on the East it passes on to the Kalahari Desert. The Kalahari is better described as grazed steppe which suggests a high grass or shrub to woody species ratio. Areas covered with sand dunes do occur, for instance in West and South-West Botswana.

Generally the Kalahari-Namib vegetation can be considered as dry shrubby or shrubby-arboreal savanna developed on poor tropical and sub-tropical soils with a low percentage of organic and nitrogen contents, with high summer temperatures and low annual rainfall (not exceeding 500-650 mm). The savanna vegetation is extremely sensitive to natural (eg drought) and anthropogenic (eg overgrazing, trampling, deforestation) factors as well as rather fragile to fire and wildlife impact; the herbage is relatively dense, forming only within the rainy season. Due to a short vegetation period and poor soils, the sod (root mat) of rangelands is frequently interrupted and rather weak causing a high sensitivity of ecosystems towards negative factors.

The introduction of livestock in the savanna eco-systems of the Kalahari-Namib region brought about serious changes in the natural vegetation, in the first place in the balance of shrubby-arboreal species and grasses. Before the active development of livestock raising in the 1920-30s the Kalahari-Namib vegetation could be defined as huge grass populations with scattered trees. Since the 30s and especially starting in the early 60s, the region's vegetation has become transformed towards a rapid shrub development and reduction in number of grass species. Most trees and shrubs are very sensitive to water and its shortage in dry periods may cause even the absence of flowering. The seeds of certain shrubs (eg Acac*ia spp.*, *Dichrostachys cinerea*) are being consumed by herbivores and distributed within the rangeland area; the seeds of other species (eg *Combretum spp.*, *Terminalia sericea*) are being distributed mainly by wind to short distances. Seasonal temperature and humidity changes influence the development of trees and shrubs causing various concentrations of nutritional substances in these species.

With overgrazing, all palatable grasses in the Kalahari-Namib region tend to disappear, being replaced by less desirable species. The Kalahari-Namib eco-systems are developing influenced to a considerable extent by fire and livestock. In the areas around watering points pastures have usually deteriorated completely. Fire is extremely hazardous for the sod

by damaging its upper part and eliminating small seeds.

Considering the rural communities alone, livestock and in particular cattle are the main resource and economic activity in the Kalahari-Namib region. Besides their traditional significance and value as storage of wealth, cattle are an important source of income, draft power, manure, food and in some cases even fuel. Crop production weighs differently from country to country, being almost insignificant in Western Zambia for instance. Nevertheless, the trend has been towards considerable growth of cultivated areas while yields remain very low. Wildlife has so far represented an important source of income to governments, in particular in Botswana, without directly benefitting the local communities. In some areas however, wildlife represents food supply for the local people and it is generally accepted that there is a great potential in wildlife development in terms of both local communities' livelihood (eg. as source of food and income) and national economies (promotion of tourism), particularly if the latter involves communities' sharing of benefits.

The combined effect of these trends is the continuous deterioration of the land resource base in the whole area and, as an unavoidable consequence, a serious threat to sustainability of agricultural production and related activities in the medium to long-term. Furthermore, the present development affects the livelihood of rural populations in general and, in particular, aggravates the situation of poverty and lack of alternative employment opportunities. Moreover, if action is not taken, the most likely result will be serious obstacles to the implementation of governments' development plans and additional stress on scarce resources elsewhere.

(Extracted from the Plan of Action for the Kalahari-Namib Region, SADCC)

Rural women-based integrated projects in Tanzania

Women being trained in afforestation projects (photo: Naoto Noda)

UNEP DC/PAC's Mr Per Mogstad visited Ruvuma district in Tanzania last December to review the proposed project villages, nurseries and afforestation sites put forward by the Ruvuma regional branch of the National Union of Women of Tanzania (UWT).

A series of meetings on the project was held with officials from Tanzania's National Environment Management Council (NEMC); members of UWT at national, regional, district and village level; regional representatives of the Revolutionary Party of Tanzania (CCM); regional forest, agriculture, water and planning officials; and representatives from the United Nations Children's Fund (UNICEF) and the International Labour Organisation (ILO).

The projects were initially proposed by UWT as an integrated part of their UWT Ruvuma implementation programme for 1984-94, which has already got underway without donor assistance. The proposed project integrates activities concerning sustainable agriculture, afforestation, nursery plot, fruit-tree, stove and water-supply. It is to be implemented by UWT under the guidance of NEMC with the aim of increasing family income and improving nutritional standards and the way of life for women in Songea, Mbinga and Tundura districts of Ruvuma in south-western Tanzania.

Mr Mogstad visited 14 of the 18 proposed sites, namely: Mshangano, Subira and Likuyufusi villages in Songea Urban district: Lilondo, Tanga, Mletele, Lumecha and Mbinga Mhalulue villages in Songea Rural district; Makako, Lipumba, Ruhuwiko, Mapera and Malindindo in Mbinga District and Cheleweni village in Tunduru District. In all these villages, deforestation, overcultivation, high rainfall erosivity, unfavourable topography and high erodibility of soils have led to serious land degradation and loss of plant cover.

In most villages, afforestation projects have already started on UWT plots and local extension officers were keen to promote indigenous tree species, particularly *Dalbergia melanoxylon* and others. However, lack of materials such as polythene tubes, pesticides, fertilizers, water and transport (for extension officers) meant that nurseries had not yet begun.

UWT suggested that problems

with infrastructure in the region have been underestimated in the project proposal and that more than one vehicle will be needed to enable extension officers to cope with the poor gravel roads and long distances between villages.

As a result of discussions held with extension officers, it was decided that the original project proposal for water-supply should also be amended since the Danish International Development Agency (DANIDA) has already carried out a water survey and assisted 35 villages with the necessary supply.

NEMC agreed to contact UNICEF, ILO and DANIDA representatives to learn of their experiences and to co-ordinate the proposed activities in Ruvuma region. They were also keen to include trials on indigenous tree species and, if possible, alternative water-lifting technology in the proposed project.

The revised project proposal has been presented to the Organisation of Petroleum Exporting Countries (OPEC) for consideration for funding. The project will be developed in line with the AMCEN Cairo Programme as a SADCC activity.

African Desert and Arid Lands Committee

The African Ministerial Conference on the Environment (AMCEN) programme drawn up in Cairo in 1985 identified four priority areas for action, namely: to halt environmental degradation; to enhance the food-producing capacity of the African continent; to achieve self-sufficiency in energy; and to correct the imbalance between population and resources.

To implement effectively these programmes AMCEN created four separate committees dealing with: rivers and lake basins, forests and woodlands, seas, and deserts and arid lands.

The African Desert and Arid Lands (ADALCO) Committee comprises a secretariat and national focal points from 30 African countries which have arid and semi-arid lands. It has provision for membership and participation of concerned UN agencies, international and regional organisations and bodies.

Its work plan for implementing AMCEN projects includes co-ordinating assistance to all 30 African governments in carrying out pilot village and pastoral zones projects. Presently only seven countries have launched such pilot projects which are under various stages of implementation, assisted by UN Food and Agriculture Organization (FAO), UN Educational, Scientific and Cultural Organization (UNESCO), UN Sudano-Sahelian Office (UNSO) and the International Labour Organization (ILO).

ADALCO is also creating an inventory of natural resources, including soils, forests, rangelands, water, minerals and population since, to date, these have been inadequately mapped and catalogued. Other plans involve researching, monitoring and surveying land degradation processes due to man's use of natural resources, such as farming, livestock raising, deforestation/afforestation, mining and manufacturing.

To facilitate resource management and conservation principles and practice, ADALCO is also implementing a comprehensive education system and is encouraging African member states to include protective legislation for the environment in their future policies and socio-economic planning processes.

ADALCO in Southern Africa

ADALCO's priority in the southern African sub-region is to control accelerated soil erosion, promote food and energy production and to combat the spread of the Kalahari/Namib desert (see previous report).

ADALCO in East Africa

At the first ADALCO meeting in Dakar, Senegal, in March 1987 the East African sub-region was not well represented and consequently no sub-regional action programme was identified.

In order to rectify this a meeting was held in February 1988 for all focal points from the sub-region to meet and select a priority activity from those defined at the AMCEN Cairo Conference in 1985.

As a result of this meeting the focal points identified the most pressing need as being the restoration of the delicate equilibrium in the East African Ecosystem, which has been destroyed by man and his socio-economic activities. However, selecting only one priority activity to deal with this problem would not achieve total restoration of the ecological balance in arid and semi-arid areas. The focal points consequently decided to comprise a number of inter-related and complementary activities to tackle the situation from all angles. These include:

- a critical re-evaluation of past, on-going and planned anti-desertification activities in the arid and semi-arid lands of East Africa so that a better framework for sustained eco-development and resource management can be formulated
- developing sub-regional co-operation on water resources management aimed at alleviating overgrazing, overcultivation and overcutting of fuelwood in order to rehabilitate degraded areas and lead towards a long-term food and energy balance

- developing ways to ensure full-scale community involvement by local people at all stages of planning and management
- finding ways to implement suitable indigenous technology, rather than adapting imported technology
- improving traditional land use systems
- exploiting locally-available alternative sources of energy and low-cost soil additives and fertilizers
- developing an accurate information system for use at all levels
- providing an alternative means of livelihood acceptable to pastoral societies who live in the arid and semi-arid areas.

The East African focal points recommended that they assist ADALCO in soliciting the political and economic will required from their national governments to resolve the problems of arid and semi-arid regions.

They also agreed to keep ADALCO informed of the current state of anti-desertification activities in their respective countries and suggested that ADALCO, through UNEP, should organise study tours for focal points within the East African sub-region to enable farmers and field workers to share practical experiences about on-going activities in desertification control.

ADALCO in North-East Africa: Nubian Sandstone Aquifer

The master plan for development of the Nubian Aquifer for Combating Desertification in North East Africa was adopted by the African Desert and Arid Lands Committee (ADALCO) following the first African Ministerial Conference on the Environment (AMCEN) in Cairo in 1985.

It is part of the UN Transnational project On Major Regional Aquifer in North East Africa. Following the UN Conference on Desertification (UNCOD) in 1977, UNEP carried out an initial regional survey on the quality and potential use of underground water for enhancing food production and reducing environmental degradation. However, more detailed research is needed before this information can be applied specifically to development of the Nubian aquifer in Sudan and Egypt.

With the aim of reinforcing the Master Plan for developing this aquifer, DC/PAC's Mr Jiri Skoupy visited both Egypt and Sudan in December 1989 to consult with United Nations Development Programme (UNDP) and government representatives and ADALCO focal points. If the project is to be successful, sound national planning and regional co-operation will be needed, which may be a long process.

The main problems in Egypt concern the way ground water is used outside the Nile region. Future projects should be based on an assessment of socio-economic, logistic and human resources constraints and should be implemented gradually.

In Sudan, the chief worry is land degradation. Future projects should concentrate on halting desert encroachment, protecting existing agricultural land and establishing small oases along desert routes.

Overall, it was agreed that the Master Plan should concentrate on reviewing and co-ordinating past and future activities by both UN and the governments concerned in combating desertification and conserving natural resources. ADALCO will draw up the basic concept of the Master Plan, including the objectives, expected results and ways the project can be implemented. ADALCO will also explore the possibility of co-ordinating activities between Sudan and Egypt by setting up a Joint Technical Steering Committee, and determine the technical and financial resources needed to implement the project successfully.

North African Green Belt

The Green Belt Project of North Africa (GBPNA) symbolizes an Arab joint effort to combat desertification. An organ of the Arab League Educational, Cultural and Scientific Organisation (ALECSO), it aims to co-ordinate anti-desertification activities between Egypt, Libya, Tunisia, Algeria, Morocco and Mauritania. Since 1977 when the programme started, thousands of hectares have been afforested and some sand dunes stabilized within these countries.

Co-ordination of national efforts within the GBPNA is secured by the Permanent Joint Committee. UNEP was responsible for forming this committee. An Executive Secretariat of GBPNA was established in Tunis to enable the Permanent Joint Committee to handle its tasks and the Technical Advisory Committee was also set up.

A meeting of the Fifth Technical Advisory Committee and the Fifteenth Permanent Joint Committee of the GBPNA was held in the Executive Council Hall of ALECSO, Tunis, 22-26 January 1990. Representatives of Tunisia, Morocco, Arab Libyan Jamahiriya, Egypt, Algeria, the Arab Centre for Studies of Arid Zones and Drylands (ACSAD), UNEP-DC/PAC, as well as the Executive Director of the Green Belt Project and directors of various departments of ALECSO were present.

These two meetings discussed on-going activities and proposed projects for the biennium 1990-1991. These projects include a second symposium for planners, leaders and desertification experts of project countries and other related Arab and international organisations; a scientific seminar on "Natural Reserves and their role in Desertification Control and Wildlife Conservation"; the propagation and

Young saplings are protected from the sun by bamboo screens (Photo: FAO)

natural regeneration of sparta plant and its utilization in North Africa; a training course on "Sand-dunes Fixation Techniques"; setting up a seed bank of North African countries; protecting and developing Tafelalet Oasis, Morocco; developing and improving Pis*tachia atlantica* plant in North Africa; sand-dune fixation and rangelands improvement at Nafta-El-Wad region; evaluating and improving a Green Belt project at Nwakshot, Mauritania; monitoring the performance and adaptability of some new plant species introduced from similar environmental conditions; multiplying and collecting seeds of native range plants with the co-operation of local peoples; future meetings of the GBPNA Permanent Joint Committee and Technical Advisory Committee; Arab and International co-operation and support to the GBPNA library.

The Executive Director presented his Technical Report outlining the status of projects for the bienniums 1982/3, 1984/5, 1986/7 and 1988/9. Each project was discussed separately and recommendations made for some of them. Special attention has been paid to the following projects: 1) a feasibility study of actions to be taken to combat desertification, 2) a feasibility study on establishing a seed bank, 3) increasing awareness through documentary films on combating desertification and protecting the environment (ARABSTAR), 4) an integrated socio-ecological study on plants and their response to grazing and seasonal changes.

Three new projects were presented and approved: the first to study behaviour and adaptations of plants from other ecological systems for use in the Green Belt Project areas. Secondly, to collect and propagate rangeland seeds, and finally, to hold a seminar on natural reserves in protected areas and their role in combating desertification.

Green Belt Project proposals are written in Arabic. It was recommended by UNEP-DC/PAC representatives to translate them into English/French and to put them into the standard UNEP format, in order to make them clearly comprehensible to potential donors.

Matters regarding studies, workshops and training courses were also discussed. The committee requested Arab member states to prepare outlines of their activities in the field of desertification to be included in a booklet on the project. It was also recommended for members to send the Executive Administration lists of national experts in desertification with their addresses and posts.

A Financial Report prepared by the Executive Administration and presented by the Finance Department staff member, contained: 1) financial accounting of the bienniums 1982/3, 1984/5, 1986/7 and the auditor's report, 2) The project's financial situation by the end of 31 December 1989, and 3) contributions of the member states and the Organisation in the budget. The committee requested member states to submit their comments on the report before the next meeting.

The committee noticed that the Organisation has reduced its contribution to the project for the bienniums 1988/9 and 1990/91 to US$ 190,000 although the fourteenth meeting (March 1987) recommended that the Organisation's contribution should be maintained at US$ 255,000.

National Plan of Action to Combat Desertification in Syria

UNEP is to assist the government of Syria in implementing its National Plan of Action to Combat Desertification (NPACD) by developing pilot projects to stabilize sand dunes and improve public health in the Jezerah Steppe for presentation to donors including the Arab Gulf Programme for UN Development Organisations (AGFUND).

Another pilot project to be funded jointly by UNEP and the Syrian government will rehabilitate saline soils in the irrigated parts of the Euphrates basin and will be implemented by the USSR Commission to UNEP (UNEPCOM).

These decisions came out of a UNEP mission to Syria in July 1988 when DC/PAC's Mr Jiri Skoupy, Regional Office for West Asia (ROWA)'s Mr A. Orabi and UNEP/ Terrestrial Ecosystems Branch (TEB)'s Mr A. Ayoub met with government and United Nations Development Programme (UNDP) officials and representatives from the Arab Centre for Studies of Arid Zones and Drylands (ACSAD). During a field visit to selected areas throughout Syria they viewed other sites where nine proposed projects are to be developed in the framework of the country's NPACD.

Dust storms and creeping sand dunes are threatening human health and cultivated areas in the Euphrates and Khator basin. Non-irrigated areas now display a visible lack of vegetation and loose soil surface due to expansion of rain-fed cultivation. Elsewhere, faulty irrigation techniques, including excessive flooding of the basin, lack of drainage, faulty levelling and poor agricultural practices in the Saalo area have resulted in extremely saline soils and a high water table at 150 cm. However, the medium to fine soil texture and high levels of calcium make this area a priority for rehabilitation.

To back up the projects, Syria's Ministry of Agriculture and Agrarian Reform (MAAR) requested UNEP's help in formulating and implementing a national soils policy and in strengthening their Soil Biology Unit (SBU). In particular, SBU needs to improve its biological nitrogen fixation and biotechnology programmes. ACSAD will assist with surveys of land and soil and provide technical support and training facilities.

During their visit, the UNEP officials toured the oasis area around Damascus and agreed to help strengthen the University of Damascus' facilities for monitoring the water quality in the Barada river. Increased urbanization and industrialisation, together with low rainfall, means the Barada river used in irrigation is now heavily polluted with city and industrial effluent containing high levels of metals.


مكافحة التصحر في سورية
خطة العمل

NPACD Syria Document

Further visits were made to the coastal plains and mountains in Latakia province, which display some of the worst signs of water erosion in Syria. Terraced land used to grow winter vegetables, food and animal crops is decaying, and fallow and sloping areas are severely eroded. A 10,000 ha reforestation project is under implementation with the assistance of the Federal Republic of Germany.

UNEP DC/PAC Training Programmes

The aim of UNEP's training policy is to create awareness of the threat of desertification and to enhance the capabilities of developing countries to deal with it in order to ensure sustainable development.

During the period 1985-1989 UNEP, in co-operation with the USSR Commission for UNEP (UNEPCOM), the Arab Centre for the Study of Arid Zones and Drylands (ACSAD), the Instituto Argentino de Investigaciones de las Zonas Aridas (IADIZA), the Governments of Argentina, Brazil, Botswana, China, Mali, Syria and the members of the Inter-Agency Working Group on Desertification (IAWGD), undertook training programmes for over 6,200 trainees (technicians and grass-roots populations) in the fields of planning for development in drylands, management and assessment of desertification, land use planning in drylands and public information in desertification control.

To increase cost-effectiveness, in 1988 DC/PAC decided to concentrate future training courses at the regional level, bringing overseas experts to participate in courses in developing countries. Evaluation of training programmes is now an integral part of training activities.

Regional Desertification Control Training Programme for SADCC Countries

Two training courses were organised for participants from SADCC countries in collaboration with UNEPCOM and the Government of Botswana. The first, held in the Desert Institute in the Turkmen SSR in September-October 1987, concentrated on Rangeland Ecology, Management and Productivity. Its aim was to train personnel in the methodologies and techniques of rehabilitating degraded rangelands and to ensure their sound management, with emphasis on increasing productivity on a sustainable basis.

This course, which had eighteen participants, consisted of theoretical sessions of lectures with round-table discussions after completion of each scientific topic, and practical field studies. The lectures were delivered by leading Soviet experts and specialists representing research and training institutions and covered various environmental aspects of desertification control, rangeland ecology, management, productivity and monitoring of pastoral ecosystems. The field study was organised in the Soviet Central Asian Republics of Turkmenia and Kazakhastan using the facilities of the Institute of Deserts (Ashkhabad) and the All-Union Sheep Breeding Research Institute (Chimkent).

On completion of the course all the trainees stressed that the training programme was a useful experience in planning of rangeland development and desertification control activities at the national and regional levels.

International Training Course on Assessment, Mapping and Monitoring of Desertification

As part of the UNEP/USSR/Arab Centre for the Study of Arid Lands and Dry Zones (ACSAD) International Project "Support to Regional Research, Training and Communication Programme on Desertification Control in the Arab States of West Asia", a training course on desertification assessment, mapping and monitoring was held in the Soviet Union in October 1989 in cooperation with the Institute of Deserts of the Academy of Sciences of the Turkmen Soviet Socialist Republic.

The course was attended by 17 specialists from Egypt, Iraq, Jordan, Kuwait, Libya, Morocco, Somalia, Syria, Tunisia, Yemen Arab Republic and two lecturers from ACSAD. It was the third training course in this field for ACSAD countries.

The main aim was to upgrade the expertise of the specialists from Arab countries and to exchange information concerning methodology of assessment, mapping and monitoring of desertification on the basis of climatological assets, types of topography, soil and vegetation cover of arid areas, including the agricultural status of lands.

Lectures were given on the present concept of desertification monitoring, general problems of desertification control and ecologically-sound management of arid environments, present status and magnitude of desertification in the world, mathematical simulation for assessment of status and rate of desertification, concept of ecologically unbalanced environments as a theoretical basis for the assessment and forecasts of the changes in ecosystems, methods to assess and forecast the productivity of rangeland, and measures to control desertification in Arab countries, among others.

Practical studies and seminars were mainly related to the use of remote sensing and ground surveys' data for interpretation of desertification processes and compilation of synthesized thematic maps. Seminars and reports were provided with visual aids, including maps, space images and slides.

Field visits were made to the Central Karakum Observation Station of the Institute of Deserts and the Repetek Biospheric Reserve's branch laboratory of irrigation on oasis sands. Here, the participants were introduced to the Institute's practices of rangelands' development, sand dune fixation, accumulation and storage of seasonal runoffs.

Rangeland and Soil Conservation in the SADCC countries

The second training course on Rangeland and Soil Conservation in the SADCC countries was organised by the Government of Botswana in conjunction with the SADCC Coordination Unit in the Botswana State University in November-December 1987.

Nineteen participants from Botswana, Lesotho, Malawi, Zambia, Swaziland and Tanzania attended the three-week-long programme which combined theoretical sessions with field work.

Lectures on various aspects of desertification were given by representatives from the Botswana Departments of Water Affairs, Agricultural Field Services (Land Utilization) and Botswana State University, as well as UNEPCOM and the Institute of Deserts, Ashkhabad. The field trip to the Kgalagadi closed the training course so that participants could observe what they had been learning about in the preceding weeks.

As a result of the two training courses, 37 specialists with relevant background and qualifications were exposed to training programmes in drylands management, the extension of new technologies, monitoring and assessment of desertification and the provision of public information. Two documents based on the training courses - Rangeland and Soil Conservation and Rangeland and Soil Conservation in the SADCC region - were prepared, published and distributed to participants,

national focal points and agencies related to desertification control.

All participants agreed that the training activities contributed to the extension of the SADCC network because close contacts between focal points were established, leading to closer co-operation between member nations in the future.

In the long-term, the project provided a direct input into the implementation of the UN Conference on Desertification (UNCOD) Plan of Action to Combat Desertification (PACD) by enabling SADCC member governments to formulate more effectively their own national programmes to combat desertification. According to the questionnaires received from the course participants, their governments are planning to incorporate PACD recommendations into national development planning programmes.

In the short-term, the training project provided a scientific basis for the formulation of projects on Assistance to SADCC countries in implementing the Regional Plan of Action for Land Use Planning in Kalahari-Namib Affected Areas (see separate article).

With this purpose, a multi-disciplinary experts mission was organised by UNEP and SADCC in April-May 1990 to collect and prepare background information about the status of natural resources in these countries. A transect for monitoring of natural resources running through the Kalahari and Namib deserts was established using joint efforts of the SADCC countries. Data collected during this mission will be used at a UNEPCOM workshop to be held in USSR in September 1990.

Research and Training in Desertification Control in West Africa

UNEP's programme of Support to West African Countries in Strengthening National Desertification Control Activities Through Research and Training has three main directions: training, research and publication.

Training: Three training courses have been held to date. The first, on Rangeland Development and Desertification Control in the West African Countries, was held in Ashkhabad, USSR in September-October 1988, for 20 trainees from eight West African countries.

The second, on Techniques of Controlling Erosion and Sand Dune Fixation, was held in Bamako, Mali, in November-December 1988 for 26 trainees from 11 countries in West Africa.

The third, on Assessment, Mapping and Monitoring Desertification, was organised in Ashkhabad, USSR, in September 1989 for 20 participants from 11 West African countries.

In all, 67 trainees were introduced to training programmes in drylands management, the extension of new technologies and monitoring and assessment of desertification techniques.

As part of the training projects the proceedings of each course have been written up into three separate booklets which are now awaiting publication and should be available for distribution to course participants at the end of 1990.

Inter-Agency Working Group on Desertification

Members of the Inter-Agency Working Group on Desertification (IAWGD) gathered for their sixteenth meeting in September 1989, hosted by UN Industrial Development Organisation (UNIDO) in Vienna. The meeting was attended by representatives from the Economic and Social Commission for West Asia (ESCWA), UN Food and Agriculture Organisation (FAO), Office of the UN Disaster Relief Co-ordinator (UNDRO), UNIDO, UN Department of Technical Co-operation for Development (UNDTCD), UN Centre for Science and Technology for Development (UNCSTD), UN Environment Programme (UNEP), UN Educational, Cultural and Scientific Organisation (UNESCO), UN Family Planning Association (UNFPA), UN Sudano-Sahelian Office (UNSO), UN Development Programme (UNDP), UN Conference on Trade and Development (UNCTAD), World Meteorological Organisation (WMO), Southern African Development Co-ordination Conference (SADCC) and the International Institute for Environment and Development (IIED).

The session focussed on co-ordinating the implementation of Plans of Action to Combat Desertification (PACD) following decision 15/23 of UNEP Governing Council which requested IAWGD to undertake joint inter-agency action to mobilize technical and financial resources for implementing national programmes to combat desertification.

In order to ensure that future projects are efficiently co-ordinated, UNEP agreed to develop a system of analysis for reporting all agency programmes. This will make constraints and gaps easier to identify and means that joint activities can be more ably promoted. The terms of reference for the analysis are to be

agreed by all IAWGD members.

The Working Group recommended desertification assessment as its priority joint programming activity. The assessment is to include general land degradation and rehabilitation and drought, since drought accelerates the process of degradation where efficient preparatory measures are not taken in time. The first joint programming ad-hoc meeting will be held along with the next regular IAWGD meeting towards the end of 1990.

At the invitation of the SADCC representative, IAWGD agreed to undertake, as its first operation, inter-agency action to mobilize technical and financial resources to assist selected member countries of SADCC to develop and implement national programmes to combat desertification, in particular in the Kalahari-Namib region (see separate article). Later, similar joint action will be developed in Asia, Latin America and elsewhere in Africa.

It was generally agreed that it is difficult to ask sub-regional organisations which are not members of the IAWGD to report on their activities at its regular sessions. As Secretariat of IAWGD, UNEP was asked to follow-up on this point to determine the legal status of inter-governmental organisations at the IAWGD.

Following the suggestion of UNDTCD, the working group recommended that member agencies include desertification control objectives in their development and sectoral desertification control projects, in line with UNEP's recommendation to include desertification issues in socio-economic planning processes. The group also asked to be kept informed of the African Ministerial Conference on the Environment (AMCEN)'s African Deserts and Arid Lands Committee (ADALCO) activities.

The secretariat presented a paper on the relationship between the various UNEP programmes addressing desertification and deforestation. It was pointed out that the connection between desertification, biological diversity and climate change should also be emphasized. WMO were asked to keep IAWGD members informed of all their activities.

All members were invited to the technological workshop on methodologies, held in Nairobi in February 1989.

UNEP's 15th Governing Council (GC) commended the IAWGD for its role in ensuring that activities related to arid lands and desertification are included within the programmes of its member organisations (resolution 15/23).

Activities of IAWGD Members

UNDTCD reported on their three water projects connected with soil erosion and marine protection in Bangladesh, Trinidad and Tobago, and four arid-area water projects in Libya, Morocco, Qatar and Somalia. Two UNDTCD energy projects in Bolivia and China are looking at preventing damage to fragile ecosystems by reinjecting waste geothermal fluids with high mineral concentrations back into reservoirs. They are also examining the impact of mineral exploitation on land resources, and preparing environmentally sound mining legislation in several other countries.

WMO are studying the causes of climate variation and change, the impact and severity of drought and monitoring and forecasting of drought. Most of these activities are under the Agricultural Meteorology Programme and Hydrology and Water Resources Programme. Research is dealt with under the World Climate Research Programme and the Research Development Programme.

WMO's ongoing programmes include the preparation and distribution of a draft drought response plan and the use of meteorological data to assess primary productivity of natural pastures in member countries of the Permanent Inter-State Committee on Drought Control in the Sahel (CILSS) and others in Africa and West Asia.

Seminars on drought preparedness and management are being prepared in co-operation with US/National Oceanic and Atmospheric Administration (NOAA) in Africa and other countries. Negotiations are going ahead with FAO to organise roving seminars on water-use efficiency.

WMO also works together with AMCEN and recently prepared a background paper for an UNCSTD seminar on drought to be held in Lanzhou, China, and helped to prepare for reporting on the UN's Programme of Action for African Economic Recovery and Development (UNPAAERD). Plans to establish ACMAD — which will study the African climate, in particular climate change — are at an advanced stage.

ESCWA have formulated two NPACD projects in Jordan and the Yemen Arab Republic. The Jordan project will support the administrative infrastructure for rangelands and will conduct research into the control of mobile sand dunes and protection techniques and integrated desertification control.

The Yemen Arab Republic project is an economic analysis of sand-dune stabilization, afforestation and shelter belt projects in Tihama.

Twenty-four trainees from ESCWA countries attended a workshop, organised with the

German Federation for International Development (DSE) and financed by the German Agency for Technical Co-operation (GTZ). The workshop aimed at upgrading participants' knowledge of desertification processes and practical measures in desertification control and preservation.

The **UNESCO** representative gave out the Biennial Report (1987-89) of the Man and the Biosphere (MAB) programme concerning activities to combat desertification and promote integrated management of arid and semi-arid lands in Africa (South of the Sahara), North Africa, Asia and Latin America.

One of their major activities in 1989 was the Coquimbo Workshop on arid zones of Africa and Latin America, attended by 58 specialists from 11 countries. The main aim was to promote scientific co-operation between the countries of Africa and Latin America in development of arid and semi-arid zones and combating desertification.

UNESCO and the Federal Republic of Germany have a joint project designed to reinforce scientific capacities of Sahelian countries in agro-sylvo-pastoralism. All CILSS countries will be involved in regional activities, such as training.

IIED circulated a report dealing with research, information, training and institutional development of their dryland programme in the Sudano-Sahelian zone. They publish a Quarterly Bulletin - *Harmata* - which analyses key topics for research and programme reports on drylands resource management. Together with Oxfam's Arid Lands Unit, they are planning a series of training videos which explain small, low technology approaches to better soil and water management, aimed at development workers in the Sahel. IIED also plan to support AMCEN pilot projects, particularly in defining and designing the programmes.

UNSO has put much emphasis on assisting governments in planning and co-ordinating efforts to manage and protect natural productive resources and to combat desertification. This involves helping governments to establish a country policy or strategic framework of action and to reinforce the governments' institutional capacity to carry out more effective and systematic desertification control efforts. Effective planning programmes involve monitoring environmental processes and phenomena and UNSO's role in this is exemplified in its project to establish an ecological monitoring centre in Senegal. UNSO is now consulting with other regional governments to establish similar centres elsewhere.

UNSO is also the focal point of the UN's Programme of Action for African Economic Recovery and Development (UNPAAERD)'s forthcoming report on "The effectiveness of new measures to combat drought and desertification". The report will focus on new efforts being made by African governments, donor agencies and international organisations to attack the problems of drought and desertification, will note the major obstacles and will put forward issues and recommendations that need to be addressed.

UNDRO told the meeting about the recent creation of UN International Emergency Network (UNIENET) and recommended that essential information concerning desertification be stored in UNIENET in unified format so that it is easily accessible to all IAWGD members.

FAO is presently updating a document on FAO's activities to combat desertification that was prepared four years ago. There are currently around 184 FAO projects addressing this problem which are implemented

Haiti: Chopping trees for firewood is a major cause of desertification

in 32 African countries and cost approximately US$ 84 million in all. These projects relate to dryland agriculture, energy, forestry, integrated land management, planning, monitoring and co-ordination of policies related to desertification and drought, range management, soil protection and improvement and water resource management and development.

An international scheme for the rehabilitation of African lands is now being prepared.

FAO is also participating in AMCEN - particularly in the network of soils and fertilizers, in developing village pilot projects in Senegal and is participating in sustainable development of arid lands.

An interdepartmental group within FAO addresses conceptual issues related to desertification in relation to agriculture, forestry and fisheries and is developing a position paper relating to rational management of arid lands.

UNFPA was keen to make their family planning programmes part of the joint activities.

Rehabilitation of the Aral Sea

Dr Tolba and Mr Salykov sign the protocol

The Executive Director of UNEP, Dr M. K. Tolba, visited Moscow in September 1989 where he met with the chairman of the Supreme Soviet Committee on Environment and Management of Natural Resources, Mr Salykov. The aim of the meeting was to discuss environmental degradation in the Aral Sea basin.

The Aral Sea is a huge, shallow, saline, endorheic lake located in the semi-arid area of south-central USSR. In the last twenty years, irrigation based on the Aral Sea basin has been developed extensively, resulting in a decrease in sea area and volume and lowering of the sea level from 53.4 m in 1960 to 12.9 m in 1987. The intensive irrigation has also decreased the inflow from the two rivers, the Amu Darya and the Syr Darya, which used to be the source of the sea.

Consequently, a huge part of the sea bottom and many bays have dried up, the groundwater level along the seashores has dropped dramatically and solonchaks have formed. As they get blown away in the wind, minerals in the atmosphere and in precipitation have increased as far as central Asia. The salinity of the sea water has increased to 27g/litre - twice that of 1960 - and in the rivers, salt-rich drainage water is dumped from the irrigated fields to increase the river water salinity.

A series of dry years in the 1970s and another in the 1980s further helped to decrease the amount of water flowing into the basin.

These phenomena have brought about considerable changes in the ecology of the area - problems which are common to most of the arid and semi-arid regions of the world, particularly in endorheic river basins. Moreover, the implications for the economy and human health in the Aral Sea region - with a population of over 30 million - are particularly negative.

As a result of Dr Tolba's meeting with Mr Salykov, it was decided that UNEP's Terrestrial Ecosystems Branch would assist the USSR in developing a Plan of Action on the Aral Sea conservation. A project document was signed between Dr Tolba and the Deputy Foreign Minister of the USSR, Mr Petrovsky, in January 1990.

The main aim of the project is to use the Aral Sea as a case study covering the first two phases of an inland water rehabilitation process: ie, preparation of a diagnostic study and an Action Plan. Preparation of manuals and advanced training schemes for the management of endorheic lakes will be considered as main features of these projects. In addition, an international network will be created so that any knowledge and experience obtained from the Aral Sea case study can be shared by other institutions concerned with the management and protection of the endorheic lakes.

In the first phase an international working group of consultants and national experts was established. Their first meeting was held in September 1990 in Nukus, USSR, with the aim of gathering background information on the Aral Sea and to decide on the structure of a diagnostic study and how further to elaborate the project.

The working group proposed to declare the Aral Sea region a zone of ecological disaster and recommended that co-operation between UNEP and the USSR in this area be accorded the highest priority. Consequently a delegation from the USSR, headed by Mr Salykov, visited Nairobi in October 1990 to revise the original project. A protocol was signed between Dr Tolba and Mr Salykov in which UNEP and the USSR agreed it is necessary to accelerate the implementation of the project and to upgrade its status. It was also agreed to follow the working group's recommendations to introduce amendments into the main directions of the project to cover the problems of combating desertification in the region and related socio-economic, sanitary and hygienic issues and to increase the funding of the project *inter alia* to support the Ecological Centre in Nukus.

DC/PAC's Mr A. Levintanus is assisting in drawing up the first draft of the amended project document which, according to the protocol, will be ready by December 1990.

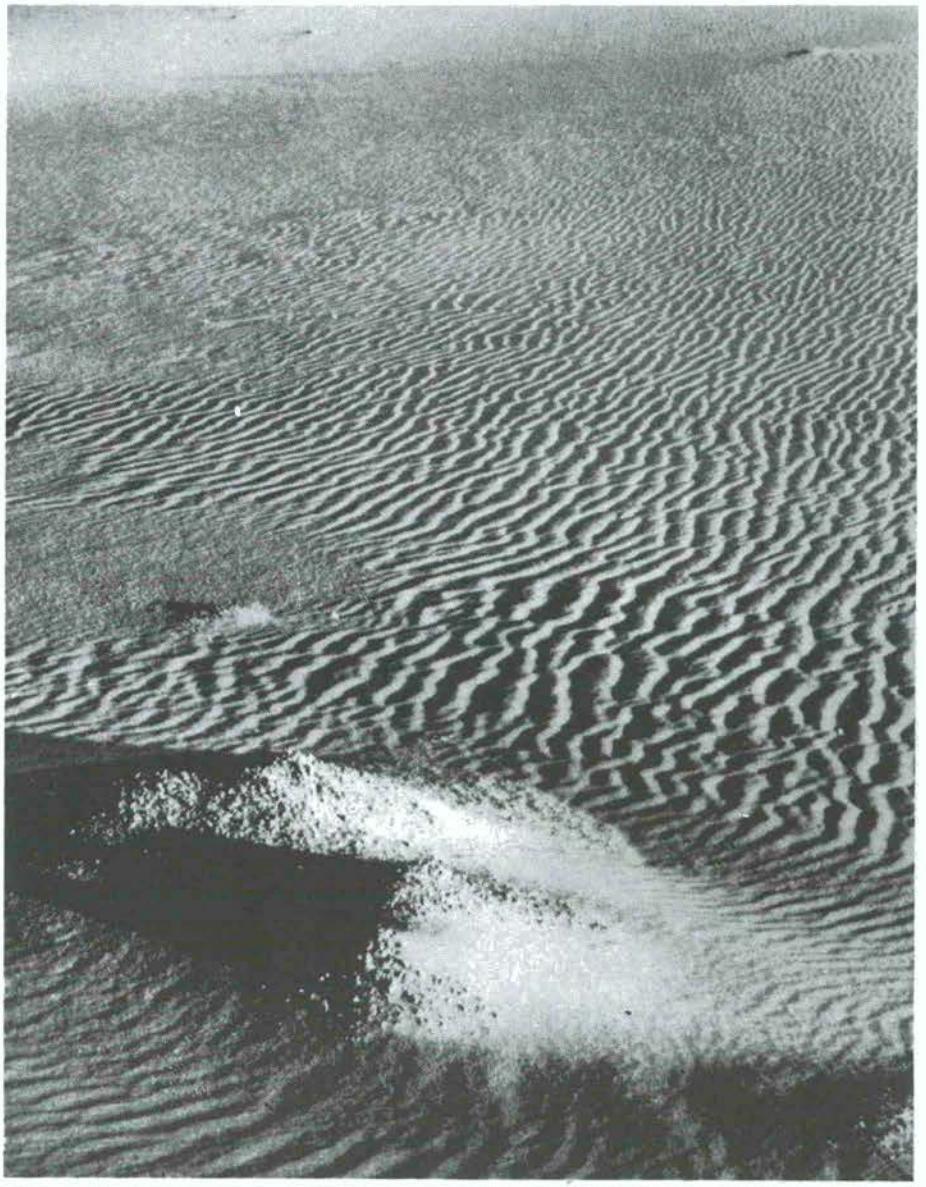
Workshop for multi-media representatives on drought and desertification

A workshop to inform journalists about issues related to drought and desertification was held in Ougadougou, Burkina Faso, from 26 August to 3 September 1989.

The thirty-five media representatives from fifteen countries in West and Central Africa who attended the workshop heard short presentations on the bio-physical and socio-economic aspects of drought and desertification in the Sudano-Sahel and were introduced to the terminology used by experts working in the field. The necessity for co-ordinating both national and regional environmental activities was emphasised.

Afterwards, during discussions about the experiences in different countries, it was stressed that rural people need to be enlightened about ways to improve their agricultural techniques, rather than having such techniques dictated to them.

The journalists asked for more resources to be made available to enable them to report thoroughly on global desertification issues and for a permanent campaign to be set up to keep them regularly informed. They proposed that a catalogue should be published as soon as possible, under the auspices of Permanent Inter-State Committee on Drought Control in the Sahel (CILSS) or UNSO, to explain the role of different UN organisations in the fight against desertification. This would enable the journalists to have a complete understanding of how the UN operates in different countries. They suggested that the UN should have a national co-ordinator in each country with the responsibility of gathering information and keeping journalists informed on a regular basis. A regional co-ordinator, assisted by UNIC, UNSO and CILSS officials could be based in Ougadougou to collate the national information and ensure that a catalogue of up-to-date material is published.



A boundless ocean of sand: Turkmenia, USSR Photo: P. Almasy, WHO

They also recommended that other forms of information, such as audio-visual presentations, should be made available to journalists to use at their discretion and asked for more workshops and information sessions to be held in order to educate local media representatives about desertification issues. They agreed to set up a Journalists Network to Combat Drought and Desertification.

The workshop, which was initiated by the United Nations Sudano-Sahel Office (UNSO) regional office for West and Central Africa and supported by the permanent Interstate Committee on Drought Control in the Sahel (CILSS), UN Information Centre (UNIC), UN Children's Fund (UNICEF) and UN Development Programme (UNDP), was opened by the Burkinabé Minister of Agriculture.

Regional Environmental NGO Network - Asia/Pacific

The increasing number of environmental non-governmental organisations (NGOs) in the Asia and Pacific region inspired UNEP-DC/PAC to set up a regional environmental network of NGOs (RENN-A/P) in 1989.

The aim of RENN-A/P is to promote regional co-operation and to share experience at grass-roots level. RENN-A/P has been welcomed by NGOs involved to facilitate the concept "act locally, think globally".

Through its Regional Office for Asia and the Pacific, UNEP contacted NGOs co-ordinating well-established national coalitions/forums to ascertain their interest in participating in such a network. The idea was so well received that by August 1989 a letter of agreement between UNEP and ten Regional Network Representatives (RNR) had been signed. The RNR represent Australia, China, India, Indonesia, Japan, Republic of Korea, Malaysia, Nepal, New Zealand and Sri Lanka.

Actual information exchange began in November 1989, marking the end of RENN-AP's initial establishment phase. The RNRs are now co-operating in various activities, including anti-soil-degradation, anti-desertification and reforestation measures, by exchanging information and disseminating their combined knowledge on good environmental and natural resource practices at grass-roots level. UNEP has allocated US$ 3,500 for annual seed funds to each RNR.

The second phase of RENN-A/P aims at bringing together NGOs which do not yet have national coalitions and encouraging them to develop national forums so that they can then join the regional network. UNEP has already contacted Bangladesh, Fiji, Pakistan, Papua New Guinea, the Philippines and Thailand. By the end of 1991 it is expected that 15 countries will be represented in RENN-A/P, increasing to around 20 by 1992/1993.

To stimulate the effectiveness of RENN-A/P, a workshop for RNRs is being organised for late 1990. The meeting will determine the need for the Network, review the objectives and preliminary activities proposed, identify solutions to problem areas that impede further development of RENN-A/P, identify two or three concrete activities that could be co-operatively implemented by Network members, and develop and agree upon an action programme for the next two or three years.

The Sahara - Fort Flatters

NEWS OF INTEREST

Chinese Eco-villages: Models of self reliance

In 1978 Shiao Zhang Zhuang village in Yingshang County, Anhui Province in China was a poor wasteland, frequently subjected to floods and droughts, with barren vegetal cover, lack of fuel and poor productivity monoculture. The few crops that managed to grow were replete with plant disease and insect pests which were aggravated by the use of chemical pesticides.

Twelve years later, thanks to the efforts of Mr Zhang Jia-Shun who led the villagers in eco-reconstruction through self-reliance without state funding, Shiao Zhang Zhuang, together with other eco-villages in China, is regarded by UNEP as a model village.

With Mr Jia-Shun's encouragement the villagers dug 20 large water canals which both created an efficient irrigation system and eliminated the impact of floods and drought and, simultaneously, helped to rehabilitate the saline soils. They also dug fish ponds with up to 15 ha of water surface and a total of 333.3 ha of arable land was brought under production.

The 11 scattered hamlets which once comprised Shiao Zhang Zhuang were consolidated into four concentrated villages with modern brick and tile houses and a primary school, health centre, sports ground, cultural centre and cinema, linked by 20 paved roads. This freed 67 ha of farmland. The quality of life for villagers was further enhanced by the introduction of small pump wells to improve domestic water quality and by birth control practices which reduced population growth rate from 10/1,000 to 5.6/1,000.

Through their tree-planting and afforestation efforts, the villagers created a 33 ha park with a 4 ha seedlings nursery containing more than 100 species of trees and flowers, which now account for 18% of the village's income. An extensive network of 20 km of wind shelter belts was also established, together with an orchard of 8.7 ha and a bamboo forest of 8.7 ha. In all, 1.67 million trees have been planted to date, creating a green belt which is the source of timber for logging, firewood, animal feed and organic fertilisers. By increasing vegetal cover from 7 to 23%, the villagers have improved relative air and soil moisture content and the farmland micro-climate and eliminated the adverse impact of natural disasters. Moreover, the increased number of birds living in wooded areas are helping to keep down the amount of insect pests and so the use of pesticides has become less widespread.

The animal husbandry and agricultural production structure was transformed by introducing improved practices for breeding cattle, sheep, rabbits, pigs and fish farming. Ten new cropping patterns were introduced together with alternative systems of mixed-planting and interplanting to increase agricultural diversity and productivity. Total grain output of the village has increased from 1,338 kg in 1976 to 2,238 million kg in 1988; per ha output was up to 8,260 kg in 1988 compared with 750 kg in 1976.

The introduction of biogas production, together with firewood-saving stoves has not only reduced the fuel problem but has also provided organic waste which is used as fish-feed and to neutralise and fertilise alkaline soils.

Village industries, such as a grain-oil processing factory, a brick and tile-making works, a plastic processing factory and a transport company have expanded the income and employment base of the village.

In all, Shiao Zhang Zhuang eco-village is a good illustration of how sustainable and environmentally sound production of food, fuel and fodder can be achieved through self-reliance. The village administration plans to improve their system still further by expanding animal and poultry production to increase biogas production and by developing agro-product processing industries and social services. This will consolidate the eco-system interlinkages and further integrate the agricultural/industrial/commercial system.

Designer Crops?

Botanists in America are combining biotechnology with traditional hybridization techniques to develop strains of crops that can survive in hot, arid conditions.

In the past, traditional methods of cross-breeding have proved time-consuming and uncertain because it was not possible to guarantee which traits would be passed on to the hybrids.

But by studying the genetic make-up of drought-resistant plants, researchers hope to identify and isolate the genes which enable some species to survive with little water.

Already researchers in Salt Lake City have reached the stage of field-testing hybrid tomato plants that combine both the drought-resistant characteristics of a South American

species and the prolific, fruit-bearing abilities of commercial varieties. They have also mapped out the hybrid's gene pattern so that they can see whether the drought-resistant characteristics are inherited or not.

Elsewhere, scientists have discovered crops that secrete hormones that slow down the plant's metabolism. Other researchers are studying sugar molecules secreted in drought-resistant Japanese soyabeans. The sugar enables the beans to survive at temperatures that would kill other varieties.

If the genes responsible for producing these sugars and hormones can be spliced successfully into high-yielding varieties of crops, scientists will be able to create a fruit-bearing hybrid specifically adapted to thriving on little water.

Biotechnology is still in its early stages of development and much work needs to be done before results can be guaranteed. No one is yet sure exactly how many different genes work together to enable a plant to resist drought, or whether it is possible genetically to programme a crop to pass on the desired characteristics to future generations.

But if researchers do succeed with their designer plants specifically adapted to hostile conditions, it could mean that today's barren, arid areas could become the productive regions of the future.
(Extracted from *Newsweek*, 22 August 1988)

Book Review

Faidherbia albida (Del) A. Chev.
(Synonyme *Acacia albida*)
Centre Technique Forestier Tropicale,
Nogent-sur-Marne, France, 1988.

Monographie - pp. 72

This excellent monograph on a typical agroforestry species is well illustrated, clearly written and easily accessible and would be almost perfect were it not marred by a number of typographical inconsistencies.

It explains why the binomial *Faidherbia albida* is preferable to *Acacia albida*. A clear description of the species' botanical features is followed by an account of its geographical distribution and genetic variations. There are two types, type B, with downy shoots and leaflets, is found especially south of the Equator; type A, which is glabrous, is to be found in West and East Africa; there are many intermediate varieties.

The authors mention a few theories about the origin of the species. In summarizing the tree's ecological requirements, they recall that it is a typical phreatophyte, i.e. it evaporates a lot of water and therefore can develop only on humid soils or where its powerful root system with its large taproot can reach the water table. Disregard of this important element — despite, or without seeking, the advice of experts — has resulted in a number of failures in projects which viewed the *Faidherbia albida* as the miracle tree that would restore fertility to all African soils. In considering the tree's foliation-defoliation cycle, the monograph presents a number of observations and recounts the main theories to explain them (Trochain, Aubreville, Portères and Lebrun). No mention is made of what is said in Mali: that the foliation pattern quite peculiar to the *balanzan* (the Bambara name for the *Faidherbia*) was imposed upon it through the conjuring of Bambara medicine men. The authors do, however, recount the experiments of *A. Nongonierma*, which show that defoliation is not due to the appearance of asphyxiating conditions in the soil but is linked to an internally determined effect inherent in the genetic make-up of the species. This could also explain why the start and length of defoliation varies considerably among individual trees and why even different large branches of the same tree do not shed their leaves according to the same timeframe.

Chapter nine includes a great deal of information on the growth of the tree. Growth is continuous throughout the year, except during the rainy season when the tree has no leaves. Considerable variations in growth and shape may be noted during the early years; the East African varieties record a better growth. Daily watering of young plants results in an increase in production well below that achieved with the *Acacia seyal* or the *Acacia nubia*, as if the *Faidherbia* plants were capable of drawing from non-irrigated soil almost all the water they can use. The growth rate of the taproot compared to that of the stalk supports this theory since it is three times higher in young plants of less than four years. The initial growth of the stalk, however, varies considerably depending on the texture and humidity of the soil, and five-year-old stalks can measure anything between 1.6 m and 4.5 m. On average, it may be said that in the early years the plant grows between 0.5 m and 0.7 m in average conditions and between 1 m and 1.5 m in conditions that are favourable or very favourable.

The root system is studied next. Nodulation occurs only with *Bradyrhizobium* stocks; it is limited by soil acidity, lack of phosphorus, drought and the presence of nitrogen

in the soil. A well inoculated plant weighs four times as much as a plant that is not inoculated. The small number and diameter of the lateral roots are positive factors for agroforestry groups. In addition, the roots are highly adaptable since, where the water table is not very deep, they can display negative geotropism and move up towards the surface to avoid suffocation.

Sowing is the main method for reproducing the *Faidherbia* although the few attempts at propagation by cuttings have shown that this method would be possible, with a success rate of about 50%. Grafting does not appear to have been widely used but it would probably yield results, especially in the species' marginal areas. On the other hand, suckering is very common and the orthotropy of the shoots (straight and vertical) should allow the development of propagation through long cuttings. Finally, the ongoing work at the Laboratory of Cytophysiology at the Dakar Faculty of Science has already led to the *in vitro* propagation of the *Faidherbia albida* and provides hope for the development of a technique for the successful micropropagation of adult trees.

Two long chapters are devoted to the role of *Faidherbia* in agriculture and livestock farming. The beneficial effects on agricultural production are explained by characteristics that are relatively peculiar to *Faidherbia* (+) or common to all trees (*):

+ a more rugged landscape, leading to less evapotranspiration;
+ beneath the tree crown, increased soil humidity to a depth of 120 cm;
+ sunlight beneath the canopy that remains quite strong during the crop-growing period;
+ improvement in many physical and chemical properties of the soil under the tree cover;
+ nitrogen-fixing bacterial activity (possibly, however, less important than had been thought, on many trees, compared to the movement of minerals though the roots and their distribution in forest litter)
* a higher relative humidity under the crown of the tree;
* moderation of temperatures under the canopy;

The pods and leaves make excellent forage. However, there is a lack of copper, manganese and zinc in the pulp of the pods. Of the macroelements, there is an adequate amount of calcium, phosphorus (except in the pulp of the pods), magnesium (only in the leaves) and potassium. There is a significant deficiency of sodium in the fruits and the K/Na ratio is too high, as is the case with almost all tropical fodder; the same goes for the Ca/P ratio and, in the leaves and pod pulp, the Ca/Mg ratio. The real quantity of pods per tree is only in the range of 10-20 kg of dry matter per tree per year, and the quantity of leaves is about the same as trees are almost always widely pruned; on unpruned trees production varies from 50 to 150 kg per year. Besides its good quality, forage from the *Faidherbia albida* is available in the dry season when it is an essential complement to the poor herbaceous fodder, compensating for lack of protein, phosphorus and carotin.

The wood is of little interest compared to the fodder and fertilizing effect. The *Faidherbia* has many different uses, one of which is in the preparation of medicines.

One very detailed chapter recounts all that is known about cultivating the species and is accompanied by well documented case-studies. While artificial regeneration methods are well developed, protecting natural regeneration often makes it possible to establish the required tree profile more economically and more rapidly in the field.

The book ends with chapters on pests and parasites, genetic improvement and the important role to be accorded to *Faidherbia albida*, which means informing rural people and giving legal protection to the assets created. Finally, mention is made of some of the research that remains to be done, one of the most promising areas being genetic improvement, which was started at the initiative of the International Board for Plant Genetic Resources and the United Nations Environment Programme and has been taken up by UN Food and Agricultural Organisation and the International Union of Forestry Research Organisation. Comparative tests of origin and studies of enzyme systems will help to increase knowledge of genetic variability, its importance and organisation within the species. Better decisions may then be made about the improvement strategy to be developed. There could, for example, be some research into the establishment of lines in which defoliation is better controlled, which grow quickly, which are well-formed, which fix a lot of nitrogen and which produce a large quantity of seed pods.

Other areas of research would be useful to answer, for example, the following questions:

- Does carbon and nitrogen enrichment entail an imbalance that might disturb the growth of certain plants - not the nitrogen-hungry cereals but other plants, such as legumes?
- Is it not possible to learn from the farmers in the Haraghe highlands of Ethiopia and develop a pruning system (time, extent, frequency) that would achieve the highest yield of seed pods, leaves and wood?
- What should be the optimal density of the *Faidherbia albida* depending on the climate, soil and associated crops?
- What is the relationship between water consumed and biomass produced?
- What is the forage value, taking into account ingestion and digestibility?

Even for the specialist, this book is rewarding and is highly recommended.

Reviewed by Michel Baumer, ICRAF, Nairobi

Prince Charles plants "wonder grass" in fight against soil erosion

Great Britain's Prince Charles, who is well-known for his interest in conservation, visited Nigeria in March 1990 where he launched the British Council/Anambra State Project on Erosion Control, otherwise known as "Project *Vetiver*".

The Prince, who is vice-president of the British Council, was invited to popularise the campaign to plant *Vetiver* grass in Anambra, a relatively prosperous state in south-east Nigeria which in the last ten years has become probably the area worst hit by soil erosion. Over 150 people have died and damage to property amounts to nearly US $755 million due to 530 erosion gullies which have appeared in 220 towns.

Attempting to control the problem, the Nigerian Government in 1986 created a national Task Force on Soil Erosion Control, made up of national soil scientists and engineers. The task force initially tried to halt the spread of the menace by building concrete embankments, but to no avail.

Their next attempt was to try planting wild grasses and they identified twenty-seven species which were both fast growing and effective in preventing soil erosion. However, local people were reluctant to take up the idea because it seemed too simple to be true.

Simultaneously, a visiting team of British scientists who were working independently also recommended the grass-planting option, apparently unaware of the efforts already made by their Nigerian colleagues in that direction. They recommended *Vetiver* which they knew to have been successful in controlling soil erosion in India.

Vetiver nigritana is indigenous to north-eastern districts of Nigeria, along the Benue River flood plains. It has all the qualities needed to prevent soil erosion at the stage when the destructive gullies have not yet set in. Its long, strong roots grow deep and help to hold the soil in place, enabling the plant to survive harsh climatic conditions. It is fast growing and soon springs back to life after a fire. One World Bank official who watched the grass-planting project in India for thirty years declared *Vetiver* "the best known plant" for the job.

The British Council joined forces with the Nigerian task force and now, thanks to the prestige brought to the project by Prince Charles' visit, the *Vetiver*-planting campaign is on in real earnest. In a statement jointly issued by the Nigerian scientists and their British helpers, they said they expect *Vetiver* to have made a significant impact on the ecology of Anambra by October next year.

Prince Charles

Soil conservationist, Anthony Chigbo, who is both secretary and project engineer of the Nigerian task force, said that Prince Charles' visit had made all the difference.

"We knew that grass-planting could work," he said. "But the problem had been to convince the average person. They believe that things are only good when they are costly."

(Extracted from *New African* magazine, June 1990)

Health For All When Disasters Strike

Throughout the world, nine hundred million people have been affected by disasters in the last 25 years.

Disasters are the main killers in Africa. Drought, famine, environmental degradation, communicable diseases outbreaks, wars and civil strife are the natural and man-made disasters affecting African people.

The World Health Organization has opened a panafrican centre for disaster reduction to study and mitigate the effects of disasters through training, planning and management of any health emergency in large populations.

Disasters strike every day: to be prepared and save lives - act today. Contact:

WORLD HEALTH ORGANIZATION
Panafrican centre for emergency preparedness and response
P.O. Box 3050,
Addis Ababa,
Ethiopia
Tel: 002511 Tlx: 21584
Fax: 002511 513264

World Meteorological Organisations's Commission for Agricultural Meteorology - forthcoming report

The World Meteorological Organisation (WMO)'s Commission for Agricultural Meteorology aims to show non-specialists how to combine data from different sources to create realistic and practical guidelines for predicting and overcoming drought.

The 150 page report, written by 12 international agronomists and meteorologists, will examine the relationship between climate, vegetation, soil types, land form and use. It aims to show field workers how to combine satellite, aerial and ground data to predict drought accurately and to indicate the most efficient means of overcoming desertification.

The report will be divided into three sections: the first concentrating on the assessment and monitoring of drought, in particular agricultural drought, which occurs when available moisture is less than the water requirement of crops.

Case studies from several countries are used to examine the pros and cons of various methods used to predict the beginning and end of drought periods. The way cloud cover, radiation and air pressure affect evapotranspiration rates is fully explained and instructions given for analysing this data, along with soil moisture content levels, to create an early warning indicator of the onset of drought spells.

This section is to be concluded with practical recommendations for food crops and desert land vegetation suitable for arid and semi-arid regions prone to drought, with suggestions for pulses, oil seeds and cereals that can be effectively grown in marginal areas of India.

The second part of the report will concentrate on practical agrometeorological ways of combating drought.

Hostile environmental conditions, including low, erratic rainfall, intense solar radiation, high winds and soils with inferior water infiltration capacity, result in low crop production. But by implementing cropping patterns which take into account soil-type and rainfall variation, stable food production can be achieved through different crop seasons.

Moreover, the adverse effects of reduced soil moisture due to inadequate rains can be overcome by planting alternative, more efficient crops, or by increasing the moisture storage capacity of soil through mulches, fertilisers and water harvesting.

The section concludes by explaining how to create a computerized micro-climate model for use in agriculture and forestry. By combining data from satellite maps of crops, soil and morphology maps, evapotranspiration levels and land, it is possible to compute the water balance of a specific region. This regional data can then be applied to more localised areas by calculating in the rate of radiation exposure of a particular piece of land.

The third section will concentrate on agrometeorological ways to combat desertification. Overgrazing, water and wind erosion, urbanization and industrialization mean that hundreds of acres of arable land are lost each year. Although some of this land is irretrievable, much of it can be reclaimed.

Quantitative analysis of the size of the area, number of people using the land and the vegetation cover can be combined to set controlled grazing levels.

Alternatively, threatened regions can be irrigated - though this is expensive and sometimes leads to salinization of the soil - or replanted with alternative vegetation, depending on the soil and land type and meteorological conditions.
The final report was due to be completed in June 1990.

Nomadic Peoples Journal Seeks Papers

Nomadic Peoples Journal is to be relaunched before the end of 1990 and will become a twice yearly publication.

New editor, Mr Anders Hjort af Ornäs, who is also director of the Nordiska afrikainstitutet in Sweden, said that his ambition is to establish *Nomadic Peoples* as a dynamic publication, well anchored in the research community.

Mr af Ornäs also plans to make the magazine more attractive, although the basic policy will remain unchanged. The forthcoming triple issue (nos. 25-27) is thematic, dealing with pastoralists and the state, with Dr M. A. Mohamed Salih as guest editor. This issue will be distributed to subscribers before the end of the year.

Mr af Ornäs took over the editorship mid-year from Prof. Salzman of McGill University, Montréal, Canada.

A Survey on Training Needs in Semi-Arid Areas

Naoto Noda
Silviculture/Training Expert
Kenya/Japan: Social Forestry Training Project
Japan International Co-operation Agency

Background

The Kenya/Japan Social Forestry Training Project (SFTP) started in November 1987 after the preparatory phase of two years, in co-operation with the Kenya Forestry Research Institute (KEFRI) and the Japan International Co-operation Agency (JICA). SFTP aims to promote social forestry in Kenya, especially in its semi-arid areas. It consists of two sub-projects, namely, the Pilot Forest Scheme which carries out plantation trials and extension activities in Kitui District, and the Training project which offers training services in social forestry at both Muguga National and Kitui Regional Training Centres.

At the Kitui Centre in particular, target groups for training are field level extension staff, local community leaders and leading farmers in the semi-arid areas of Kitui, Machakos, Embu and Meru Districts of Eastern Province. The Muguga Centre's target groups are mainly senior government field officers at the national level.

In August 1988, SFTP carried out a survey on training needs in the above four districts. The purpose was to obtain information on the actual situation of rural tree planting, its outstanding problems and local needs, on which the basis of the training courses would be designed.

Survey Method

The surveys were undertaken in the following manner:

1 The District Forest Officer (DFO) in each of the four districts and two on-going projects in the area were asked to select about five persons from the extension staff and ten persons from the "grass-roots level" leaders.

2 The people selected were interviewed by a team of KEFRI staff and JICA experts using two questionnaires prepared for extension staff and "grass-roots level" people respectively.

Through field visits made during this survey, a total of 45 extension staff from the Forest Department (FD), the Ministry of Agriculture (MoA) and non-governmental organisations (NGOs) were interviewed as the trainers group. Fifty-three local leaders and farmers were also interviewed as the trainees group.

Table 1: Source of Seedlings

	Kitui	Machakos	Embu	Meru	Total	%
Individual or group nursery*	6	10	8	4	28	52.8
FD nursery	1	6	8	9	24	45.3
MoA nursery	2	2	2	1	7	13.2
Projects	4	6	1	0	11	20.8
Private nursery	0	2	4	0	6	11.3
Chief's nursery	0	0	1	1	2	3.8
Other nurseries	1	3	2	0	6	11.3
Wild plants	0	2	2	1	5	9.4

* Nurseries owned or operated by interviewee either individually or in a group

Findings and Recommendations

About two thirds of the extension staff interviewed were not satisfied with the tree planting activities in the areas under their responsibility. Those who answered "satisfied" were still endeavouring to see further improvement. All the extension staff thought that it was essential to give proper training to farmers in their localities as such training would facilitate the farmers' activities in the field. The extension staff also requested that training courses be implemented for themselves to upgrade their own capacity.

Besides the Forest Department extension staff, other extension staff belonging to different ministries and NGOs were included among the target groups of the training course. In particular the number of MoA extension staff was much larger than that of Forest Department staff and the former seemed much closer to the "grass-roots level". However, usually agriculture staff had not received specific training in tree planting and/or tree seedlings production.

Among the extension staff as a whole, two different groups were identified according to their technical backgrounds and their level of understanding, i.e. the intermediate level extension staff (divisional level) and the field technical assistant level (location and sub-location level) employed locally. Therefore, the training courses for extension staff should be organised in two separate courses to suit their respective levels.

Out of 53 people interviewed at the "grass roots level" 51 had planted trees and all of them were willing to plant more in the future. Table 1 shows that more than half of

the people had raised tree seedlings in their small-scale nurseries (see "individual or group nursery").

People's motivation towards tree planting seemed very high. The obstacles to tree planting mentioned by them were shortage of nearby nurseries and lack of technical guidance. Table 2 shows that only the pitting technique had been well practiced and other techniques had not. Establishment method and operation techniques of small-scale nurseries as well as planting and tending techniques would be essential subjects of the training courses.

People tended to prefer fast-growing species such as *Grevillea robusta*, regardless of climate and other conditions in their respective areas. Selection and introduction of tree species adaptable to different local conditions and related training would be required in the future.

Trees were mostly used as the source of energy in semi-arid areas, not only for local peoples' daily use, but also to generate income through the sale of firewood and charcoal to urban areas and high-potential farming areas where only cash crops were being cultivated. In this regard, improvement of fuel-saving stoves (see Table 3), charcoal-making methods and the marketing system were considered as possible topics of training.

More than 90% of the farmers interviewed were facing or had faced soil erosion problems on their lands and most of them had already applied some improvement measures (Table 4). Bench terracing especially was well known and practiced. However, use of trees for maintaining soil fertility and stability could further be promoted through training.

The usefulness of trees as fodder and green manure - which is a rather common purpose of agroforestry - was not well known among farmers and should be included in future training courses.

Among other forestry-related activities, grazing and bee-keeping

Table 2: Techniques Practiced in Planting

Organisation	Kitui	Machakos	Embu	Meru	Total	%
Pitting	8	20	12	10	50	94.3
Watering	1	1	0	3	5	9.4
Micro-catchment	2	0	0	0	2	3.8
Mulching	0	1	0	0	1	1.9
Fertilizing*	5	2	2	3	12	22.6

* Including manure and chemical fertilizer

Table 3: Type of Cooking Stove Being Used

Type	Kitui	Machakos	Embu	Meru	Total	%
Improved stove	2	6	5	2	15	28.3
Traditional Three stones	6	15	7	10	38	71.7

Table 4: Measures Taken To Prevent Soil Erosion

	Kitui	Machakos	Embu	Meru	Total	%
Bench terrace	7	18	6	5	36	67.9
Grass strip	3	1	10	6	20	37.7
Cut-off drain	2	3	5	6	16	30.2
Tree planting	3	1	1	3	8	15.1
Windbreak	0	0	2	0	2	3.8

Table 5: Number of Livestock-Holders and Bee-Keepers

	Kitui	Machakos	Embu	Meru	Total	%
Cattle	7	17	11	12	47	88.7
Goats	6	15	8	10	39	73.6
Sheep	2	12	3	6	23	43.4
Bees	5	7	7	6	25	47.2

Table 6: Suitable Language for Training

Language	Kitui	Machakos	Embu	Meru	Total	%
English	5	9	8	7	29	54.7
Kiswahili	8	19	7	11	45	84.9
Local languages*	6	16	12	12	46	86.6

* Includes Kimeru, Kikuyu, Kiembu, Buran and Kamba. There are also some other languages of small groups in the area.

were very important, or even indispensable, to the subsistence of the people in the semi-arid areas (Table 5). It is recommended that these be included as training subjects in combination with tree planting activities.

Almost all the "grass roots level" people interviewed were willing to receive training on tree planting and related activities. Adequate duration suggested by interviewees was two to four weeks.

Schools could be considered as bases of extension activities and sources of tree seedlings for surrounding areas. School teachers would be given training and, in view of their higher educational and understanding level, a special course may be designed for them.

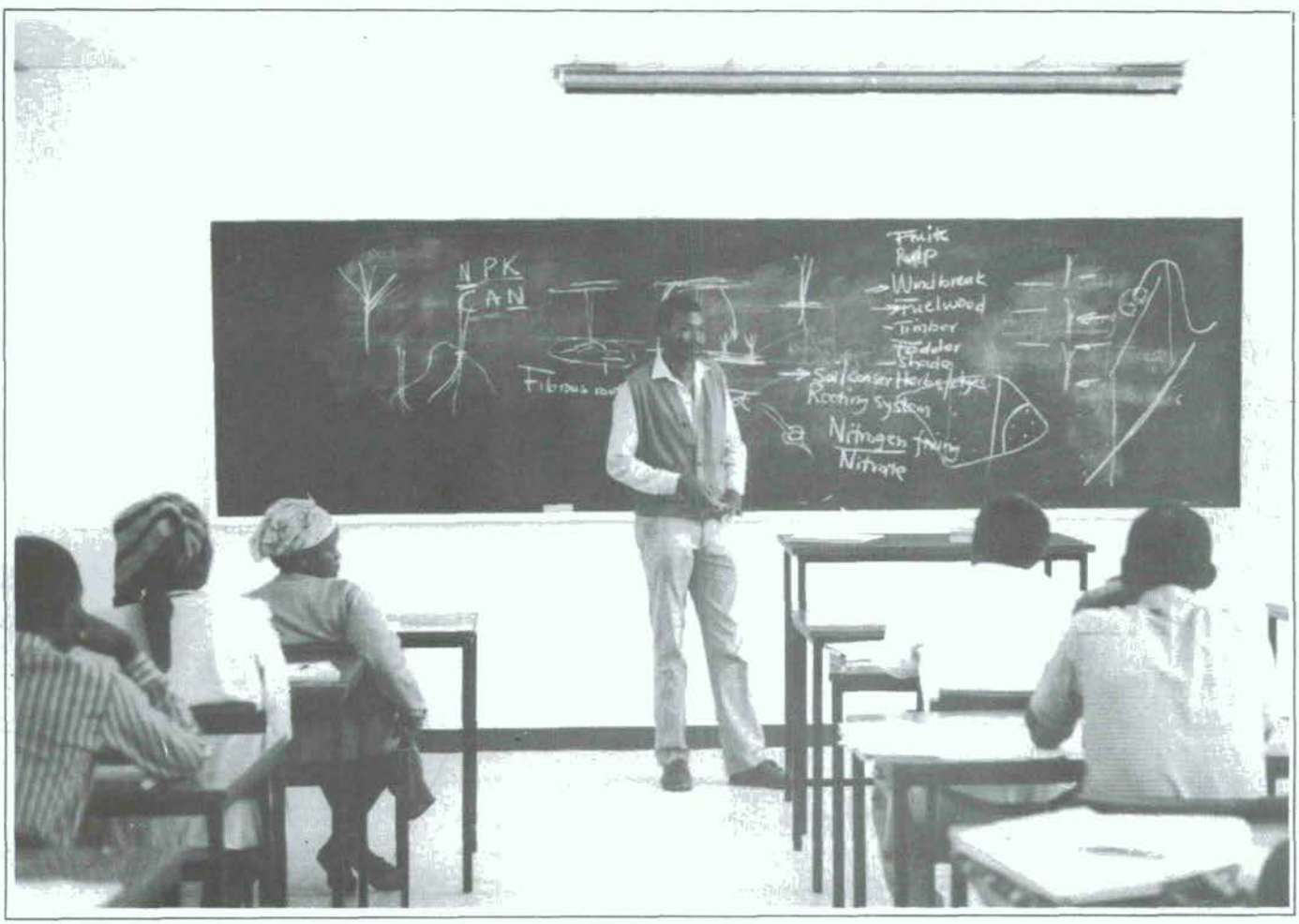
In the courses to be held at Kitui, oriented for the extension staff and local community, practical knowledge and techniques rather than theoretical ones should be taught systematically. Table 6 indicates that use of Kiswahili or other relevant local languages would be required especially in the courses for the assistant extension staff and "grass-roots level".

In view of the high concern and motivation expressed by the local community through this survey, it was felt that a package of techniques on tree seedlings production, planting, tending and harvesting in semi-arid areas, practicable by the rural people, should be developed as a matter of urgency.

Furthermore, considering the important roles in farming and tree planting played by housewives in the rural area, their activities and participation should further be encouraged. However, housewives are usually occupied not only with farming but also other household chores, especially with taking care of their small children. They find it difficult to leave aside their family responsibilities for a certain period to attend the training courses. Therefore, a special approach to them, either through training courses in the field or through extension activities by trained workers, also needs to be considered.

Material support as well as technical assistance to the extension workers and small-scale tree nurseries being operated by women's groups, other institutions and individuals will easily enable them to promote rural tree planting activities.

A training manual prepared by the group is due to be available in early 1991.



Training Course in Kitui

Field Research Proposals Invited in Development Anthropology

The Center for Field Research (CFR) has made funding for applied anthropology projects a priority in 1991 and 1992. Proposals that address the social and economic causes of environmental destruction are particularly welcome.

Field grants are derived from funds contributed by volunteer participants who are members of Earthwatch and join the research team in the field. These volunteers are qualified nonspecialists, recruited and screened according to the needs of the team they are assisting.

To date, CFR has supported 1,265 research expeditions worldwide. Grants range from $16,000 to $150,000. Preliminary proposals are accepted and reviewed all year round and should be submitted one year in advance of anticipated field dates

CFR is a private, non-profit organisation established in 1971 to promote significant scholarship and to improve communication between scholars and public through participant funding.

For more information and to discuss your research goals and their appropriateness for Earthwatch funding, please contact Catherine Schlager, CFR Program Officer, 680 Mt. Aubun Street, Watertown, MA, 02172 USA. Tel: (617) 926-8200. FAX: (617) 926-8532.

International Course on the Design of Community Forestry

A fourth international course on the design of community forestry programmes will be organised at Wageningen in the Netherlands in September-December 1991 by the International Agricultural Centre (IAC).

Community forestry, or tree growing by local people, is one of the most promising production strategies to counter the threatening consequences of increasing environmental degradation. There is growing international awareness of the need for a more sustainable use of land and natural resources, in particular, for the rural poor who are confronted with scarcities of fertile land, food, fodder and wood.

The aim of the Wageningen course will be to give participants the necessary knowledge, skills and motivation to encourage and support the active participation of rural populations in community forestry programmes. It will further help to strengthen national capacities to design, implement and evaluate community forestry activities within the framework of rural development.

The course is designed for programme officers who are engaged in policy formulation or in the design, management and evaluation of rural development programmes. Application by women is strongly recommended.

Those interested should write to: the Director of the International Agricultural Centre, PO Box 88, 6700 AB Wageningen, The Netherlands. Completed application forms must be returned before 10 June 1991.

Ecology and Society in the History of the African Sahel and Savannah

An international workshop on Ecology and Society in the History of the African Sahel and Savannah will be held in Nigeria in September 1991.

The aim of the workshop is to study, explain, interpret and establish the ecological history of the Sahel and Savannah regions of West and Central Africa, in relation to the historical transformation of the societies of the regions.

It is hoped that the workshop will bring together scholars and experts from all parts of the world who have been working on, or associated with, the study of the climatic and ecological changes which have been taking place in the region. Ecology is used here to refer to the multiplicity of features that constitute the natural habitat of man - including vegetation, flora and fauna, mineral and other resources, etc.

The workshop is being organised by the Department of History, Ahmadu Bello University, Zaria, Nigeria, in conjunction with the Department of History, University of Maiduguri, Nigeria and the Département d'Histoire, Université de Niamey, Niger.

Those interested in participating should write to: The Secretary, Organising Committee for Ecology and Society in the History of the African Sahel and Savannah, Department of History, Ahmadu Bello University, Zaria, Nigeria.

United Nations Environment Programme
Desertification Control Bulletin