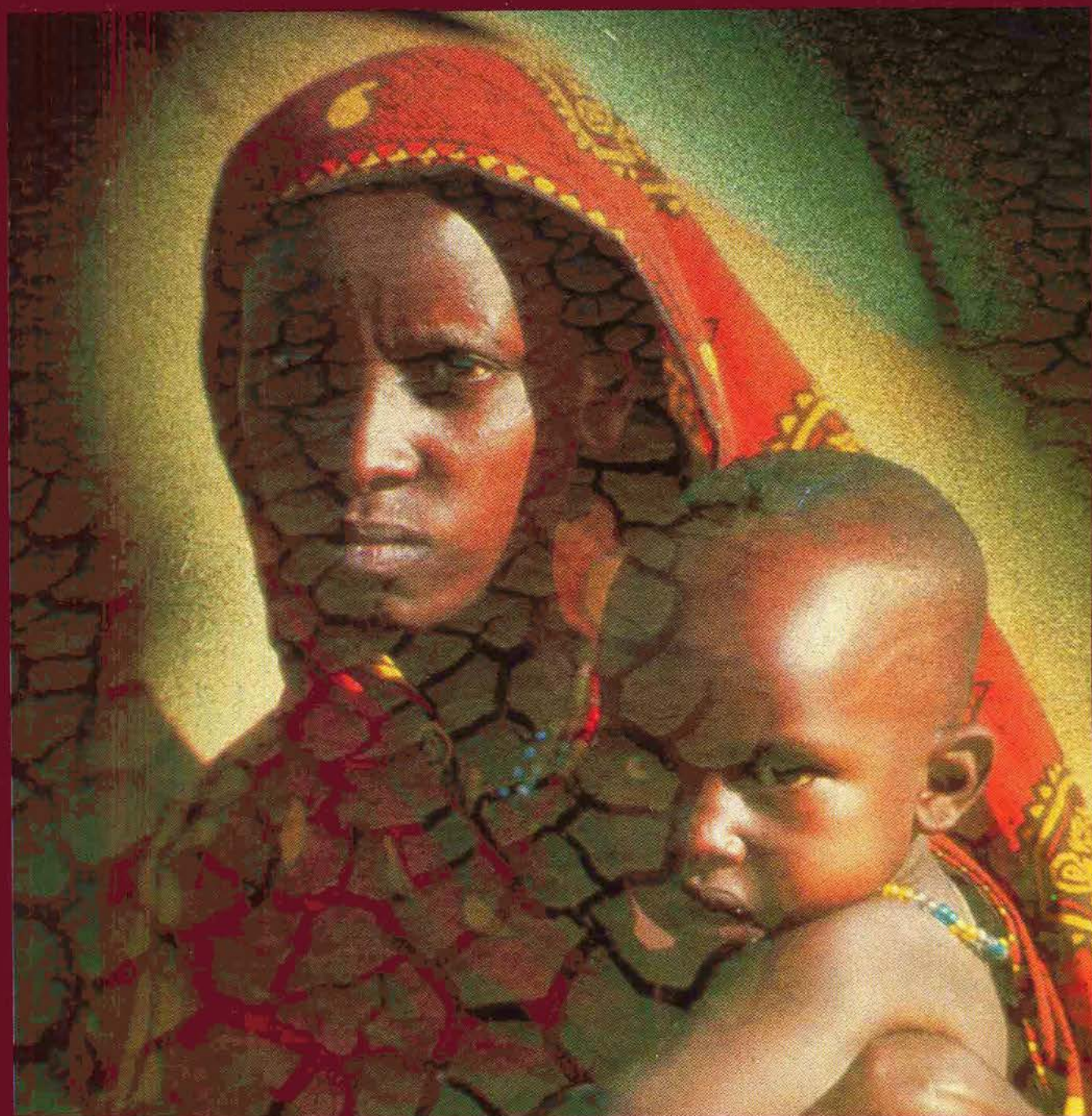


Desertification Control Bulletin

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

Special 10th Anniversary of UNCED Issue, Number 13, 1987.



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

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

- Immediately after approval of the Plan of Action, the Desertification Unit was established within the UNEP Office of the Environment Programme 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 combat against desertification around the world.

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Desertification Control Bulletin



United Nations Environment Programme

No. 15 1987

CONTENTS

PAGE

| | | |
|--|-------------------------|----|
| Desertification is a Human Tragedy: a foreword | <i>Mostafa K. Tolba</i> | 2 |
| The Tenth Anniversary of UNCOD | <i>Mostafa K. Tolba</i> | 3 |
| Reflections on the PACD | <i>H.E. Dregne</i> | 8 |
| A Review of Progress since the UN Conference on Desertification | <i>J.A. Mabbutt</i> | 12 |
| Seven Paths to Desertification | <i>Mohammed Kassas</i> | 24 |
| Reflections on Desertification 1977- 1987: Problems and Prospects | <i>Anders Rapp</i> | 27 |
| Lutte contre la désertification en Tunisie | <i>Christian Floret</i> | 34 |
| The Paradoxes of Desertification | <i>Brian Spooner</i> | 40 |

COVER PHOTOGRAPH:

Children suffer most from desertification. (UNEP/Daniel Stiles).

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

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Desertification Control Bulletin is published in English. Enquiries should be addressed to:

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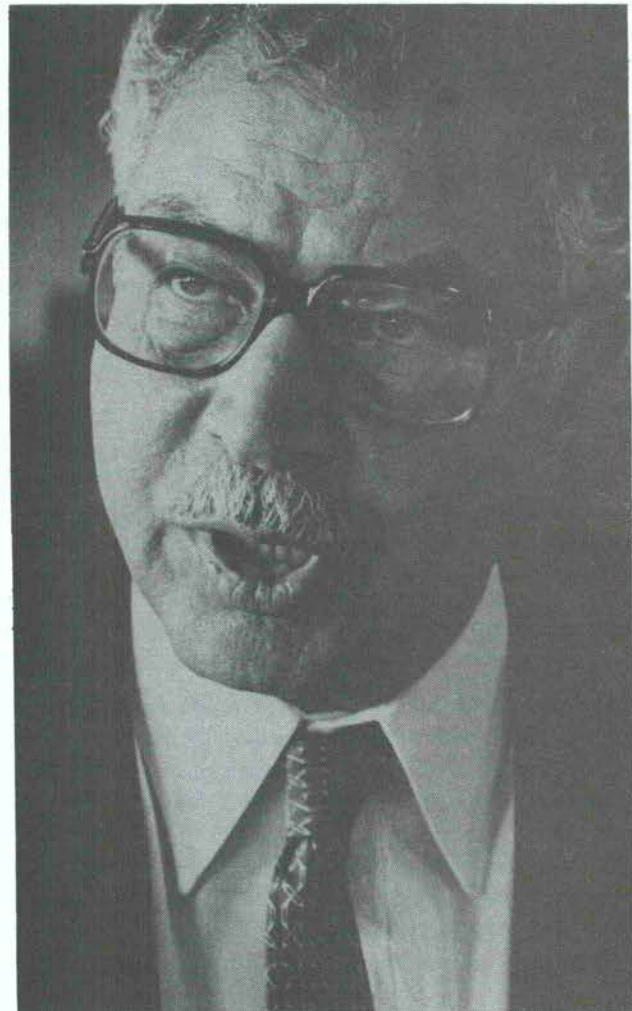
Desertification is a Human Tragedy

Ten years ago in Nairobi the United Nations Conference on Desertification was held. The Conference focused world attention on a process that was crippling food-production capabilities in extensive tracts of land in all continents. I was the Secretary-General of the Conference and I have vivid memories of the spirited debate, long working sessions and great sense of satisfaction all of the participants experienced at the end when the Plan of Action to Combat Desertification was approved. Desertification is one of the most serious environmental threats facing mankind, and I am dedicated to halting its spread. I realised that the road ahead would not be easy for UNEP, as the designated agency to follow up on co-ordination of the implementation of the Plan.

Where are we ten years after UNCOD? It grieves me to say it, but more land and, tragically, more people are affected by desertification today than in 1977. Hundreds of millions of dollars were spent on projects for controlling the spread of deserts over the past ten years, but they continue to roll forward. The task before us, the international community, is immense. A few hundred million dollars is not enough, we need billions of dollars. These billions need to be well spent and well managed. We are talking about saving at least 4.5 million square kilometers of food-producing lands, and almost one billion people who live on that land.

Desertification is a human tragedy. People chop down more trees than they plant, put too many livestock beyond the carrying capacity of the rangelands, cultivate on marginal lands and vulnerable steep slopes and cause waterlogging and salinization from improper irrigation. There are many different reasons why these things occur, but generally they need not if appropriate outside help is forthcoming. The people who cause desertification inevitably suffer from its effects.

UNEP has not lost hope. I personally believe that desertification is stoppable. This special issue of the *Desertification Control Bulletin* presents the personal views of some of the world's experts on the problem of desertification on what has been achieved since UNCOD.



Mostafa K. Tolba
Executive Director

The Tenth Anniversary of UNCOD

Mostafa K. Tolba
Executive Director
UNEP.

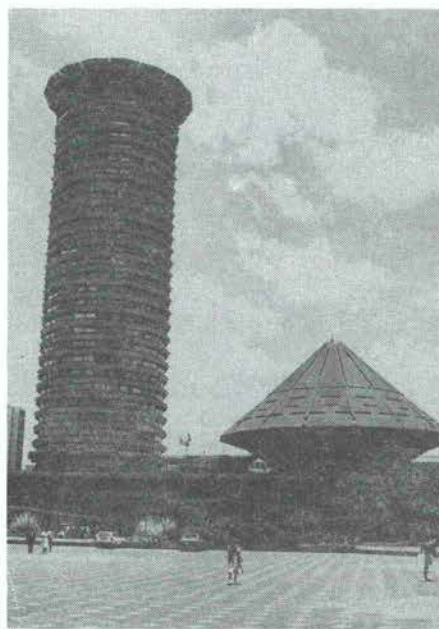
In the late 1960s, there were a few years of below average rainfall in the Sudano-Sahelian region of Africa. It was not known at the time that this small climatic fluctuation would become a general trend in the region over the next 15 years, up to 1985 when good rains finally returned. No one knows how long good rains will last; perhaps they will just be a temporary respite as they were in 1974 and 1975. By 1973 many tens of thousands of people and hundreds of thousands of livestock had perished as a result of drought-related causes. It became a good story for the news media.

As the Sahel became daily international news, the horror of its environmental disaster was also etched into world consciousness. There were haunting visions of peanut fields turned into dustbowls, dead livestock mummified by the sun, and starving children wasted into pot-bellied skeletons. The Sahelian disaster was a turning point. Just as the Sahel (derived from the Arabic word for border) forms the border between the Sahara desert and fertile lands to its south, so this juncture in its history would form the border between human ignorance of desertification processes and the beginning of a slow evolution towards knowledge.

The Sahel disaster raised many questions. Was the global climate changing? Was the Sahara expanding south? What implications did this have for the future? What could be done to prevent similar disasters? It was in the absence of answers to such questions that the U.N. General Assembly called for a world conference on desertification. Following more than two years of intensive preparations, some 500 delegates from 94 countries gathered in Nairobi from 29 August to 9 September 1977, to discuss desertification - the definitions, problems,

implications and, most importantly, the solutions.

The General Assembly resolution that called for the conference (Res. 3337 (XXIX)) delegated responsibility of preparing for the meeting to the Executive Director of the United Nations Environment Programme, with UNEP's Governing Council of 58 member-countries serving as the international authority in charge. As Secretary-General of the conference, I drew extensively on the resources of the world scientific community in order to ensure, as the General Assembly resolution directed, that "all available knowledge in this area is fully utilized." Four scholarly reviews were commissioned that looked at the relationship of desertification to climate, ecological change, technology and society¹. Underpinning these reviews was a second set of studies, funded by the United Nations Development Programme, that looked at the actual processes of desertification in a number of countries². A further group of scientists looked at the feasibility of transnational attempts to fight desertification. Other scientists within and outside the U.N. system prepared world



The Kenyatta International Conference Centre, where UNCOD was held in 1977. (UNEP/Daniel Stiles).

and regional desertification maps. Based on this an Overview was prepared, which served as the main document for the conference delegates³. As Lloyd Timberlake commented in his book *Africa in Crisis*,⁴ "UNEP mounted one of the best UN conferences ever in terms of scientific data and explication of an issue".

Some of the findings of the scientific studies were striking. It was clear that desertification was not just affecting a few countries in Africa. Based on climatic data, more than a third of the earth's surface is desert or semi-desert and more than 15 per cent of the world's population lived in those areas. Based on vegetation and soil criteria, however, it was found that 43 per cent of the earth's land surface was desert. The difference of some 9,115,000 square kilometres, an area larger than Brazil, was man-made desert. One hundred countries were identified as being threatened by desertification. This was clearly a global problem of major proportions.

The Plan of Action

A professional paper written in 1978 by the International Institute for Applied Systems Analysis found that UNCOD produced unprecedented "reverberations" in the form of increased spending on desertification control, attempts to formulate plans and strategies, additional research and the spread of awareness about the issues. Finally, the paper said that "UNCOD has generated more post-conference discussion than any previous UN conference."

But the true test of the value of UNCOD would be the Plan of Action to Combat Desertification (PACD). Their Plan was based on the belief that desertification is man-made and, therefore, that man has the power to control it. The following statement issued by the conference sums up the UNCOD philosophy:

"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. These degraded patches, like a skin disease, link up to carry the process over extended areas. It is generally incorrect to envision the process as an advance of the desert frontier engulfing usable land on its perimeter: the advancing sand dune is in fact a very special and localized case. Desertification, as a patchy destruction that may be far removed from any nebulous front line, is a more subtle and insidious process."⁵

The central theme of the PACD is that action must not await complete knowledge of the complex causes and effects of the processes. Immediate action was needed to apply the considerable existing knowledge, not only to halt the physical deterioration manifested by the phenomenon, but also to educate people about it. There was, and still is, a strong belief amongst the general public that desertification is caused by drought. This question raises much heat and dust of its own, but UNEP's view, based on the UNCOD studies, supports a belief that drought only exacerbates desertification. It does not cause it: improper land use is the cause.

The 28 recommendations of the PACD, therefore, were oriented towards what could be done to halt desertification, recognizing that droughts would occur, and acknowledging that drylands have a low level of biological productivity. Trying to stretch that productivity puts the land under dangerous stress. The PACD proposed provisions dealing with monitoring and assessment, land and water management, application of anti-desertification corrective measures, socio-economic aspects, science and technology, and formulation of proper policies and plans. It called for specific actions to be taken at the national, regional and international levels.

The body designated by the General Assembly for implementing the Plan was UNEP, whose task was "to request and co-ordinate actions throughout the UN system; stimulate national and regional action; provide assistance in project design;

suggest strategies for financing projects; and arrange for and co-ordinate publications, training and research." UNEP would act in its traditional role of catalyst and co-ordinator, while the actual work of combating desertification would be handled by governments through their national institutions, in co-operation with UN and bilateral aid agencies.

Desertification Control PAC

In 1978, UNEP's newly-created Desertification Unit went to work with a mandate to put recommendations of the PACD into effect. In addition, the UNEP Governing Council and the UN General Assembly would specify particular activities for priority action. As part of this mechanism, the UNEP Executive Director is to submit annually a detailed report to the Governing Council outlining the progress made on the PACD.

The name and status of the original Desertification Unit has been upgraded twice, in recognition of the growing importance of desertification work. In 1980, it became the Desertification Branch, and in 1985 it assumed its present identity as the Desertification Control Programme Activity Centre, or DC/PAC. It operates now with a staff of eight to ten professionals. It carries out seven functions to implement the PACD:

- 1) assisting governments in national policy planning;
- 2) supporting international bodies and networks;
- 3) acting as a catalyst and co-ordinator of anti-desertification activities;
- 4) monitoring, assessing and mapping desertification;
- 5) supporting pilot demonstration projects;
- 6) setting up research and training projects;
- 7) collecting and disseminating information.

From 1978 to 1983, UNEP spent almost \$17 million on some twenty-five desertification control projects.⁶ DC/PAC currently has more than twenty projects, with several more in the pipeline, costing well over \$50 million, of which UNEP is providing about 40 per cent. Through DE-

SCON, the Consultative Group for Desertification Control, a further \$45 million has been mobilized for implementing the PACD. DESCON is composed of UN agencies, donor agencies and national governments. The object of DESCON is to identify existing resources, stimulate new ones and undertake collaboration between donor groups and receiving countries. DESCON also acts as a forum for donor and recipient countries to meet and discuss desertification control policy. DC/PAC serves as DESCON's secretariat, and also assists governments in formulating project proposals and channeling them to DESCON for consideration and support.

Another key mechanism is the Inter-Agency Working Group for Desertification Control (IAWGD), a body whose purpose is to co-ordinate UN activities related to desertification control. IAWGD also acts for information exchange between agencies, plans co-operative activities such as the preparation of teaching and management manuals, and advises UNEP on its own planned activities. Serviced by DC/PAC, it cuts down on duplication of effort by UN agencies. It has not yet managed to put together a comprehensive plan, however, to co-ordinate all UN activities in the desertification field.

The Gap

The PACD called for the first major review of progress on its implementation after seven years, in 1984. This General Assessment of Progress (GAP), turned out to have an appropriate acronym. UNEP sent out some 100 questionnaires to the countries affected by desertification and a sample of developed countries. It turned out that no one could supply the data necessary to fill out the questionnaires. UNEP commissioned a group of expert consultants to prepare reports on various aspects of the status and rate of desertification in different parts of the world, and on the implementation of the PACD from both technical and financial points of view. The consultants found out that there was indeed a Desertification GAP.

From the 4,000 pages of background documentation produced for the GAP, it became apparent that one of the main reasons the PACD was not being implemented, and

that desertification was spreading unabated,⁷ was a lack of political will on the part of affected and potential donor countries to tackle the problem. As I said at the time:

“Desertification and the other threats to the planet’s life-support systems are causing social and political breakdown which in turn threatens our tenuous global security. In UNEP, we believe that a failure to recognize this ultimate, environmentally-induced threat lies at the root of the apparent unwillingness of nations to tackle desertification and resource exhaustion on anything like the scale demanded.”

We need look no further than the absurdly inadequate level of contributions to the Special Account set up in 1979 to finance the PACD for an illustration of the low priority nations attach to tackling the problem. By the end of 1983 it had received less than \$50,000 - all from developing countries⁸.

The GAP studies also resulted in the identification of two phenomena which were closely correlated with desertification processes: high population growth and underdevelopment. In 1984, when I presented the GAP report to UNEP’s twelfth Governing Council,⁹ the Three Horsemen of the Apocalypse, Desertification, Population Growth and Underdevelopment were joined by the Fourth, Famine. Millions of people were threatened by starvation in over twenty African countries. Desertification destroys the productive capacity of the land and, when drought strikes, the weakened land collapses.¹⁰ Many thousands of people died of starvation, as tragically portrayed in the UNEP-sponsored film “Seeds of Despair”, which was screened in Great Britain in July 1984 and resulted in the creation of the Ethiopian Famine Relief Fund.

The African drought of 1982-1984 and subsequent famine refocused attention on the need to provide food security to the world’s poor. UNEP’s message during this period was that the best way of achieving this goal was to safeguard the land’s productivity. That meant stopping desertification and rehabilitating degraded land. From 1985 onwards there have been encouraging signs that perhaps the message

of the GAP has been received by governments. There is now much more discussion in the halls of power about incorporating environmental concerns in development policy and planning as related to agricultural production and land management. Perhaps at UNEP’s second General Assessment of Progress, planned for release in 1992, there will not be such a GAP.

UNEP’s Actions

It is not possible to present everything that UNEP is doing on the implementation of the PACD, but I can highlight some of the more important actions which we have taken.

Formulation and adoption of National Plans of Action to Combat Desertification (NPACD) is a vital first step for effective action at the national level. UNEP’s approach is to integrate a NPACD into the development plans of a country, thereby linking environmental concerns with development. To date, plans have been prepared for Tanzania, Burundi, Sudan, Tunisia and Uruguay, and plans are underway for several more countries. In the early years following UNCOD, there were few requests received for UNEP assistance, but many more countries are now interested in formulating NPACDs.

UNEP provides substantial institutional and programme support to the United Nations Sudano-Sahelian Office (UNSO), a joint venture with UNDP. UNSO has assisted several countries in its mandated range of 22 African states in formulating NPACDs.

UNSO has also been successful in mobilizing funding for desertification control projects and in 1986, its programme was composed of activities with a total funding of \$47.6 million. Its activities are mainly in the areas of reforestation, alternative sources of energy (in a region where fuelwood supplies about 90 per cent of the demand), water resource management, range management, soil conservation and sand dune stabilization. UNSO and UNEP co-operate directly in five projects in the region.

UNEP has also co-operated closely with UNESCO in its arid lands part of the Man

and the Biosphere programme, both in Tunisia and by providing initial financial support to the Integrated Project on Arid Lands (IPAL) in Kenya, which subsequently received generous assistance from the Federal Republic of Germany. IPAL’s objectives were to study the ecological and socio-economic aspects of desertification processes in pastoral nomadic dryland areas and design management plans based on the results. The outputs of the Tunisia project have been put to practical use in the formulation of the Tunisia NPACD and in subsequent priority projects, three of which have received UNEP support. The management plan emanating from the Kenya project is about to be implemented with UNEP’s co-operation.

The PACD recommended a series of transnational projects intended to operate on a regional or sub-regional basis. Unfortunately, most of these failed to materialize as planned owing to strained political relationships between countries. However, two of the proposed projects did start up in reduced form: the Transnational Green Belt in North Africa and The Regional Aquifer of North-East Africa. The first involves the improved management of land and water resources and includes a large scale tree planting programme intended to halt the northward spread of the Sahara Desert. The second is the evaluation of the potential of the Nubian Sandstone Aquifer that extends over areas of Libya, Chad, Sudan and Egypt. Only the latter two countries are participants in this project. UNEP helped form and fund the Permanent Joint Secretariat for the Transnational Green Belt and it finances the co-ordination secretariat for the North-East Africa Aquifer project, which is receiving support and funds from UNDTCD and the Governments of the Federal Republic of Germany and Italy.

The PACD called for extensive FAO/UNEP collaboration on producing a Desertification Map of the World. Phase I, starting in 1979, was designed for the development of a provisional methodology for assessing and mapping desertification dynamics.¹¹ Scientists tested the methodology under field conditions in Mexico, Texas (U.S.A), Burkina Faso, Sudan, Tunisia, Syria, Pakistan, Turkmen SSR (U.S.S.R) and Australia. Phase II began in

1983 and resulted in the production of a world map (1:10 million scale), of soil elements used in assessing desertification, and a map of desertification hazard in Africa on a scale of 1:5 million. These were prepared using advanced Geographic Information System technology and digitized cartography. UNEP is now making final revisions to the methodology for assessing and mapping desertification in a national case study, in co-operation with the Government of Kenya. When the methodology has been refined by field testing and evaluation by Kenyan users and other experts, it will be disseminated to governments and research institutions for use as a standardized methodology.



Desertification Control PAC is establishing a Desertification Information System. (UNEP/Daniel Stiles).

In 1986, DC/PAC initiated a Desertification Information System (DESIS) for use with micro-computers. DESIS will be composed of a number of databases on various desertification subjects. An annotated directory of more than 500 institutions concerned with desertification-related work has already been completed, as has a compendium of UN activities in the field of desertification. Detailed annotated bibliographies are being established on wind erosion and its control, and on NGOs and their actions.

Disseminating information is also one of UNEP's major activities. DC/PAC does this in a number of ways, beginning with the *Desertification Control Bulletin*. The

Bulletin appears twice a year and reports on what UNEP and other organizations and governments are doing to combat desertification. It also publishes high quality scientific articles on topical subjects related to desertification and its control.

DC/PAC has also prepared a two-volume work on institutions and actions in Africa related to desertification control, and the database mentioned above of a global annotated directory has been published. Teaching and management manuals, as recommended in the PACD, are being prepared in collaboration with FAO for use in training programmes, covering such topics as water management, sand dune stabiliza-

tion, afforestation, range management, etc. A number of manuals and reports have also been published as a result of UNEP-sponsored training courses in the U.S.S.R and China, and these are available upon request from DC/PAC.

Audio-visual programmes have proven themselves to be one of the most effective ways of getting information across to the public and scientific community. A commented slide show, "Harvest of Dust", has been prepared for distribution in four languages, and DC/PAC has contributed to the production of several television documentaries in collaboration with the Television Trust for the Environment (TVE). TVE was started up in 1985 as a joint

venture between UNEP and Central Independent Television in the U.K; it is turning into a great success through the production of entertaining, but scientifically sound films on various environmental issues of importance to mankind.

The most direct, and perhaps lasting, method of passing information is through training. DC/PAC supports training in desertification control in co-operation with the Government of China, the U.S.S.R Commission for UNEP (UNEP/COM), the UN members of the IAWGD and training institutes. During 1986, a total of 2,184 trainees were given instruction in various desertification control principles and methods in DC/PAC-supported projects. Networks of research and training institutions in the Asia and the Pacific region and West Asia are far along in development, and similar networks in Africa and Latin America are planned to follow.

Co-operation with NGOs is a growing activity with UNEP, particularly since there is an increasing awareness on the part of governments and aid agencies that community-based development projects have higher rates of success and longer-lasting impact than projects planned from above. DC/PAC has assisted in strengthening the African NGOs Environmental Network (ANEN), and, through it, is supporting several grassroots level projects in West, East and Southern Africa. Workshops, a newsletter and other publications are also being financed under the project. Similar networks of NGOs in the Asia-Pacific and Latin America regions are being established which will boost NGO activities in these regions. DC/PAC is also supporting, as a pilot demonstration project, an afforestation and education project in southern India run by the Millions of Trees Club.

The Cairo Plan

A promising omen for the future took place in December 1985 in Cairo, when the First African Ministerial Conference on the Environment convened. Sponsored by UNEP in co-operation with the UN Economic Commission for Africa and the Organization of African Unity, the conference served as a forum on the environment for ministers from almost every country in

Africa, observers from more than fifteen non-African countries, and from thirty UN, NGO and specialized agencies. The conference plotted a specific strategy for the foreseeable future in Africa called the Cairo Plan. UNEP was given the responsibility for implementing two types of regional desertification projects as a follow-up to the Plan.



Under the Cairo Plan, water traction animal pumps will be used to produce irrigated fodder. (WHO/PA. Almasy).

The first type of project involves pilot schemes in thirty African countries having semi-arid stock-raising zones. The idea is to rehabilitate pastures and livestock herds by the provision of irrigated fodder, in the wake of the terrible droughts which have affected various parts of Africa.

Water pumps powered by animal traction will irrigate small plots to produce fodder that will provide dry season forage for family herds, reducing pressure on rangelands and allowing them to recover.

The other plan is to take three villages from separate environmental zones in each of 50 African countries and undertake an integrated development scheme on each village. The goal is to make these villages self-sufficient in food and energy by using local traditional skills and experience in the application of economically feasible, environmentally sound and socially acceptable methods. The aim is to return to the cultural and economic self-reliance and know-how that rural African people possessed and used before the arrival of external ideas for development. Development often serves not to wipe out poverty but to modernize it.

The Road Ahead

The PACD which resulted from the UNCOD meeting remains a valid document. It will continue to guide UNEP in the years ahead in its fight to halt the scourge of land destruction called desertification. However, UNEP cannot do it alone, and I call on governments, international organizations, NGOs and concerned individuals to work with us. The alternative is falling food production, continuing underdevelopment and increased numbers of environmental refugees. This is not acceptable.

NOTES

1. These reviews, including the Overview mentioned below, were published in *Desertification: Its Causes and Consequences*, Secretariat of UNCOD eds, Pergamon Press, Oxford, 1977.
2. See J.A. Mabbutt and C. Floret, eds, *Case Studies on Desertification*, Natural Resources Research XVIII, UNESCO, 1980 and J.K. Jain, ed, *Combating Desertification in Developing Countries*, Scientific Publishers, Jodhpur, 1986.
3. *Op cit* Ref 1.
4. Lloyd Timberlake, *Africa in Crisis*, Earthscan, London, 1985.
5. United Nations, *United Nations Conference on Desertification, Round-Up, Plan of Action and Resolutions*, United Nations, New York, 1978.
6. Desertification Branch, *Activities of the United Nations Environment Programme in the Combat Against Desertification*, UNEP, 1983.
7. For a summary of the report GC. 12/9 on the General Assessment see J.A. Mabbutt, 1984, 'A new global assessment of the status and trends of desertification', *Environmental Conservation*, 11(2):103-113.
8. Mostafa K. Tolba, 1984, 'Harvest of Dust', *Desertification Control Bulletin*, 10:2-4.
9. UNEP/GC. 12/9, 1984.
10. See Daniel Stiles and Ross Brennan, 1986, 'The Food Crisis and Environmental Conservation in Africa', *Food*

Policy, November, pp 298-310 for a detailed argument.

11. FAO, *Provisional Methodology for Assessment and Mapping of Desertification* FAO/UNEP 1983.

Reflections on the PACD

H.E. Dregne
Texas Tech University

The United Nations Conference on Desertification (UNCOD) and the Plan of Action to Combat Desertification (PACD) were the result of a lengthy and involved series of preparatory actions and decisions. UNCOD and the PACD were notable, in my opinion, because they called the world's attention to drought and its impact on human welfare, and to the insidious nature of desertification. Moreover, the conference and the Plan of Action probably did more to arouse concern for the future of drylands than any action that had taken place in the previous decade.

Originally, UNCOD seems to have been regarded by Sahelian countries as a golden opportunity to seek help in coping with the social and economic disruption caused by the 1969-1973 sequence of drought years. Although the Sahel region certainly was, and continues to be, at the forefront of global concern, planning for UNCOD was extended to dry regions everywhere. No conference before or since has provided a comparable forum on the threat of land degradation in arid and semi-arid regions.

My personal reflections on desertification control are centered on four topics: definition of desertification, drought and humans as causes of desertification, mapping of the hazards or status of desertification and progress made in desertification control.

Definition of Desertification

How the term desertification came to be associated with drought and the proposed United Nations conference is unclear. A. Aubreville, a French forester working in the humid tropics of West Africa, apparently was the first to use the term, in his book on *Climats, Forêts, et Désertification* in 1949. M. Kassas published an article in 1970, entitled "Desertification versus potential for recovery in circum-Saharan ter-

ritories". This seems to have been the first time the word was used in an English-language publication. One year prior to UNCOD, Anders Rapp edited a booklet on desert encroachment in which he said that he treated desertification, desertization, and desert encroachment as synonymous because it was too difficult to define the separate terms in a way that would be understood and accepted by both scientists and laymen. He correctly foresaw the confusion that the terms engendered. Rapp defined the combined terms as the spread of desert-like conditions in arid or semi-arid lands. Aubreville did not define desertification. Kassas implied that desertification was the same as LeHouérou's 'desertization', which was described as degradation of drylands owing to mismanagement of native vegetation. It seems likely that Professor Kassas was the person who suggested that the proposed United Nations conference be called a desertification conference.

Irrespective of who was responsible for the name, the choice was a stroke of political genius. Desertification carried the connotation of disaster and required no explanation. Practically everyone knew intuitively that desertification was bad, irrespective of what it referred to. And if it was bad, something should be done to stop it. Few persons ever asked what "it" was. As I recall, the UNCOD consultants spent at least a year discussing desertification before we got around to asking what the term meant. By the time we did, we had already achieved a consensus about the processes of desertification and their causes, so a definition was fairly easy to devise. As given in the PACD, desertification is the diminution or destruction of the biological potential of the land.

The PACD definition seemed to me to be straightforward and unambiguous. However, we learned during and after UNCOD that a lot of people either found the definition ambiguous, or never read the UNCOD

documents, or had their own ideas of what desertification was. The first real warning that the term meant vastly different things to different people came at UNCOD when one speaker claimed that desertification included something called "hydrologic quandary". What that meant was never clear to me except that somehow it was associated with river flow in a humid region. Strange though that extension of the desertification concept was, it had its counterpart in the term "ocean desertification" that was used in a well-known book. And those examples are only of extreme cases. A more common variation is represented by a sentence in *World Resources 1986*, that refers to "critical resource problems, including soil erosion, deforestation, desertification, salinization, and loss of soil nutrients". The book does not say what desertification is, but it is obvious that the writer has a very narrow view of desertification.

The most frustrating aspect of desertification, to me, has been the lack of agreement about what it is. With so many different concepts of what the terms means, it is impossible to discuss the process or its cause and effect without first defining it. Articles and books written before UNCOD could be forgiven for using desertification, desertization, desert encroachment, desert creep, and expanding desert as synonyms or as completely different phenomena. After UNCOD and the PACD definition, however, I thought that there would be a reasonably good agreement on the term desertification, at least. It was not to be.

It baffles me why the simple PACD interpretation is not accepted widely. It says that desertification is the diminution or destruction of the biological potential of the land. I prefer my own definition because it spells out the major process involved in the diminution or destruction of the land's biological potential and assigns blame to humans. However, there is no conflict between that definition and the one

in the PACD; the concepts are the same.

Given the seemingly endless number of ways in which "desertification" is used, I am forced to conclude that a lot of writers who profess to speak knowledgeably about it, are unaware of what UNCOD was all about and are unfamiliar with the PACD. They also seem to not know what Aubreville was referring to in his book. His failure to define desertification may be responsible for some of the varied interpretations of the word, but I doubt that his omission made much difference. He, after all, used the term with reference to deforestation and soil erosion in the humid tropics, whereas practically everyone today associates it with dry regions. Interestingly enough, the PACD definition says nothing about the climatic regions in which desertification occurs.

Perhaps we need an international conference to define desertification. I recommend that the convenors of the conference state categorically that the definition against which all others will be compared is that in the PACD. Anyone who wants to change the definition will have to justify it before his peers. Since the conference should be run democratically, all proposed definitions would have to be reviewed. Then the alternative proposals would be discarded and the PACD definition would emerge as the proper one. Any mean-spirited person who opposed that decision could be ejected as a disruptive force. The likelihood that such a meritorious conference would be held in the foreseeable future ranges from zero to none. Therefore, I suggest that the editor of the *Desertification Control Bulletin* print the PACD definition of desertification on the Contents page of each and every issue of the Bulletin. Furthermore, the Desertification Control Programme Activity Center would be wise to publicize the PACD definition at every opportunity. The world needs to be educated.

Causes of Desertification

In the 1975 meetings of the consultants whom Dr. Mostafa Tolba, Executive Director of UNEP, invited to assist in establishing the scientific basis for desertification and its control, emphasis was on drought as the cause. Walter Orr Roberts,

Reed Bryson, and Herman Flohn, each of them a distinguished meteorologist, furnished insights into weather and climate phenomena that were highly useful. Dr. Flohn, with a colleague at the University of Bonn, produced a global climate aridity index map that was published by UNEP for UNCOD.

As discussions continued over the next two years, there was a gradual shift away from drought as the causative agent for desertification. Instead, human action began to receive more and more attention. By the time UNCOD was convened, droughts and humans had about equal prominence as desertification causes, with considerable talk about drought only exacerbating the human impact. Today, human action is widely blamed and drought is looked upon as a contributing factor for the special case of rangeland deterioration and accelerated wind erosion. Nevertheless, a large segment of the environmentally-concerned public appears to believe that there is no desertification without drought.

The difference in emphasis is significant. If drought is the cause, it becomes an act of God over which humans have no control. If the cause is human actions, then humans can take steps necessary to control the problem, if they have the will to do so. There can be no hiding behind the lament that God has willed it. Enclosure studies around the world have demonstrated the potential for recovery of overgrazed and drought-affected pastoral lands, even during droughts.

Mapping Desertification

One of the preparatory tasks assigned to FAO and UNESCO was to produce a global desertification map. Much to my disappointment, it turned out to be a desertification hazard map rather than the desertification status map I had hoped for. None of the other persons participating in the consultants meetings seemed to be concerned about the difference between a status map showing where desertification was a problem and a hazard map indicating where desertification might be a problem unless appropriate measures were taken to avoid it. I thought it was important to have some indication of the severity of current desertification processes so I prepared such a map.

My map was based on very little data and a lot of opinions. Many changes have had to be made. I think the original map would have been better if FAO/UNESCO scientists had prepared it, not because they would have had more data, but because they would have had access to more reliable opinions. I think hazard maps are of little value because they are basically soil maps, better versions of which were published in the FAO/UNESCO Soil Map of the World Project, and they provide no guidance about where action programmes are needed. Furthermore, comments I hear about the map make it clear that most people think it is a status map, not a hazard map. I well remember the cries of outrage that went up among some Australians because the map showed salinity and erosion hazards where there currently was no such problem.

Few people seem to be concerned about something I continue to believe is important. The absence of real interest in assessing and monitoring desertification confirms the lack of concern. I find it difficult to accept a situation in which our failure to collect at least a modicum of good field data on desertification status and trends means that the next global assessment will be no better than the 1984 assessment.

Progress on Controlling Desertification

At first glance, little progress seems to have been made in carrying out the recommendations of the Plan of Action to Combat Desertification. No national plans of action have been carried out, water and wind erosion continue to plague agriculture, more and more wells are dug and the vegetation around them is devastated, mobile sand dunes threaten communities and lines of communication, dust still fills the air when the winds rise, and rural people do not share the benefits development has conferred on their urban cousins.

Despite the essentially pessimistic results of the 1984 assessment of progress, I believe that much has been accomplished. There is no question in my mind about the contribution UNEP has made since 1977 in bringing about awareness of the impacts of desertification on society as well as the magnitude of the problem and the potential



During the dry season the landscape is barren in Niger. (Photo: Harold Dregne).

for controlling it. In addition, the desertification awareness activities have had the broader benefit of focusing global attention on the limitations of arid lands for development. Although no single agency can take credit for increased environmental awareness, certainly reaction to the word desertification has heightened concern about land degradation globally, and not only in the dry regions. Desertification is no longer a strange word associated only with UNCOD and UNEP.

Two recent reports by the World Bank and the U.S. Office of Technology Assessment reflect a change in attitude towards drought and desertification that seem to me to be of far-reaching importance. The 1984 World Bank study is titled "Toward Sustained Development in Sub-Saharan Africa". The 1986 Office of Technology Assessment volume, which analyzes programmes of the U.S. Agency for International Development, is entitled "Continuing the Commitment: Agricultural Development in the Sahel". Both reports place high priority on achieving a sustainable agriculture, which means a type of development that will accommodate the shocks of drought and desertification. Desertification control, then, finally becomes an integral part of the development process, not an isolated activity. That was a central theme enunciated in the PACD.

When I look back on what has been accomplished in desertification control, I see a

multitude of small actions that in the aggregate are significant. UNCOD undoubtedly was a powerful stimulus for an expanded interest in afforestation around the world. In the United States, the National Academy of Sciences undertook comprehensive investigations of potentially valuable trees for arid regions. Publications dealing with fuelwood crops, *Leucaena*, and other underexploited tropical plants have been distributed worldwide. *Leucaena*, a fast-growing woody plant, was almost unknown several years ago; now every development specialist in the world seems to have heard of it.

Desertification proved useful as the theme for support to Sahelian countries through the French Ministry of Cooperation. A 1980 report listed desertification in the Sahel. The report also stated that desertification was caused by the multiple actions of humans and that desertification control should be done in the context of national development, two themes that UNCOD had enunciated. It is of interest to note that not one of the desertification projects had the word "desertification" in its title.

A 1986 report prepared by the German Agency for Technical Cooperation (GTZ) reviewed the problems and experiences of desertification in African drylands and proposed guidelines for combating it. As with the French example, desertification control was seen as a part of national development and as caused by man. Perhaps in response to the 1984 assessment of prog-

ress in combating desertification conducted by UNEP, the German report emphasized the need to give primary attention to resource conservation in rainfed croplands. The report cites numerous examples of desertification projects that have been carried out by governmental and non-governmental agencies (NGO's). Few, if any, had titles that mentioned desertification.

It seems to me that we make a mistake when we assess progress in desertification control by the number of governments that have established national agencies on desertification or have prepared national plans of action to combat desertification. United Nations agencies, national governments, donor agencies, and NGO's simply do not set up individual projects whose immediate objective is to control desertification. That makes sense if desertification is thought of as the land degradation processes of soil erosion, deforestation, destruction of rangeland vegetative cover, salinization, soil compaction, loss of plant nutrients, or soil pollution. Individual projects are directed towards controlling deforestation or water erosion, not desertification. There are desertification control programmes and almost an endless number of desertification meetings and conferences, but few projects bearing the desertification name. That is as true of United Nations projects as it is of French, German, and the United States technical assistance projects. For the most part, existing agencies are capable of handling desertification issues.

When I look around, I see many examples of a heightened awareness of the threat posed by desertification. Yet, on-the-ground control of desertification leaves much to be desired. When I ask myself why this is so, I conclude, as many others have, that it is the result of factors other than insufficient technical knowledge, although local applied research certainly needs strengthening. The problem is, in my view, that land degradation is a pervasive threat having such large dimensions that coping with it seems almost impossible, given the meager financial, administrative, operational, and technical resources of less developed countries. When we phrase desertification hazards in terms of millions or billions (milliards) of hectares affected and billions of dollars needed to combat the

problem, we may be instilling a sense of hopelessness that a poor country can never do anything about it. Perhaps we need to prioritize our objectives and place more emphasis on small successes than on the immensity of the remaining problem.



After the rains, the same general area is transformed. (Photo: Harold Dregne).

There are countless examples of successes in combating desertification, some of them detailed in the 1985 report on Africa by the Desertification Control PAC. The successes I know affect land areas ranging from a few hectares to a few thousand hectares. Stopping the sand dune encroachment threat to the Al-Hasa oasis in Saudi Arabia involves only a few hundred hectares, as did windbreak planting in the Maggia Valley in Niger, gully plugs in the Potwar Plateau of Pakistan, and salinity control in the North China Plain. It is unrealistic to expect all of the arable sandy lands in Niger to be protected by windbreaks in ten or even twenty years, yet we are disappointed if it is not done.

If accomplishments are greater than we thought and failure to act less than we feared, as I think is true, then we should be inspired to continue the battle. The important thing, I believe, is to not be unduly discouraged. We must stay on course. In view of the significance of the threat to humankind, we really have no choice.

Monitoring Desertification

My major disappointment in the last ten years has been the absence of degradation monitoring in developing countries of the arid regions. We do not have any more

good information on rangeland deterioration, shifting of vegetation zones, severity of wind and water erosion, and salinization of cropland in 1987 than we did in 1977. Monitoring is being done in several developed countries and in a few developing countries in the humid regions. Deforestation in the humid regions currently receives much-needed attention, including monitoring. No such attempt is directed toward assessing land degradation trends in the arid regions.

Aside from the need for more reliable information than that provided by guesses and estimates in understanding where desertification is worsening or improving, we need data because the credibility of statements on desertification is now in question. Claims that the Sahara is expanding at some horrendous rate are still made despite the absence of evidence to support them. It may have been permissible to say such things 10 or 20 years ago when remote sensing was in its infancy and errors could easily be made in extrapolating limited

observations. It is unacceptable today. I think that we must set up a few monitoring points in strategic ecological locations that will incorporate ground and remote observations. It is wrong to allege that the Sahel or the Indus Valley are consigned to inevitable destruction when it is obvious that a favourable moisture year in the Sahel or a successful salinity reclamation project in Pakistan can profoundly change the perception of land damage.

Concluding Reflections

Participation in the planning for UNCOD was a truly rewarding experience. Having the opportunity to benefit from the valuable insights of Mohamed Kassas, Jack Mabbutt, Boris Rozanov, and Gilbert White, in particular, was a distinct pleasure. Mostafa Tolba, as chairman of the consultant meetings, made it clear from the beginning that he was interested only in establishing a sound scientific foundation for understanding and combating desertification. No bombast, no politics. With the tone of the deliberations having been so well set, the meetings had to be informative and fruitful.

The Desertification Control PAC can take much credit for increasing public awareness of desertification. While we need to maintain that awareness, we now need more emphasis on information exchange. I have hoped that people wanting to know about the extent, severity, and methods of control of desertification would automatically turn to the Desertification Control PAC for help. Inability to provide that help has been a hindrance but activities now underway should alleviate the problem. Much has been learned during the past ten years. Now we need to capitalize on it.

A Review of Progress Since The UN Conference on Desertification

J.A. Mabbutt

Background to the Plan of Action

The political initiatives that led to the convening of the United Nations Conference on Desertification (UNCOD) in Nairobi in 1977 were in the first place a response to the social and economic crisis in the Sahelian countries following several years of severe drought in the southern borderlands of the Sahara. However, the global perspectives of the Conference and the worldwide evidence of the reviews, case studies and country reports presented at UNCOD revealed the existence of general and longer-term land degradation which threatened all the world's drylands and which was held to be causally linked with the critical manifestations of poverty and famine and the breakdown of entire systems of livelihood in the more vulnerable countries of the developing world.

This degradation, described by the term "desertification", was defined as "the diminution or destruction of the biological potential of the land" (United Nations, 1978), reducing its capacity for plant and animal production and amounting to an extension or intensification of desert-like conditions. Its more visible expressions included the destruction of forest and woodland, the devegetation and mobilisation of formerly stable dunes and sand sheets, accelerated soil erosion by gully-ing, sheet erosion and wind erosion in croplands, and the water logging and salinization of once-productive irrigated lands. Over large areas, desertification was advancing in a less obvious but more insidious fashion through loss of fertility and structure in agricultural soils and the impoverishment of natural pastures. The patterns of its advance left little doubt that the primary cause of desertification were the human pressure on natural resources and man's mismanagement of the land, rather than climatic change, although the stress of drought had undoubtedly aggra-

vated problems of regional resource management and had triggered or accelerated the processes of degradation.

Studies of desertification prepared for UNCOD focused on the arid and semi-arid zones and on areas of irrigated agriculture in otherwise little-settled arid zones, covering together some 40 million square kilometers or one third of the earth's land surface, and with a population put at more than 600 million. Three-quarters of this area was regarded as either threatened by or already affected by desertification, whilst almost 20 per cent was regarded as severely desertified, putting at serious risk the livelihoods of about 50 million people in less-advantaged areas (UNCOD Secretariat, 1977). It was claimed the the world's 9 million square kilometres of man-made desert was being enlarged each year by the loss of almost 60,000 square kilometres of productive rangeland, rainfed cropland or irrigated land through desertification, representing an annual capital loss of almost US\$13 billion in 1975 values.

The evidence was that desertification had generally progressed most rapidly in the developing countries, where its social and economic impact had also been most severe. This drew attention to the social, economic and political factors in desertification, which increases local pressure on land resources and restricts the options for improved land use and rehabilitation. They include lack of alternative sources of livelihood, the vicious cycle of poverty contributing to land degradation, thereby further increasing poverty, and the social, economic and technical deprivation among the worst-affected communities, which stood in the way of improvement. All too often the dryland sectors within countries and the dryland countries within regions tended to be the marginal areas, geographically, economically, and in terms of political influence and claims on investment. Ac-

cordingly, programmes to combat desertification would need to address not only its ecological manifestations, but also the economic and social ills contributing to the mismanagement of dryland resources.

Objectives and Principles of the UN Plan of Action to Combat Desertification

The Plan of Action to Combat Desertification (PACD) formulated by UNCOD and subsequently endorsed by the UN General Assembly (United Nations, 1978), recognised the magnitude, complexity and urgency of what was recognized as a global problem and attempted to address it through a co-operative approach at the regional, national and international level.

Three related objectives are identified in its recommendations: to arrest and reverse the environmental processes of desertification; to establish ecologically appropriate, productive and sustainable land uses; and to secure the social and economic advancement of the communities affected. The integration of measures to reconcile these several aims was stressed and the Plan recognized that actions would be mainly undertaken through national programmes based on local priorities and capabilities, as part of wider plans for economic development and social progress. It also emphasized the need for supportive regional and international actions since desertification processes do not stop at national boundaries. International involvement would also serve as a source of technical and financial assistance, in view of the limited resources of many of the worst-affected nations.

It was held that the technical knowledge for the immediate implementation of the Plan already existed, although it might need to be adapted to differing circumstances. The problem was rather the strengthening of technological resources in developing countries affected by desertification. The Plan set the year 2000 for the attainment of

its goal of overcoming the threat of desertification, but identified some measures for priority action, notably the establishment of national co-ordinating machineries, monitoring the nature, extent, severity and trends of desertification, and formulating plans to combat it.

The extent to which man was the prime agent of desertification was in effect a measure of his ability to combat the problem, and the corrective measures called for under the Plan were grouped under the main forms of land use: rangelands, rainfed cropping and irrigated lands, or in relation to the rehabilitation, conservation and management of water and vegetation resources, including forest and woodland.

An overview of the desertification problem prepared by the Secretariat of the Conference (UNCOD Secretariat, 1977) put the costs of salvaging the 60,000 square kilometres of productive lands of annual loss at US\$400 million (1977 values), and the total gains from reclamation at US\$1300 million providing financial benefits of around US\$900 million in addition to the wider-ranging social benefits. A later study commissioned for the UN General Assembly in 1980 estimated that the implementation of the PACD called for an expenditure of US\$4.5 billion a year over a period of 20 years and that the developing countries would need assistance at the level of US\$2.4 billion annually for this to be possible.

General Assessment of Progress

Responsibility for following up and co-ordinating the PACD was placed with the United Nations Environment Programme (UNEP), and this included an assessment of progress in its implementation seven years after its inception. Accordingly, the Executive Director of UNEP reported on a General Assessment of Progress (GAP) to the Twelfth Session of his Governing Council in May 1984. His report contained three related components, a global summary of the status and trends of desertification, an assessment of progress in implementing the recommendations of the PACD, and an evaluation of the institutional and financial arrangements for that purpose. That report, together with the background studies upon which it was based, is the main source of the present document.

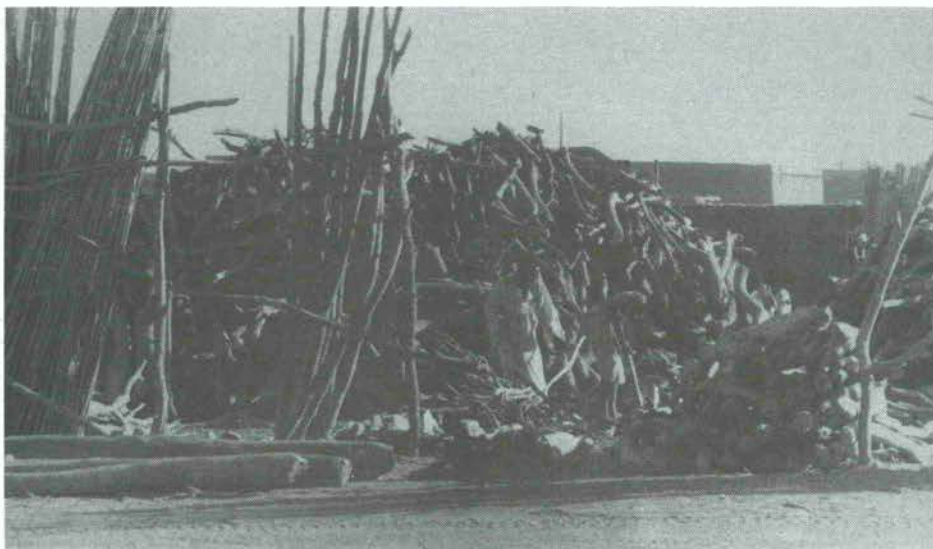
Establishing the Machinery, Monitoring Desertification and Drawing up National Plans

Progress in these areas, which were initial recommendations of the Plan, has generally been disappointing. The PACD had stressed the need for a national body at a high level in the central government, to co-ordinate actions to control desertification. Instead, Governments have tended to delegate this responsibility either to an existing department with sectoral responsibilities

relevant to desertification, such as forestry or soil conservation, or as one of the several briefs of newer organisations set up to deal with environmental management or natural resource planning. In some countries this may reflect the shortage of professional skills; in others, there are constitutional problems, as in Australia where resource management rests with provincial or state authorities rather than with the central government. Unfortunately, it may also indicate a low national political priority accorded to combating desertification. Whatever the reason, such arrangements have undoubtedly stood in the way of securing the urgent response requested in the PACD.

The GAP revealed, and was hampered by, a sad lack of information at the national level concerning the extent and nature of desertification, as well as on progress in combating it, which reflected general shortcomings in its assessment and monitoring. Apart from the inadequate institutional arrangements referred to, several factors appear to have contributed to this. One is technological: lack of the equipment or expertise for surveillance of desertification. Whilst important locally, this can by no means account for the general failure in assessment, since many of the developing countries affected by desertification, including some of the least-developed economies, either have receiving stations for satellite scanning imagery or have access to the output, both owning the equipment for image-analysis and having staff trained to use it. This is an area of considerable interest for national defence and mapping, and one in which there has been a great deal of international co-operation.

A second problem is methodological, in particular the continuing absence of standard and easily applied procedures for broad-scale assessment of many aspects of desertification. Whilst the situation is satisfactory in some areas, for example in surveying the *extent* of forest and woodland, the *degradation* of these resources is less readily monitored. There have been significant advances in rangeland assessment using band-ratio techniques, but these still generally remain at the investigational stage and have yet to be adapted for systematic inventories. The largest prob-



Large amounts of wood are brought into Khartoum and stockpiled for use in construction and as firewood. It is now brought by lorry from up to 200 kilometres away. (UNEP/Daniel Stiles).

lems remain the assessment of the status of rainfed croplands, particularly those in the early stages of soil degeneration which precede the more visible processes of accelerated erosion.

Lack of central co-ordinating authority to deal with desertification has undoubtedly contributed to the lack of integrated national programmes to combat it. It was an awareness of the many-faceted nature of desertification that led to the emphasis in the PACD on the need for this capacity, its absence has meant that focus on desertification control has been lost, and actions have remained unco-ordinated and dispersed and therefore less effective.

Corrective Anti-Desertification Measures

Field measures to combat the processes of degradation in various forms of land use and resource management rank first among the recommendations in the PACD. Since they concern both the most visible manifestations of desertification and the man-made components of the problem they constitute sensitive criteria of progress and are accordingly dealt with in some detail.

1. Management of Water Resources

Consistent with the Mar del Plata Plan of Action of the UN Water Conference held earlier in 1977, the PACD calls for "efficient, socially, economically and environmentally sound planning, development and management of water resources" as some of the measures to combat desertification.

This aspect of desertification control has received widespread attention in the most of the affected countries, since the view of water as an essential but finite resource is well-entrenched in dryland communities. Most such countries have central or provincial bodies responsible for water resources, and in many the harnessing of these resources is an integral part of national development plans.

Progress under this recommendation has commonly taken one of three forms: extension of irrigation, particularly through damming and

diversion of rivers and in some areas by tapping additional reserves of groundwater; improvement of community water supplies; and provision of additional water points in rangelands, commonly from boreholes.

Integrated development based on irrigation has been the key to continuing success in desertification control on piedmont steppes in the Central Asian Republics of the USSR; in Turkmenistan, the Karakum Canal has been further extended, whilst in Uzbekistan experience in reclaiming the Golodnaya Steppe is now being mobilized in the Karshi and Djizak Steppes. The effective harnessing of mountain rivers has also supported the rehabilitation of irrigated oases as a main feature of the outstanding anti-desertification achievements in western China.

In some other areas however, extension of irrigation has brought further environmental and socio-economic problems. In Nigeria, for example,



Groundwater is being tapped for irrigation in Algeria. Here experts at the Zelfana drilling station examine the overflow. (UNESCO/IF. Verhoog).

the introduction of large projects in areas of established rainfed cropping has caused disruption of the traditional farming systems without bringing compensatory benefits to the displaced peasant farmers.

Improved efficiency in water use, stressed in the PACD, is an important feature of many projects for controlling water logging and salinity in irrigated lands, but the changes so far have been mainly in the engineering domain; improvements at the farm level have commonly been opposed by traditional systems of water rights or by water-pricing policies, lack of money or credit, inadequate extension services and farmer education, and by failure to provide incentives for better water use. Comparable problems have occurred in areas of rainfed cropping, despite considerable advances at the research station level in water harvesting, methods of planting and tillage and in the use of mulches and barriers to reduce water loss from the soil. In many rangelands the provision of additional permanent watering points for livestock has not been accompanied by appropriate livestock and pasture management, so this intervention has contributed to rather than alleviated the desertification.

Weather forecasting and hydrological monitoring in support of surface water management have been improved in many countries, often with international support as in the Sahelian region. In contrast, there has been a general failure to develop and manage groundwater reserves with respect to recharge and transmission; overpumping and uncontrolled sinking of wells have gone on as before, water tables have continued to fall and supplies to diminish, with the attendant risks of salinization in irrigation areas and salt-water incursion in coastal tracts. With few exceptions, projects have concentrated on the discovery of new reserves and the establishment of additional wells, but groundwater exploration has rarely been accompanied by determinations of safe

yield. In the absence of controls, competition between agricultural and urban users for scarce groundwater resources has increased the risk of desertification in many closer-settled arid areas.

Through the hydrological cycle, the consequences of desertification can be widely transmitted, whether by siltation, flooding, salinization or deterioration in quality of irrigation or drinking water. For this reason, water management is often the key to many aspects of desertification control. This has been exemplified in Bangladesh which was faced with a complex of water-related problems linked with salt-water incursion in its south-western areas. It has addressed them through a master plan for the development of its regional water resources, taking account of ecological and environmental aspects although placing immediate emphasis on increasing agricultural production. The first phase has now been carried through. Control of groundwater regimes and flooding has restricted the incursion of saline waters and has allowed significant extension of irrigation and improvements in navigation and fisheries.

In some cases, as with the Ganges and Colorado Rivers, hydrological problems extend across national frontiers and their solution calls for international co-operation. This may also be desirable in the management of large groundwater basins. Several problems of this type were recognized at UNCOD, but remain outstanding.

2. Reclamation of Desertified Rangelands

There has been little progress in combating this type of desertification, which UNCOD identified as the most extensive form, affecting most of the arid lands as well as those semi-arid and sub-humid areas where cropping is impracticable. These are mainly areas of low productivity, often restricted to seasonal usage, whilst all are subject to periodic drought. Intensive reclamation methods such as seeding, replanting or soil treatments have limited application, whilst the natural rehabilitation of pastures under controlled grazing is commonly very slow and dependent on rainfall. Some arid rangelands degraded many decades ago have shown negligible recovery when left unpro-



Rangelands in Senegal are being reseeded using water harvesting techniques. (USAID/T. Catterson).

tected, whilst at present costs, fencing for range management is impracticable.

Range improvements have been achieved in some environmentally favoured commercial rangelands, as in the montane states of the southern USA, where progress in sagebrush control and pasture improvement is reported. The main successes however have been through large-scale government intervention, for example in the Central Asian sand deserts of the USSR, where there has been rational development of groundwater and aerial re-seeding, or in the semi-arid sandy areas in China where labour-intensive methods, for planting and re-seeding have been used. Otherwise the main emphasis has been on animal improvement, as shown by a review of international aid projects made for the GAP.

In the traditional, systems of pastoralism, commonly nomadic or transhumant, desertification has generally continued to advance. Customary practices and safeguards which may in the past have maintained an ecological balance are proving increasingly inadequate to cope with new pressures, particularly for increasing livestock numbers resulting from population growth, and the increasing demand for meat, particularly from growing urban markets. Sedentarisation of nomads, and permanent borehole waters provided to assist it, have also increased local grazing pressure on the rangelands, as have political restrictions on the seasonal movements of animals and herders. There have been some successes in the past decade, for example the hema, range management, forage cropping and sheep fattening schemes in Syria, but these have had a local impact in comparison with the regional scale of the problem. Generally, the traditional rangelands have remained neglected by Governments, with investment going to more productive sectors.

The situation is perhaps most critical in Southern Africa, South Asia and Andean Latin America on pastures used by closely-settled mixed-farming people. These are mainly sub-humid areas receiving intense summer rainfall, in which the rangelands commonly occupy the watersheds and are therefore, liable to severe erosion. Accelerating desertification of these rangelands, exacerbated by further droughts since UNCOD, is linked with a continuing rise in livestock numbers related to growth of rural populations, difficulties of management of communal range, and loss of pastures through extension of cropping that result from acute land hunger. The risk of very severe desertification is probably greater here than in the sparsely settled more arid rangelands, but these areas have attracted even less attention.

3. Soil and Water Conservation in Areas of Rainfed Cropping

The rainfed croplands, which provide subsistence for more than 250 million people in the semi-arid and sub-humid zones, must count as the land use type most threatened by desertification in terms of the potential human impact, but in those developing countries most affected, little has been done to arrest the process. The high levels of emigration from these communities reflect the low returns from farming, both a cause and consequence of the degraded state of land, further disadvantaged through national cheap-food policies in face of rising costs of inputs.

There have been considerable technical advances in methods of planting and tillage to conserve water, as well as into cropping systems to enrich and stabilise the soil, for example by the Central Arid Zone Research Institute (CAZRI), in India and by a number of agencies in the Sahelian countries, but these have generally not been adopted by farmers, who have been resistant to

change because of lack of incentives in the face of obstacles such as unsatisfactory conditions of land tenure, a shortage or an unreliable supply of inputs, and inadequate credit facilities and support services.

In the Mediterranean lands of West Asia and North Africa and the dry monsoonal areas of South Asia, where traditional crop-fallow systems have been pushed to the climatic limits of cultivation, yields remain at unsatisfactory levels on soils low in nutrients and organic matter. The result is a vicious cycle of poverty and further desertification continues. Rising food requirements have been met by an extension of cropping on marginal lands rather than through agricultural improvements on the better land. In Western Asia and the Mediterranean areas, this has been assisted by an increased use of tractors and heavy farm machinery which has contributed to increased soil erosion. The mixed farming and silviculture stressed in the PACD have made some headway as commercial enterprises by the better-off farmers on the better lands, as in southern Tunisia, but otherwise there have been few improvements since 1977.

In tropical summer-rainfall areas there has been a dearth of desertification-control projects, as shown for example by a recent African survey (UNEP, 1985). The situation is most acute where farming populations are concentrated in uplands, as in much of Southern and East Africa and in Latin America. The climate and soils make these lands particularly vulnerable to erosion and together with demographic and socio-economic conditions these could become the crisis areas of the future.

Some progress has been made in areas of higher rainfall through the introduction of alley-cropping and other forms of agroforestry, for example in Kenya, Sri Lanka and

Northeastern Thailand where governments are involved in land reclamation projects in partnership with donor countries and agencies. Future success will depend on the extent to which such land developments can cope with rapidly growing, still largely agricultural populations, and provide the infrastructure and market incentives for farmers.

The temperate areas of commercial grain-farming in North America and Australia experienced severe wind erosion and sand drifting in the 1930's, bringing a first realization that these land resources were finite and destructible. Soil conservation activities were inaugurated and, assisted by better seasons, economic recovery and some restructuring of agriculture, the situation was considered to have been stabilized. This complacency was shaken in the drought years of the 1970's and 1980's, when major dust storms carried to political centres downwind. The harmful effects of exploitive commercial monocropping with heavy machinery and repeated clean tillage in crop fallow systems are now recognized and the public costs of desertification are beginning to be counted; in Australia at least, the view that the soil must be treated as a non-renewable resource is also gaining ground. Effecting change in heavily capitalized, market-oriented, private-enterprise freehold systems currently under a cost-price squeeze in highly competitive export markets is not easy. The main gains since 1977 have been in the wider recognition of the problem, by the public at large if not on the farm. Fortunately, desertification in these regions is still generally moderate compared with that in the drylands of the developing world. Complacency is perhaps the main danger.

A relatively new and growing problem has arisen in these extensive croplands in the form of dryland salting, where clearing of perennial native vegetation for annual crops has reduced evapotranspiration, al-

lowing a rise in saline watertables. The areas affected are not large, but include valuable footslopes and valley flats whilst, as in Western Australia, salinization may extend to streamflows, threatening urban and irrigation supplies. Measures to restrict clearing of watersheds, combined with revegetation, are already in place in several Australian states.

4. Combating Waterlogging and Salinization in Irrigated Lands

On irrigated lands desertification threatens maximum losses in production and investment, and the number of livelihoods placed at risk is exceeded only in the rainfed croplands. In countries such as Egypt, Pakistan and Iraq where irrigation dominates agricultural production, the economy as a whole may be threatened by waterlogging and salinization.

In modern irrigation systems, the dimensions of the problems are generally recognised and the solutions understood, at least in engineering terms. For example, in Pakistan salinity control and reclamation projects were begun in 1958 and accelerated in a major programme with World Bank support in 1973. Case studies of successes in such projects were presented at UNCOD by China, Iraq, Pakistan and the USSR. A decade after the inauguration the PACD however, the proportion of irrigated lands affected by water logging or salinization is still around 30 per cent, with perhaps 20 per cent at least moderately desertified and incurring significant losses in production, despite considerable successes in Asiatic USSR, China, Pakistan and elsewhere.

Causes of the continuing problems include faulty design aspects, such as unlined distribution canals and inadequate land drainage; these are often an attempt to reduce costs in the initial development phase of a

scheme. In addition poor quality irrigation water, extension of irrigation on unsuitable terrain and soils, and poor water management at the application stage, including excessive irrigation resulting from bad scheduling or unskilled farming, or conversely, incomplete soil leaching where irrigation is inadequate are contributing to desertification. Where the engineering remedies are straightforward, the works required are commonly costly, involving major government commitments. In practice, few are straightforward: for example, the disposal of saline groundwater can involve conflicts of interest, possibly on an international scale. Where water storages have diminished through siltation, large-scale watershed rehabilitation may be required, again possibly extending beyond the national territory.

Remedies at the farm level may call for long-term programmes in farmer education, development of infrastructure, and above all the provision of economic incentives through marketing policies. The social and economic problems are generally even more complex and demanding than the engineering ones.

In some cases, lack of progress with this recommendation has resulted less from technological shortcomings per-se than from an inability to muster the necessary large-scale engineering forces, as employed for example in successful projects in the USSR. In the developing countries particularly, changes in established farming methods are unlikely to be effected rapidly. In developed countries such as Australia and the United States, the environmental problems of irrigation farming are linked with highly contentious issues concerning wider environmental impacts or the extent of governmental support, bringing them into a political arena.

The position is even less satisfactory where irrigation is dependent

on groundwater, which traditionally has been developed without regard to natural limitations set by aquifer storage, transmissivity and recharge. Falling watertables and rising pumping costs, and decline in water yield and quality have been commonplace in the absence of restrictions on the exploitation of reserves. The PACD has brought little change in attitudes; emphasis in project investment has been on the discovery of additional resources rather than on the conservational management of those already in use. Salinization continues on oasis perimeters, which tend to be vulnerable to lowered watertables, and in the lowermost parts of irrigated depressions where the consequences of excessive irrigation are compounded by natural difficulties in the disposal of saline drainage waters. Incursion of sea-water is a problem in over-exploited coastal aquifers. Where groundwater has been mined rather than used as a finite renewable resource, conflicts as to its use have arisen between urban or industrial users and agricultural users, for example in the southwestern United States, and this can lead to further desertification where cropland has to be abandoned.

The Plan of Action stressed the potential for irrigation developments to control desertification and increase productivity in the drylands, but experience since UNCOD shows that it is not a panacea. The finding of the GAP was that slight gains could be expected at best over the next two decades with success in some areas being largely offset by losses elsewhere. At this rate, and given the many problems raised by the introduction of large schemes in developing countries, irrigation developments will not make the expected major contribution to desertification control.

5. Restoring and Maintaining Vegetation Cover

Some conspicuous successes have been recorded in this area, notably in dune stabilization and in reforestation, both in technology development and in field projects. Monitoring the destruction of tree cover is a relatively straightforward application of remote sensing, and the dimensions of this aspect of desertification are better-known than most others, although the extent and degree of the large area of degradation of forest and woodland are less certain. Government involvement in forest management is widespread and long-standing, and the institutional and technological bases for combative actions commonly exist. Tree planting has an immediate visible impact that has assisted its adoption into popular programmes; it can be effective in informal, village-scale projects, where it meets perceived needs, particularly for fuelwood, and it improves the environment.

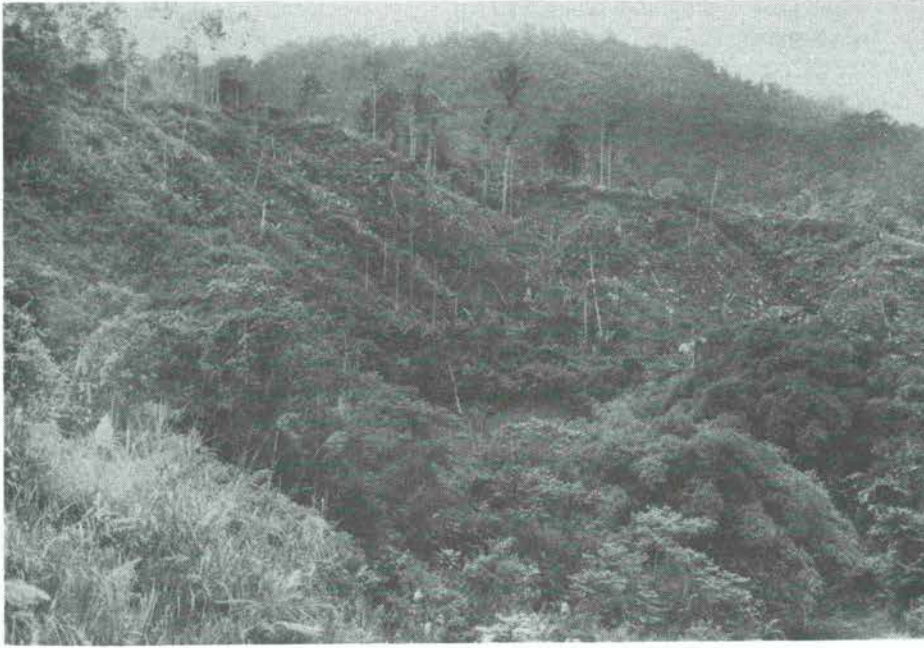
The GAP showed afforestation projects to be by far the commonest among activities by donor countries and international aid agencies in support of the PACD, with a particularly important share taken by NGO's. With help from UNESCO and FAO, there have been significant gains in the knowledge and use of tree species suited to dry areas, and in agroforestry and silvipastoralism. Indeed, a view that combating desertification is merely reforestation under a new name has become so widespread in some quarters that it may unfortunately mask the complexity of the problem and its causes.

These projects have had varying success. For example, an analysis of USAID afforestation projects in West Africa showed that many of the larger government schemes had not been effective, largely because of administrative costs and poor management. In contrast, the smaller projects conducted by

NGO's with community involvement had proved successful in meeting shortages of fuelwood and forage, in generating additional income and in improving the living environment. Similar successes are reported from northern India. On the other hand, China has an impressive record of government-sponsored afforestation in a wide range of environments with the involvement of local communities.

Nevertheless, in large areas of the drylands, and especially in the non-oil producing countries, forest and woodland have continued to diminish in the last decade, mainly in face of the demand for fuelwood. The situation is at its worst in those semi-arid areas where growing urban populations have accelerated the demand, but where regrowth is nevertheless limited by low rainfall and human pressure on the land, for example, on the savanna border of the Sahel, where depredation of woodland is occurring over ever-widening supply areas about the towns, thereby far outstripping any benefits from new plantings. Agricultural clearing, burning and browsing by livestock also continue to aggravate the problem. The situation in such areas call for large-scale government intervention, but most efforts at that scale have been disappointing; for example, the projected establishment of Green Belts to north and south of the Sahara failed as transnational enterprises under the PACD, although individual national successes, as in Libya, have shown what can be done, given the political will.

The problem is also being solved through reducing fuelwood consumption by using more fuel-efficient stoves. Here the efforts of NGO's in West Africa and India have met with local success. Other alternatives are biogas generators and solar heaters. Small biogas generators are being widely used in China, but costs and customs have impeded their adoption in India, where it had been hoped to replace



The rate of forest destruction in South-East Asia, as here in Kalimantan, is five times the rate of afforestation. (UNEP/Daniel Stiles).

the use of animal dung as fuel.

In higher rainfall areas in South and South-East Asia, it is a question of restoring the balance between forest exploitation and planting in the interests of environmental stability. Governments have taken steps to control commercial logging, and forest reserves have been established in most countries of the regions. However, in Indonesia receipts from forestry are an essential part of national revenues, and this gives rise to limitation difficulties. Deforestation has also resulted from clearing cultivation by upland farmers and from agricultural colonisation in the densely-populated lowlands. Despite counter-measures such as reforestation, the resettlement of upland farmers, and agroforestry projects, the rate of forest destruction in South and South-East Asia is still almost five times as great as the rate of afforestation.

Nevertheless, there have been substantial regional successes, notably in southeast China and the Republic of Korea, and a significant ingredient in these has been the enlistment of villagers, for example in small

forest farms in China, in village forest in Nepal, and in agroforestry schemes involving partnership between farmers and forestry organisations, as in Indonesia.

The revegetation and stabilisation of sand dunes mobilized by desertification is another aspect of this recommendation and existing technology has been proved to be adequate in a number of successful projects. The Chinese have used shelter belts, combined with revegetation or mulching, on windward slopes to protect oasis perimeters from moving sands; bituminous mulches have assisted the planting and seeding of dunes in Iran, Libya and USSR; checker-board planting of shrubs protected by planted grasses, mulches or palisades of dead shrubs has been successfully employed in many smaller Indian projects. The Chinese and USSR projects in particular, have been supported by irrigation. These and other countries have introduced the reshaping of dunes on aerodynamic principles using heavy machinery or the use of water jets or floodwaters. Aerial reseeding has also been carried out on dunes in the USSR.

Such projects are straightforward to the extent that technological interventions were carried out at government cost under specialist direction in little-used areas of moving sand bordering settlements, oases and communications. The eventual test of success is whether the revegetated areas can be protected and eventually managed for grazing, forage or fuelwood production, particularly with the co-operation of local land-users. This is a feature of the Chinese achievements.

The revegetation of watersheds, mentioned under this recommendation, is relevant to the entire group of corrective measures. Watershed degradation lies at the core of many forms of desertification because the consequences of devegetation and soil loss are transmitted widely through surface runoff. It is occurring under many forms of land use: in drier areas it is mainly linked with overgrazing, fuelwood collection and burning; in wetter regions, with exploitive upland cropping or logging. Emphasis in the PACD on an integrative approach to desertification control partly relates to the need to treat drainage catchments in their entirety and this has become increasingly accepted both at national and international levels. For example, the numerous projects to stabilise watersheds now being taken in Nepal are of concern to Bangladesh and India. Among the regional bodies established to secure such integration is the Interim Committee for Co-ordination of Investigations of the Lower Mekong Basin based in Bangkok, with its own Environmental Unit.

Watershed management is an element of many projects for the improvement of upland agriculture in tropical sub-humid to semi-arid areas, as in northeast Thailand and similar parts of the continental and insular South-East Asia; pressure for cropland and timber production however, combined with high natural erosion rates constitutes a continuing threat and there is urgent

need of wider action. In comparable areas in Latin America equally serious problems still remain to be addressed.

In the temperate drylands there has been a notable afforestation of watersheds in Mediterranean Europe where upland grazing has diminished or has been restricted, but the situation remains unsatisfactory in North Africa and in similar environments of Western and South Asia, to the detriment of water supplies and irrigation works in adjoining lowlands.

Conservation of Plants and Animals

This recommendation acknowledges the valuable genetic resources of the drylands and our obligation to conserve them. Many countries have responded through legislation to protect flora and fauna and by establishing parks and reserves, and many are signatories to international conventions aimed at protecting endangered species and their habitats. Policing the reserves still presents problems however; for example, poaching continues in many African game parks, and there is little report of progress in monitoring these habitats, as required under the PACD.

Combating the Social and Economic Dimensions of Desertification

The PACD states "the implementation of this Plan implies more than a campaign against desertification; it is an essential part of the broad process of development and the provision of basic human needs". This is not merely a question of social justice as the end of human endeavour, but a recognition that desertification arises in large part from social and economic inequity, including poverty and the struggle for subsistence. The commitment under this section of the PACD is vast, for it embraces almost any measure to improve the human condition in the

drylands and to provide the infrastructure for economic and social development.

There has been considerable progress in improving social welfare in developing countries in the drylands, despite the problems of remoteness and the scattered, often nomadic populations. The provision of health and education services, village water supplies and improved housing has made progress in the last decade. By far the larger part of aid spending in the drylands in the period has been on projects in this general category: indeed it has been suggested that aid in this sphere has been to the detriment of progress field measures to halt the physical and biological processes of desertification. But it is neither practicable nor useful to see the social and environmental aspects of desertification control as separate problems and alternative priorities. To the extent that excessive human pressure on land resources has arisen from poverty, ignorance or lack of the facilities to bring about change, environmental improvements independent of action in the social and economic sector can have only short-term prospects of success. This is also implicit in the emphasis given in the PACD on the need to integrate control measures.

The magnitude of these tasks is such that progress can only be very slow, and in many parts of the Third World the problems have continued to grow in the last decade, and these are connected with the growing migration from rural areas to the towns, the need for urban housing, and the resettlement of refugees from drought-stricken areas or from the turbulence of civil strife.

Measures to Reduce the Risk and Effects of Droughts

A great deal has been learned in the past decade about the causes and patterns of drought, notably about global-scale controls such as oscil-

lations in major atmospheric pressure systems and related changes in sea temperatures and oceanic circulation, such as the relationships between the Southern Oscillation and the El Niño phenomenon or the South Asiatic monsoon. This has led to an understanding of the nature and impacts of climatic fluctuations with a periodicity of a century or so, which might for example explain an increase in drought risk in the tropical drylands from the 1960's onwards and which could in turn lead to more realistic estimates of the likelihood of severe drought in coming decades.

At the other end of the scale, the development of weather satellites has given improved weather forecasting for periods of a few days ahead, the benefits of which will accrue to the drylands as their sparse networks of meteorological stations are strengthened. In this respect, improvements in the Sahelian countries under the AGROHYMRET project are noteworthy. However, prospects for seasonal forecasts from one to six months ahead are still remote and rainfall enhancement through cloud seeding seems likely to remain of localised value only. Accordingly, measures to reduce drought impact in the PACD remain as relevant now as in 1977.

Most traditional dryland societies have evolved strategies to deal with drought, whether through methods of land use to minimise losses, or through social arrangements to lessen their impact. Extreme drought nevertheless has always brought severe suffering, which is unacceptable by modern standards. Factors operating both within and outside these societies have now tended to make them even more economically vulnerable to drought. Although government and international relief through the establishment of food storage networks, assisted by improved communications and water supplies, may lessen the magnitude of human disaster, little has been done to

strengthen the ability of farmers at risk to cope more effectively with future droughts. Some areas have been helped through the extension of irrigation, but there has been little progress in the introduction of water harvesting or improved methods of water use into rainfed cropping. Additional livestock watering points and improved roads have brought previously inaccessible rangelands into use, but the maintenance of drought-forage reserves has proved difficult under communal range use, whilst insurance against stock losses is scarcely available at all, in traditional pastoral communities.

The commercial farming systems in the drylands of the developed countries already enjoy considerable government support through drought insurance, subsidies in transporting stock or forage, price equalisation schemes, and direct grants or low-interest loans where losses have been severe. The primary producer has grown to expect disaster relief during drought, but is generally less willing to co-operate in stabilisation schemes which set aside part of the profits from better years or to accept the need for investment in restructuring of operations to lessen the impact of drought.

Strengthening Science and Technology at National Levels

The adequacy of national science and technology to serve desertification control programmes still varies greatly between countries, as does expertise in dealing with differing aspects of the problem. Most developed countries have the necessary infrastructure and trained staff. Some large developing countries such as India and China have a network of research institutions but have still to satisfy their large requirement for junior professional and technical staff, particularly for extension work with farmers. Many of the poorer developing nations

still lack both institutional resources and trained staff at all levels.

This is a situation calling for international aid, and one third of all World Bank, USAID and FAO anti-desertification projects in the past decade have had a significant science and technology component, generally in the field of resource

management. Practically every nation has established or strengthened universities, agricultural colleges or research institutes in relevant fields. Nevertheless, a good deal remains to be done, particularly in dissemination of research and the provision of trained personnel who will carry the benefits of research into practice.



Photogrammetry is being taught in a UNDP/FAO project at the Forestry Training Centre in Conocoto, Ecuador, for strengthening technological applications to forest management. (Photo: FAO).

Creating Public Awareness and Securing Participation

This can imply several levels of action. The first is broadly educational: creating an awareness of the significance of desertification, of the potential benefits of controlling it, and of the costs of doing nothing about it. Most countries have responded to some extent at this level, aided by developments in communications technology and media services, but a great deal remains to be done to ensure the effectiveness of these efforts. A second level requires the recruitment of the local community and its traditional skills, as essential resources for desertifi-

cation control. Respect for traditional skills has grown over the last decade, reinforced by some unfortunate experiences of wholesale and injudicious innovation, and with it, an acceptance of the need for evolutionary change in resource use and the need to adapt introduced technologies to local environmental and cultural requirements.

A third level recognizes the right of the community to be involved in planning and implementing desertification control programmes, as the arbiter of its own living conditions. The importance of the "bottom-up" and "self-help" approaches in desertification control has been

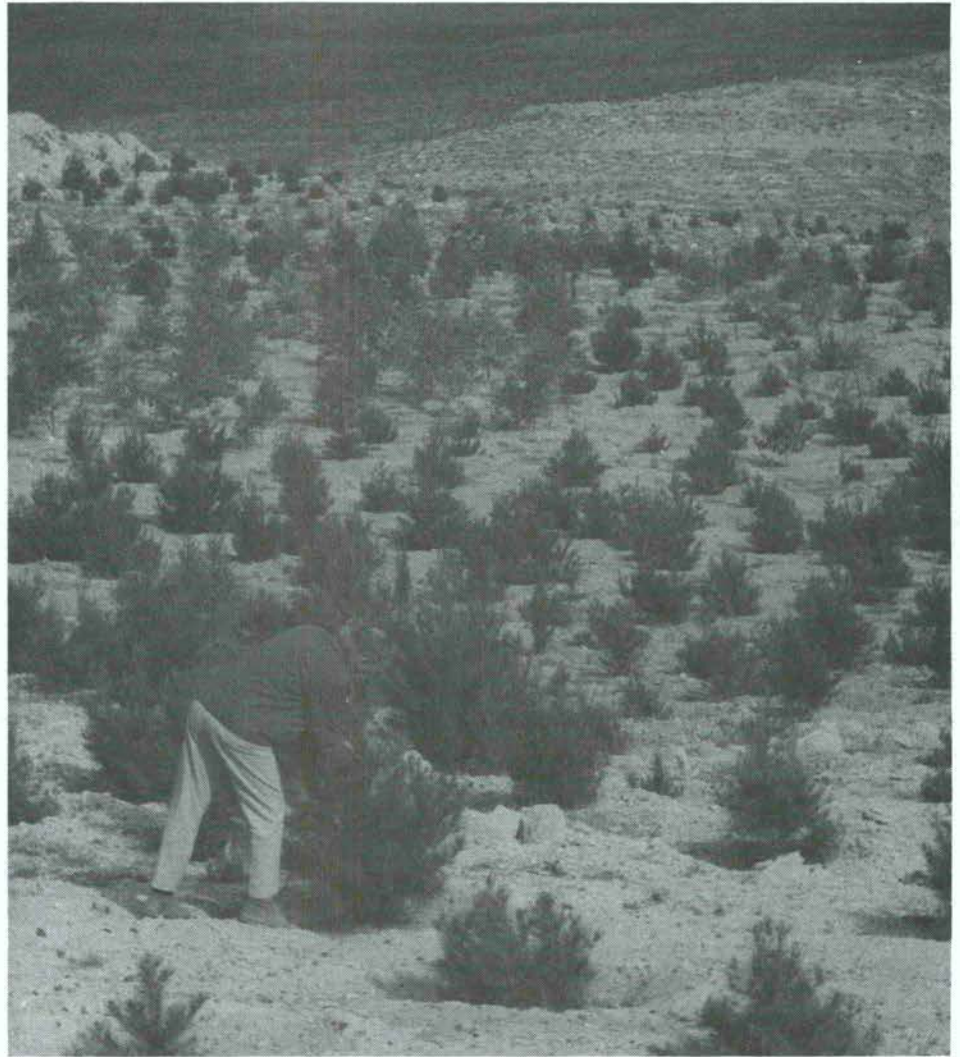
demonstrated by the relative success of the generally small projects carried through by NGO's with the close involvement of community leaders, and attention is being given to embodying these elements in government programmes.

Finally, there is the recognition of the need to identify the goal of desertification control with the advancement of the local community by linking it with the creation of employment, raising of incomes and improvement of living conditions. This has become a central theme of non-governmental programmes among the poorest communities, as in India, but it has also been successful in securing a partnership between the community and government administration, as in social forestry and agroforestry projects in South and South-East Asia. It emphasizes the need to interpret desertification problems in terms of their social, economic and political ingredients and to target these in the proposed control measures. It involves all the elements mentioned above, as well as the development of community organisations and local leadership, the creation of linkages between the community and the administration and devolution of decision-making, including financial decisions.

Regional Support for the PACD

Whilst the implementation of the PACD is mainly the domain of national governments, acting according to their own priorities, the Plan itself recognized the need at regional levels for support for and co-ordination of national responses, through the UN regional commissions and other regional organisations. It endorsed six transnational projects as evidence of regional co-operation.

Desertification does not stop at national frontiers and the regional framework is an appropriate one for pooling experience, as shown for



One of the regional programmes called for in the PACD that was begun is the Transnational Green Belt in North Africa. (WFP/H. Null).

example by the important role of the regional commissions in the GAP. Developing countries also need to pool their scarce financial and technical resources, and this is attested by the establishment of a number of regional bodies such as the United Nations Sudano-Sahelian Office (UNSO), The Permanent Inter-State Committee for Drought Control in the Sahel (CILSS), the Southern African Development Co-ordination Conference (SADCC), the Adevan Pact etc.

So far, the most successful regional actions have been in the field of information exchange, seminars and workshops. UNSO, the most effective of the regional bodies on account of its high political profile and clear charter in the field of desertifi-

cation control, has gone further by helping with desertification assessment, establishing scientific institutions and assisting countries to secure external funds.

To date, there have been few co-operative regional actions to combat desertification: of the six transnational projects under the PACD, there has been activity only in two, and that at a limited level. Nevertheless, enough has been done to establish the potential value of regional action. It remains for national governments to avail themselves of the opportunity, and this must depend on recognition of an overriding need, as in the successful co-operation in desert locust control.

Actions by the UN Family

Recommendation 23 of the PACD asks for a wide range of actions by UN agencies in fields such as assessment and monitoring, research, training and the provision of technical assistance. The agencies have responded in attempting to give desertification control an important place in their programmes, for example UNESCO in the Man and Biosphere Programme, WMO in the World Climate and Global Atmospheric Research Programmes, and FAO towards developing a methodology of assessing and mapping desertification. Within budgetary limits, the agencies have also attempted to respond to requests from Governments for consulting services and technical assistance. The United Nations University has conducted a programme on problems in applying existing knowledge for desertification control.

UNEP, as the UN body entrusted with co-ordination and implementation of the PACD, has sponsored training programmes and assisted with the publication of handbooks on several aspects of desertification control. Its Desertification Branch, later the Desertification Control PAC, has assisted Governments in drawing up national plans or project proposals. Through its publication of the *Desertification Control Bulletin* it has provided a valuable international forum and within its limited resources it has served as a repository of information on desertification. The development of the GEMS and GRID projects are particularly relevant in the assessment and monitoring of desertification at global levels. Through IAWGD, it has helped to co-ordinate the efforts of the UN to combat desertification and through DESCON, it has brought donors into contact with those needing assistance. Finally, by undertaking the GAP, it has provided a compelling reminder of the need for further commitment under the PACD.

Intergovernmental and non-governmental organisations such as the International Union for the Conservation of Nature and Natural Resources, and the International Geographical Union have organised conferences on desertification, commonly with the support of UN agencies, which have strengthened the network of professional and non-professional people involved with the problem.

EVALUATION

A review of achievements under the PACD makes for generally disappointing reading, but how can we judge the inadequacy of that response? A measure adopted by the Executive Director of UNEP in his report on the GAP was the level of financial commitment made in comparison with what was thought to be needed. An expert study reporting to the General Assembly in 1980 estimated for example, that the developing countries would require an average annual expenditure of US\$2.4 billion over a 20-year period, whereas the present resources available, including external assistance, were around US\$600 million. Clearly, the funds available have been grossly inadequate, but it should not be assumed that this was the only, or even the main constraint on progress.

Another possible measure of the adequacy of the achievements is their impact on the problem. Here, the findings of a global assessment of the status and trends of desertification as part of the GAP are illuminating. Trends towards improved conditions were found in a few areas only, for instance, in irrigated lands in USSR and China and in minor degree in the USA, in the extent of forest in Southern Europe, USSR, China and North America, in rangelands in USSR, China and locally, in North America. The developed countries were mainly shown as areas of slight decline or of relatively stable condition, but the entire developing world, with the exception of accelerated desertification.

Furthermore, the problem has been shown to be more widespread than envisaged at

UNCOD, with large parts of the sub-humid tropics now recognized as being under serious threat. The rural population at risk is now put at 135 million compared with the estimate of 80 million in 1977. Not only have we fallen behind: more is required of us than was at first thought. With present trends, perhaps with the sole exception of the irrigated lands, the situation will be significantly worse in the year 2000, the date set for achievement of the PACD, than in the year of its inception.

The PACD was formulated at Nairobi in an atmosphere of crisis engendered by the Sahelian drought, and it seems for example, as measured by attendance at DESCON meetings, that interest in desertification subsided as the sense of crisis dissipated. Long-term ecological degradation is less newsworthy and attracts less political notice. It has been suggested that the presentation of desertification in terms of land degradation may have contributed to the lack of continuing political commitment to the PACD. Perhaps the problem should be formulated in terms of social costs together with the benefits of control measures, so bringing it within the arena of public policy and making it a high priority in the allocation of scarce resources. Whatever the reason, it is difficult to escape the conclusion that the essential ingredient of success so far has been the political will to combat desertification.

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Seven Paths to Desertification

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The year 1987 sees the 10th Anniversary of the United Nations Conference on Desertification (UNCOD). The main outcome of that Nairobi conference was a Plan of Action to Combat Desertification (PACD), which recommended a number of ways to arrest the spread of deserts worldwide. A decade after the 1977 UNCOD meeting, the man-made deserts of the world are advancing at an estimate rate of 60,000 square kilometres per annum. The severity of the drought and subsequent famine in 1984/5 was worse in human terms than anything seen before and yet the urgency of the situation has still not been sufficiently appreciated to guarantee a co-ordinated, global and immediate attack on this potentially devastating environmental crisis.

This paper presents seven case studies on the various ways in which a fall in productivity in semi-arid or arid regions can precipitate the onset of desertification.

1. Bush Encroachment

The term bush encroachment refers to the invasion of productive grassland by tree and shrub species that are frequently unpalatable and of little economic or practical use. It is a widespread problem throughout the semi-arid regions of the world. Thomas *et al* (1968) reported that 88 per cent of the 100 million acres (40.5 million hectares) of rangeland in Texas were infested with bush, much of it mesquite (*Prosopis* spp.), which had invaded more than half of the total area of Texas within the lifetime of many ranchers, particularly in the west of the State.

The effects of mesquite were to reduce the available water in the soil

when it would otherwise be used for the production of palatable forage, resulting in a reduction in the livestock carrying capacity of the land. Schuster (1969) noted that unwanted weeds and brush were gradually engulfing the rangeland so that 82 per cent of the rangeland of Texas was infested, reducing the efficiency of livestock production and increasing labour costs.

Similar problems have been encountered in Australia (Newman and Condon, 1964), and in South Africa (Acocks, 1964). The replacement of grass by bush may be part of a natural cycle although, in many pastoral areas, bush has been controlled by the regular use of fire to maintain a sub-climax vegetation community. Legislation against annual burning may therefore be a mixed blessing, since the encroachment of unpalatable bush species will cause a decline in annual offtake from rangeland in terms of livestock production even if the primary productivity (total annual production of vegetation) is unchanged or even enhanced. Bush encroachment can even be considered as a type of desertification.

2. Wind Erosion

Increasing population growth has led to land hunger and the gradual invasion of cultivators into semi-arid areas which are unsuitable for cultivation. The cropping of marginal lands is often prohibited: in Niger, cultivation below the 300 mm isohyet is illegal, although in practice it is often difficult to enforce such legislation. During periods of above-average rainfall, the temptation to extend their cultivation into pastoral areas is greater and this is exacerbated by the sedentarization

of pastoralists who look to mixed farming as a means of supplementing their income. The effect of these practices is twofold. First, the land available to livestock is reduced and overgrazing inevitably ensues, leading to a reduction in the protective cover of vegetation and an increased trampling and pulverization of bare topsoil by hooves. This leaves the soil vulnerable both to wind and water erosion. Secondly, the effect of cultivation is to leave the topsoil broken and exposed after harvesting the protective layer of crops. Floret and Le Floch (1972), calculated that wind erosion could carry off 1.3 tonnes of soil per hectare in southern Tunisia. The combined effects of overgrazing and cropping on land degradation have been well documented in Africa (De Vos, 1975; Warren and Maizels, 1977; Le Houerou, 1977). The final product is patches of denuded desert-like landscape.

3. Gum Arabic Cultivation: An Insidious Path to Desertification

The production of gum arabic from the tree *Acacia senegal* is a long-established practice in the eastern part of the central belt of the Sudan, below 14°S. It forms part of a long rotation of shifting agriculture that can be separated into different phases (Jackson and Shauki, 1956).

The cycle begins with the burning of the natural vegetation and the cultivation of cereal crops (in particular *Pennisetum typhoideum* and *Sorghum vulgare*), for a four to ten year period. As the soil becomes exhausted, yields fall, fields are infested with weeds (especially *Striga hermonthica*), and the land is abandoned. Natural vegetation takes

over and after a further eight to ten years, secondary tree growth colonizes the land to form an open woodland dominated by *Acacia senegal*. The stand of trees, known as a *geneina*, or orchard, is exploited by tapping the gum-producing trees for 6-10 years, after which the trees dies and eventually falls down, the thorns providing protection against grazing. Tall, dense grass takes over and after a few more years, the cycle resumes with land clearing.

This ten year rotation is an ecologically sound use of natural resources and it simulates the natural grass-bush cycle. Yet despite having been sustained for centuries, the cycle shows signs of deteriorating. *Acacia senegal* is failing to recolonize and its place is taken by *Acacia tortilis* and *Acacia raddiana*, trees of the more arid regions. The productivity and the economic production falls and the yield of the rain fed crops goes down. The reasons for this gradual breakdown of the system appears to be the result of over exploitation owing to increased population pressure. The crop cultivation period is prolonged, the periods of fallow shortened. The soil becomes exhausted, and the original gum-arabic areas of the Kordofan and Darfur sands in the 250-450 mm rainfall belt are becoming desertified and the people have moved south to the wetter regions (500-900 mm), leaving their abandoned villages to the desert winds.

4. Loss of Land to Urbanization

Between 1950 and 1980, 912,000 feddans (360,000 hectares) of saline wetlands were reclaimed in the Nile Delta and the desertified land at the fringe of the Nile Valley in Egypt. This area is now being irrigated using water from the Aswan High Dam although, by 1980, only 60% of the total area was under agricultural production owing to the great cost and effort required to reclaim the saline soils and lift the irrigation water 50-100 metres above the level of the dam.

These recently reclaimed lands should have increased Egypt's cultivable land area by 15%, yet no increase has taken place because an equal area of prime farmland has been lost to industrialization and urban sprawl: This is an example of wholly man-made 'desertification': the loss of land of high productivity owing to the absence of a national land use policy.

5. Misuse of Irrigation

A number of case studies presented at UNCOD illustrated the dangers of improper irrigation practices in Iraq and Pakistan (UNESCO-UNEP-UNDP, 1980), and in the USSR and China (Biswas and Biswas, 1980). The effects of poor

irrigation were discussed, in particular salinization, waterlogging and the eventual abandonment of the land. However, examples of the feasibility of soil reclamation were also given.

In Iraq, local sheikhs were responsible for the irrigation of cereal crops by channelling water from the Tigris and Euphrates. Siltation of the irrigation ditches and build-up of salinity caused them to move to new areas so that by 1960, approximately 60% of Iraq's agricultural land (mostly in the potentially fertile lower Mesopotamia plain), had been affected by salinity. Twenty to thirty per cent of this had been entirely abandoned with an additional one per cent loss each year.



A canal flows across the plain on the southern slope of the Tianshan, north-west China. The area is now experiencing problems related to intensive irrigation.

6. Labour Shortage Causing Land Degradation

Agriculture in the rugged, dry highlands of North Yemen has depended for millenia upon the maintenance of rock terraces on steep mountain slopes, which vary in altitude from 1,000 to 3,700 metres. An FAO report (1960) noted the critical role of these terraces in the agriculture of the country.

However, in recent years there has been a decline in agricultural productivity (Kates *et al*, 1977; UNEP, 1987), and a concomitant decline in

the standards of maintenance of the terraces. Repair to these structures is labour intensive, but emigration of a large section of the work force to work in the lucrative economies of their oil-rich neighbours has meant that the labour is no longer available to maintain the terraces. The terraces collapse, water runoff increases and soil is lost and a 'vertical domino effect' ensues with the breakdown of a terrace endangering the stability of the terrace immediately below it, and so on. The resource base is jeopardized by the absence of workers needed for the maintenance and operation of la-

bour-intensive cropping systems (Kates *et al.*, 1977). This is an example of desertification caused by underpopulation.

7. Desertification and Water Supplies

The history of land-use in the arid and semi-arid regions of the world abounds with examples of great civilizations and prosperous agriculture reverting to decline, desertification and abandonment (Dudley-Stamp, 1961). The ancient Greeks, the Babylonians and the Carthaginians flourished amidst forest and amid some of the most productive cereal-growing lands in the ancient world; today only the silence of bare hillsides and deserts remains. Some of these were dependent on groundwater resources from deep aquifers, mostly extensive, but non-renewable fossil water, or renewable but at such a slow rate that the rate of extraction usually exceeded replenishment, with the result that the water table fell, water resources diminished and the land could no longer support the population. Great civilizations and villages alike depend upon a regular supply of fresh water and without that supply, emigration, abandonment and eventually desertification of the over-exploited lands follow.

Similarly, in coastal areas, shallow layers of fresh water overlie a larger body of saline ground water and excessive use of these supplies, often associated with modern technological developments such as pumps or windmills, results in contamination of the fresh water supplies.

A third problem is one of siltation. Some irrigated areas depend upon ephemeral water flows which are collected in *wadis* and reservoirs that store water from large catchment areas. With time, siltation ensues and the reservoirs become useless.

Conclusion

Desertification is a chronic process

whereby land becomes less productive. While this is usually caused by ecological degradation, I have given examples whereby land can be 'desertified' by urbanization or even under-population. In the final analysis, the process of desertification continues until a desert-like environment results, incapable of sustaining human life where before the land sustained thriving communities.

The global scale of the tragedy of desertification is immense. Tolba (1986) cited UNEP's estimate that there are some 34.75 million square kilometres of dryland which are moderately desertified (with a 25% loss of potential productivity), and a further 15 million square kilometres which are severely desertified (with a loss of 50% of potential productivity). Some 850 million people are affected by this desertification and seven examples of how people may be affected have been given, five of which are related to pressures which overtax the ecological resilience of the productive system. The major effect on man in the events leading to desertification is now well-recognized, and the combination of non-sustainable land use with major fluctuations of rainfall make the arid and semi-arid zones of the world particularly vulnerable to this preventable catastrophe called desertification.

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Reflections on Desertification 1977-1987: Problems and Prospects.

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Introduction

The 1973 Sahelian catastrophe of starvation and death among people and cattle was in part the result of a five to six year drought lasting from 1968 to 1973. What were the other reasons behind this catastrophe and how could it be avoided in the future? These were two of the main themes discussed and analysed at the UN Conference on Desertification (UNCOD), held in Nairobi in 1977.

However, most of the countries which participated in the UNCOD conference did not take seriously the warnings concerning repeated drought, desertification and famine, as there was only limited financial and other support for the Plan of Action adopted at UNCOD. In 1984, a follow-up assessment was prepared by UNEP, seven years after the conference on desertification. It was concluded that the threat of desertification in 1984 was worse than ever, with a second phase of Sahelian drought in Africa's drylands south of the Sahara having returned in the late 1970s and worsened in the years 1981-1984. The human death toll in Ethiopia, Sudan and Chad was this time even worse than in the 1970's.

The 1984 UNEP report concluded that:

“desertification is related to four principal groups of factors: natural vulnerability of the ecosystems in drylands and adjoining subhumid territories; population pressures often leading to over-exploitation of resources; economic considerations that hinder the establishment of appropriate land use on a long-term basis; and political unrest that is not conducive to the long-term actions required for such programmes.”

This paper contains some personal views on the first decade after the Nairobi conference in 1977, and the problems and prospects we are now facing in an effort to understand and counteract the environmental and social plague called desertification, or in more flexible terms, dryland degradation. I will deal mainly with the conditions in African drylands having accepted the four concluding points quoted above from UNEP's evaluation in 1984.

I use the term desertification to mean the spread of desert-like-conditions of low biological productivity to drylands outside the previous desert boundaries. Desertification is severe degradation of drylands, lasting more than one year, and is manifested by the loss of vegetation cover, loss of topsoil by wind or water erosion, reduction in primary productivity through soil exhaustion, salinization, or excessive deposition of sand dunes, sheets or coarse flood sediments. Highland degradation is different from dryland degradation in arid to subhumid climates, since rainfall may frequently be intense and run-off the principal destructive force although the results, falling productivity, are the same. It results either from over use of land by man and his animals, or from natural causes such as climatic fluctuations, or from a combination of both. I have regarded rainfall fluctuations as contributing to desertification, although I viewed the degradation as mainly man-made (Rapp, 1974). The drought disasters in Africa of the 1970s and 1980s were caused by a combination of human actions and climatic fluctuations, although the relative contribution of man and climate, and the reversibility of the process remain topics of controversy.

UNCOD's Recommendations for Action to Combat Desertification

The final “Plan of Action to Combat Desertification” (PACD), adopted by UNCOD in 1977 had 28 recommendations. The recommendations were divided into two

groups: those for national action (nos. 1-22) and those for international action (nos. 23-28).

Of those recommendations dealing with national actions in the countries under threat, No. 1 recommends that desertification and degradation processes leading to it should be evaluated, “carrying out new surveys whenever required”. No. 2 recommends improved land use planning and management and No. 3 stresses the need for local people's participation in the work.

Then follow a number of recommendations on specific fields of resource use and abuse in arid lands which should be tackled for counteracting desertification. These include industrialization and urbanization (No.4), water resources management (No.5), rangelands, rainfed agriculture, irrigated lands (Nos. 6-8), revegetation of denuded lands, conservation of flora and fauna, and improved monitoring of the environment (nos 9-11).

Socio-economic aspects on the national level are covered by a number of recommendations: evaluation of social, economical and political factors (no.12), sustained agricultural productivity (No.13), primary health care and human settlements (Nos. 14,15) demography and insurances (Nos. 16 17).

Strengthening science and technology at the national level, training and education and integration of conservation with programmes of general rural development plans are topics covered in recommendations Nos. 18-22. Recommendations for international action, co-operation and implementation are dealt with in Nos. 23-28.

In my view, these UNCOD recommendations were all well-founded and thoroughly discussed to reflect the knowledge and aspirations at the time. However, the very limited success in the battle against dryland

degradation in Africa has demonstrated that the priorities of 1977 have to be changed. Resources of funds, skilled manpower, and infrastructure have been too limited or difficult to handle, and political obstacles have made progress difficult.

Suggested Priorities for Sustainable Development in Arid Lands

Based on the experiences of attempts to implement the Plan of Action to Combat Desertification and other programmes of soil and water conservation in developing countries since 1977 or earlier, the following four priorities are suggested for sustainable development of land use and society in arid and semi-arid areas. The term sustainable development is used to stress that the goal for soil and water conservation measures is the long-term improvement in productivity of the environment for the benefit and welfare of the local people. Sustainable development is the key concept of the recent final report of the UN-connected World Commission on Environment and Development (WCED, 1987).

My suggestions of four priority areas are:

1. Development of early warning systems for drought.
2. Improved land use of local farmers and herders.
3. Improved services and welfare policy.
4. Increased international co-operation.

Development of Early Warning Systems for Drought Disasters

Recommendations: The development of better systems of early warning against droughts by improved environmental and socio-economic monitoring for disaster prediction is a priority. Efforts for better information and education on arid land management have to go hand-in-hand with improved disaster prevention.

The sequence of drought, soil degradation and famines in Ethiopia, Sudan, Chad and other countries during 1984 were examples of early warning systems that apparently did not work. People and organizations had issued warnings at least since the autumn of 1983, but no action was taken until it was too late. Then, suddenly, international aid was triggered by TV-films from a camp of starving victims in Ethiopia in

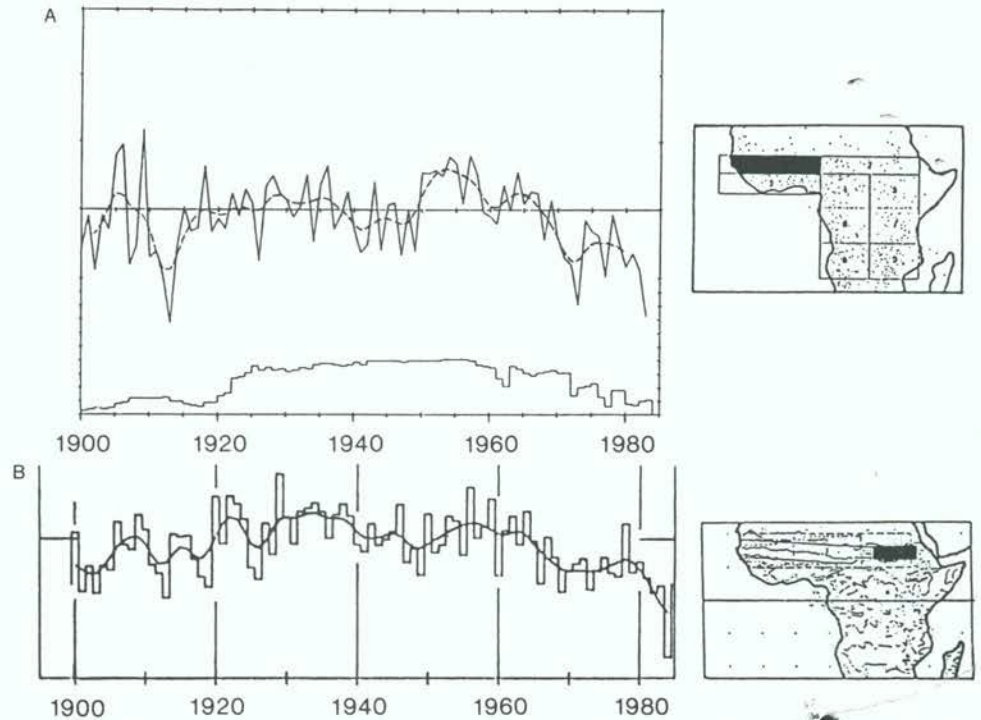


Fig. 1. A. Normalized area average rainfall for a region in West African Sahel 1900 - 1984. The lower curve shows the number of rainfall stations available for analysis.

B. Area-average time series of rainfall in Eastern Sahel 1900 - 1984. The smooth curve shows decadal time scale variations. Note the deep and long-lasting Sahelian drought of 1968 - 1984 in both areas 1 A and 1 B. Source: Farmer & Wigley 1985.

July 1984, and these were shown by ITV UK and other TV agencies. The response was large-scale food and medical relief, and an internationally co-ordinated campaign which came too late for some of the victims. What lessons can be learned from this failure of early warnings? Aspects of the causes of desertification will now be discussed.

a) Climatic Fluctuations

The impact of climatic fluctuations on man and society is frequently the subject of debate among scientists of many disciplines. Fluctuations occur in the *short-term* (year-to-year variability) in the *medium term* (10-200 years) and in the *long-term* (more than 200 years) following Parry (1986). It is important to distinguish between them.

In the late 1970's, many scientists were of the opinion that the 1968-73 years of rainfall shortage in the Sahelian zone was a random fluctuation similar to the drought periods culminating in the years 1913 and 1944 (cf. Hare 1984). The impact of the drought in 1973 on man and animals was probably

more severe than earlier this century because of the much larger populations and their over-exploitation of resources. However, the persistence of the Sahelian drought in a second phase into the 1980's meant that both the severity and the length of the drought was greater than those earlier in this century. (Fig. 1 from Farmer & Wigley, 1985). If the climate is changing towards greater aridity in Africa south of the Sahara, then man will face increasing difficulties in a continued use of the Sahelian zone. The long persistence of the Sahelian drought 1968-1984 has been discussed by Lamb (1982), Nicholson (1980, 1983), Olsson 1983, 1985), and Farmer & Wigley (1985).

In the last few years considerable progress has been made in the understanding of the large-scale circulation patterns in the atmosphere and oceans behind the so-called el Niño events in the tropical Pacific (Ramage 1986). It has been clearly demonstrated that el Niño and Southern Oscillations (ENSO), in the tropical Pacific have an impact on the droughts in Indonesia, Aus-

tralia and also in south-eastern Africa (WMO/GEMS 1985, p.6). Of twenty - eight ENSO events during the past 110 years, twenty-two were accompanied by droughts in south-eastern Africa. The Sahelian droughts of the 1970's and 1980's seem to have corresponded with low temperatures in the Caribbean Atlantic and high temperatures in the equatorial and Guinean Atlantic during July, August and September. The WMO/GEMS report suggests that the appearance of these anomalies prior to the sub-Saharan rainy season merits further studies of the possible predictive relationships.

Rognon (1984) pointed out the parallelism between long-term and anomalous period of cold in Europe/North Atlantic and dry phases in the Sahelian zone of Africa (cf. comments by Rapp 1987). Nicholson (1980) discussed her reconstructions of Saharan climates in historical times: "A very recent such episode (mainly drier), occurred in about the 16th, 17th and 18th centuries, and was probably synchronous with a period of glacial advance and frequent severe winters in the higher latitudes (especially in Europe), generally referred to as the "Little Ice Age." (Fig. 2).

Two other factors which have been much discussed in connection with the recent Sahelian droughts are the possible influence of local albedo and the rising CO₂ content in the atmosphere. Both these factors were discussed by Hare (1984). He quoted Charney (1975), who suggested that a sharp rise in albedo over the margins of the Sahara should diminish rainfall by accelerated subsidence of air. But large-scale regional drought derives from global controls of atmospheric circulation which is why the Global Circulation Models (GCM) are necessary to test ideas about the causes of drought. To be most effective these demand international co-operation.

Like the albedo hypothesis, the CO₂ effect has been widely tested by

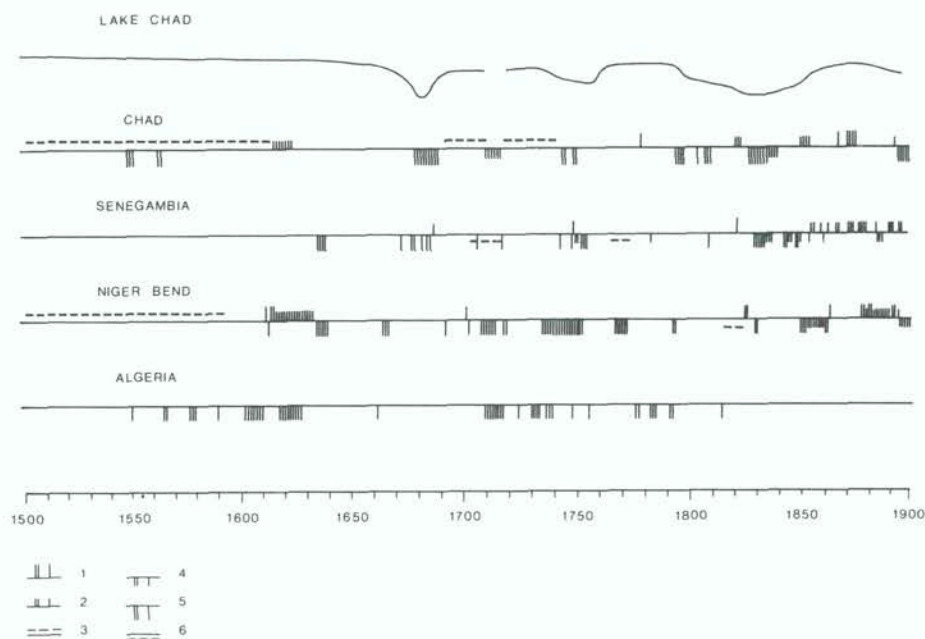


Fig. 2. Chronology of famine and drought in Chad, Senegambia, the Niger Bend, and northern Algeria, 1500 - 1900. The Sahelian areas had droughts which seem to have been contemporary to the "Little Ice Age" of N. Europe. From Nicholson 1980.

Key: 1 = Exceptionally high floods. 2 = Above average rainfall.
 3 = Period of general prosperity according to the chronicles.
 4 = Below-average rainfall. 5 = Famine and/or drought.
 6 = Period of generally low precipitation or drought.

GCM experiments. It is reasonable to expect that warmer conditions in lower latitudes would increase evaporation from the oceans and hence intensify the whole hydrological cycle. There is no clear sign that most arid lands would profit appreciably. In any case, an increase in temperature can only be unwelcome in environments in which heat stress is frequently present, for humans as well as for ecosystems (Hare 1984, p. 20)

b) **Monitoring by Remote Sensing and Ground Check**

Several recent case studies have shown examples of progress in environmental monitoring of drylands. To take examples from articles published in this journal, Ringrose & Matheson (1986) discussed a case study using Landsat data for local surveys in Botswana, while Tucker & Justice (1986) in the same issue discussed global or continental maps. To quote from the last mentioned article:

"In several studies remotely-sensed

data have been reported to accurately map vegetation, crops and other land cover types. The majority of these studies have used Landsat data .. (which) for continental and global-scale inventory is impractical An alternative to Landsat is the Advance Very High Resolution Radiometer (AVHRR) sensor carried on the NOAA operational meteorological satellites.

AVHRR data have much coarser resolution (1 and 4 km) than Landsat and hence a lower data volume and cost. More importantly, the AVHRR 4-km data are available daily on a global basis." Use of the albedo or reflectance techniques for desert boundary definition have been hindered by the difficulties in extrapolating between satellite images. Time of day, time of year, conditions of atmosphere and surface soil (erosion, moisture content), must be taken into account but nevertheless, the authors showed that desert boundaries can be defined and green leaf biomass be monitored by NOAA AVHRR data.

For local mapping in more detail, the new French-Swedish SPOT satellite is of great interest, with a resolution of 20 m in multispectral bands or 10 m in black and white images.

Continued development of remote sensing methods can be expected and research and applications in semi-arid countries should be supported.

Among other successful applications of satellite-based remote sensing is the monitoring of the effects of sand-storms (Mainguet *et al.*, 1980, 1984), dust plume trajectories (Gigoryev and Kondratyev, 1981 (See Fig. 3); McCauley *et al.* 1981), fuelwood resources (K. Olsson, 1985) and dryland degradation/recovery in general (Bernus *et al.*, 1980; Hellden 1984, 1986; L. Olsson, 1985; Stern, 1985; Ahlcrona, 1986). For the monitoring of soil losses by erosion, continued ground checks of erosion plots are necessary in many environments and they should include nutrient losses by water or wind as well as bulk soil losses (Sundborg & Rapp, 1986).

Research and applications or improved methods for early warning must be accompanied by the provision of information to and education of users. There is a considerable need for environmental education both in industrialized and developing countries in order to make existing and new knowledge available and understood by leaders and users, and to avoid overselling and misuse of new technology.

c) Socio-Economic Monitoring

Monitoring by remote sensing should be combined to some extent with ground checking, although much time and money can be saved by a combined approach. In systems for early drought warning socio-economic monitoring by data sampling through interview with local people is necessary. It has been demonstrated in case studies from Ethiopia, for instance, that local prices of grain increased with shortage of food, and this information could be used as a reliable indicator of famine and emigration of environmental refugees from the

province of Wollo in 1984 (Cutler, personal communication). Agricultural yield predictions and human nutritional status are other factors which should be monitored in a developed early warning system.

Improved Land Use of Local Farmers and Herders

Recommendations: Raise levels of viable agricultural productivity in drylands by improved range management, dryland agroforestry and adapted irrigation farming. Methods in soil and water conservation of particular importance for improvements. Methods in soil and water conservation of particular importance for improvements are the following: water harvesting and storing of run-off; shelterbelts and fodder plantations for erosion control and staff feeding; dryland agroforestry; increased irrigation farming, avoiding degradation by salinization. Degradation of drylands as a result of overexploitation by man and his animals is generally ascribed to one or several kinds of over-use: overgrazing, excessive cultivation, or bad irrigation causing salinization of soils, and excessive use of wood for fuel, fencing, bushfires etc. Human poverty of people living in marginal areas lies at the root of the problem. "Poor people make poor land, and poor land makes poor people" is a West African proverb, which describes the vicious circle of dryland degradation, drought and starvation of local people.

The extent of desertification six years after the UNCOD conference was estimated by Mabbutt (1983), who condensed his findings in a table of "Desertification trends 1977 - 1984" which has columns for rangelands, rainfed croplands, irrigated lands, forest and woodlands and groundwater reserves. According to his estimates, Sudano-Sahelian Africa shows trends of deterioration in all aspects except groundwater depletion. Mediterranean Africa shows deterioration in all five respects. Improvements in rangelands over the same time was reported in the USSR, Asia and North America only.

Another assessment for UNEP was made by Berry (1984), who reported on desertification in the Sudano-Sahelian region 1977 - 1984, relying on a questionnaire technique. His conclusions showed an

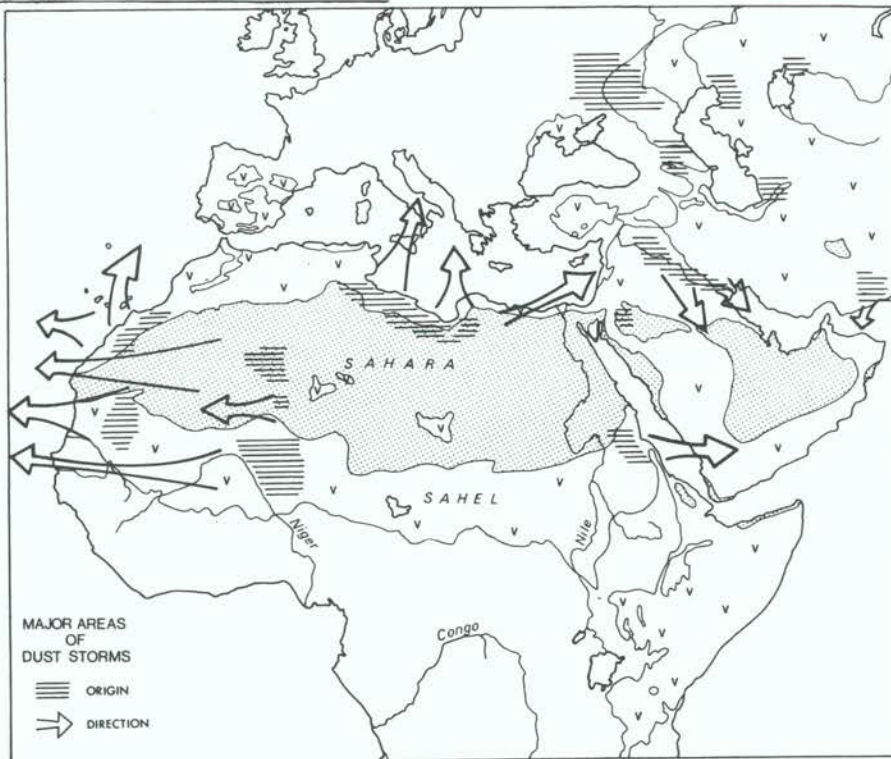


Fig. 3. Map of major areas of dust storms from Africa and SW Asia in 1970 - 1974. The map is based on an inventory of storms appearing in satellite images (Gigoryev & Kondratyev 1981). Symbols for true deserts (grey) and areas threatened by desertification ("v" inside boundary line) added from UNCOD desertification map (1977). Note that most areas of origin of dust storms are outside the true desert boundaries.

increase in desertification in all Sudano-Sahelian countries as a result of sand dune encroachment and deterioration of rangelands, forests, irrigation systems and rainfed croplands. He suggested that the problem of desertification was created over decades or even centuries of misuse of natural resources. It is equally clear that a long period of sustained effort will be needed to begin to deal effectively with this problem. Environment, economy and politics have all been unfavourable in the time period discussed.

After thorough studies of the situation in Ethiopia 1984- 1986, the Swedish Red Cross and SIDA have made similar conclusions for their future activity there. They have decided that support for rural development should be focused on long-term soil and water conservation to restore the environmental basis for sustainable agriculture (Hagman 1984).

Improved Welfare Policy and Services to Dryland People

Recommendations: Improve road communications, transport facilities, education, health and family planning services in drylands. The improvement in pricing and welfare policy for vulnerable dryland populations and the raising of the level of awareness among local and national politicians for these needs is equally important.

Improved land use and alternative employment for part of the threatened populations represent two major strategies to be applied, together with improved health and family planning services. In spite of the repeated famines, Africa's rural population is doubling every 20-30 years. Therefore, family planning is one of the most important issues to lessen the possibility of starvation in future droughts.

The main method for sustainable development of dryland agriculture among poor farmers and herders is through soil and water conservation in order to increase yields. Yet the poor farmers and herders of Africa's Sahel or other vulnerable regions cannot achieve this on their own. They depend on co-operation and support from local authorities and national governments, and also on international co-operation. My recommendations on this issue stress the very important actions that have

to be taken by local authorities and governments to improve the situation for the people inhabiting dryland zones. These people are generally living in marginal positions both from a geographical and political point of view, far away from the capital cities. Yet a common pattern of drought disaster is that vulnerable people from remote famine districts become environmental refugees who migrate to the cities, over-populate the urban slums and get trapped in social and political tensions there.

Both national and international welfare policy should aim to prevent the spread of such disasters.

International Co-operation

Recommendation: To increase the international co-operation for the prevention and relief of dryland disasters.

This recommendation is the easiest to formulate and probably the most difficult one to put into practice, at least when it comes to matters of political co-operation or confrontation between countries. This problem was of course known to the UN authorities and was also highlighted in the discussions at UNCOD in Nairobi in 1977. However, much hope at this conference was attached to the transnational projects of action against desertification. The extent of desertification six years after the conference was assessed by Mabbutt (1983), and one of his conclusions was that warfare and political strife were two of the main obstacles to the transnational projects. Prospects for monitoring desertification in Western Asia were hampered by wars in Afghanistan and Iran. Similarly, four transnational projects had been located in Africa. Chad was supposed to have been a participant in three, before it was involved in a prolonged war. Based on these experiences, it is evident that the worst obstacle to all efforts of sustainable development for man and environment in arid zones are wars.

This sad reality can also be used as an argument for increased efforts where the possibilities of working together exist. "Threats to environmental security can only be dealt with by joint management and multilateral procedures and mechanisms"

(WCED 1987, Chapter 11). Fortunately, there are international projects in the field of dryland development and conservation which have been successful, and which should be used as pilot projects.

We should also be prepared to learn by experience in the case of less successful projects. This can be done if a component of constructive evaluation is planned, financed and agreed by donors and recipients from its inception.

Conclusions

The occurrence during the 1970's and 1980's of widespread malnutrition, famine and desertification in the Sahelian belt and other drylands has generated a combination of social and environmental problems with severe effects on man, his animals and the whole environment. The prevention and reversal of dryland degradation is mainly achieved through an improved and ecologically adapted management of soil, water and vegetation. The frequency of famines shows that traditional approaches to land use in drylands are insufficient to meet the changing situations of increased pressure from growing populations and annually fluctuating rainfall. Research into the causes and effects of drought and desertification must continue. Surveys and management aimed at ending the shortages of food, water and firewood must be introduced. Improved land use and alternative employment for part of the threatened populations represent two major strategies to be applied, and must be given a higher political priority than they receive today. Through co-operation between developing and industrialized countries, efficient methods for monitoring of desertification could be developed and applied in a number of representative areas. This work should combine information from ground, aerial and satellite sources. Furthermore, such monitoring systems must be based on valid assessments of the rate of desertification or recovery from it. This is a task for continued research and critical evaluation.

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This barren hillside exists in a region of over 3000 mm average annual rainfall in Karnataka State, India. "Wet" deserts are created by man. (UNEP: Daniel Stiles).

Lutte Contre La Désertification en Tunisie

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Introduction

La Tunisie a plus de la moitié de sa superficie, soit située dans les zones désertiques, nord-sahariennes, soit susceptible de devenir désertique par dégradation progressive et irréversible. Le Gouvernement tunisien a attaché la plus haute importance à la Conférence des Nations Unies sur la désertification de 1977, tenue à Nairobi, et au Plan d'action qui a été approuvé par l'Assemblée Générale des Nations Unies à la fin de cette même année.

L'objet de cet article est de résumer les actions réalisées en Tunisie depuis 1977 pour évaluer l'étendue et la vitesse des phénomènes de désertification sur son territoire ainsi que les efforts déployés pour mettre en oeuvre une stratégie de lutte conformément aux principes énoncés dans le Plan d'Action.

1. Les Processus

Les processus de la désertification en Tunisie ne sont pas spécifiques à ce pays et il n'est pas nécessaire de s'y étendre beaucoup. La population du Sud a augmenté et surtout s'est sédentarisée. Les grands troupeaux nomades ont éclaté en petits troupeaux transhumant. Les agriculteurs sédentaires ont défriché la steppe, pour faire des céréales, et aussi dans l'espoir de s'approprier des terres auparavant collectives. La végétation qui retenait les couches superficielles du sol s'est donc raréfiée et de grandes masses sableuses ont été mises en mouvement par le vent, provoquant des formations dunaires par endroit qui menacent villages et routes. Ailleurs il subsiste de grandes étendues sans végétation qui ne sont plus

cultivées que durant les années à pluviosité exceptionnelle. D'une façon générale, on a assisté, sur une grande partie du territoire, à une baisse continue de la productivité biologique depuis une trentaine d'années.

2. L'évaluation

A l'occasion d'une cartographie réalisée un peu avant la Conférence des Nations Unies sur la désertification de 1977, on a évalué l'état de la désertification dans le Centre et le Sud du pays. A cette date plus de 50% de ces régions pouvaient être considérés comme moyennement ou très affectés par la désertification (tableau 1), et environ 40% restaient sensibles aux processus de la désertification en cours (tableau 2) (Floret et al., 1976).

Pour cette conférence, le PNUE et l'UNESCO ont aidé à la réalisation d'une étude de cas sur une zone représentative de 20,000 ha afin d'analyser les mécanismes de la dégradation et de la désertification du milieu et de proposer des solutions (Nations Unies, 1977). Dix ans plus tard on a procédé à la révision de cette étude de cas, afin d'évaluer l'évolution du phénomène au cours de cette période. Au bout de ces dix années une surface supplémentaire représentant 2,5% de cette région avait été désertifiée et rendue inutilisable pour le parcours (mais était encore éventuellement cultivable), les surfaces nouvelles impropres à toute utilisation représentaient 1% des 20,000 ha. Donc une augmentation de la désertification, relativement faible, mais réelle malgré des aménagements réalisés par le gouvernement durant cette période.

3. Les Projets de Recherche et de Développement

Le Gouvernement tunisien a eu très tôt conscience de la dégradation du patrimoine national en cours, et, dès 1972, un séminaire sur la désertification a eu lieu à Gabès. Il est apparu que l'on manquait d'informations sur les processus de ce phénomène, qu'on n'en connaissait ni la vitesse ni l'étendue et aussi que les cadres formés pour participer à la recherche sur les régions arides et à leur développement étaient en nombre très insuffisant.

La Tunisie a donc fait appel depuis les années 1970, à l'aide internationale (PNUD, PNUE, FAO, UNESCO), et bilatérale (principalement la France) pour mettre en place une série de projets de recherche et de développement des régions arides permettant en même temps la formation des cadres. Ces projets d'abord rattachés à l'Institut National de la Recherche Agronomique (INRA) ont été ensuite réalisés au sein d'un Institut des Régions Arides (IRA), créé en 1976, qui compte maintenant plus de 150 agents. Cet Institut a pour mission de:

- réaliser toute recherche à caractère technique et socio-économique intéressant le domaine agricole des régions arides du pays;
- coordonner dans la région toute recherche accomplie par les organismes nationaux ou étrangers dans la zone;
- à partir des données recueillies, proposer des modèles développement socioéconomiques;



Les dunes de sable peuvent être fixées par les feuilles de palmiers. (UNEP/T. Farkas).

- contribuer aux actions de vulgarisation et de sensibilisation des masses, aux actions de formation des cadres.

Les Projets qui ont contribué le plus directement à l'augmentation des connaissances sur ces phénomènes de désertification en Tunisie et à la recherche de méthodes de lutte sont brièvement analysés ici.

Projet de Recherche et de Développement des Parcours du Centre-sud Tunisien

Le projet lancé en 1970 s'est terminé en 1978. Ce fut un excellent exemple d'études interdisciplinaires réalisées par la Tunisie en coopération avec des organismes internationaux comme la FAO, l'UNESCO, le PNUD ou nationaux comme le Centre Emberger (Montpellier) et l'ORSTOM (Paris).

Les études ont porté sur les ressources naturelles de la Tunisie aride (climat, sol, végétation principalement), et leur utilisation par l'homme. L'évolution dans le temps, les déséquilibres, la désertisation, l'utilisation de la télédétection pour la zone aride ont été particulièrement étudiés. Le projet a également tenté d'établir des modèles d'aménagement à différentes échelles, sur des bases écologiques (périmètres d'amélioration pastorale, modèles régionaux).

Malheureusement le projet ne disposait ni des données socio-économiques

nécessaires ni des équipes de vulgarisation qui auraient permis de valoriser les études techniques réalisées. Quoiqu'il en soit les données de base existent et les principes généraux d'aménagement qui en résultent restent valables (FAO-PNUD, 1979).

Projet D'expérimentation et de Vulgarisation pour la Mise en Valeur Agro-pastorale et la Lutte Contre la Désertification dans les Régions Arides de Tunisie

Ce projet s'est présenté comme la continuation du projet précédent. L'aide des Nations Unies s'est achevée à la fin de 1981 mais certaines actions incitées continuent à l'IRA. Les principales lignes directrices du projet ont été les suivantes:

- recherche d'outils non-désertifiants pour remplacer la charrue polydisque;
- évaluation des espèces et variétés de céréales cultivées par les paysans (blé et orge);
- recherches de lignées d'orge adoptées à la région (programme en collaboration avec l'ACSAD);
- l'étude et évaluation de parcours des zones salées;
- régénération (par coupe ou brûlis) des parcours à *Lygeum spartum*;

- recherche des meilleures formules d'animation rurale. Il s'agit en particulier d'encourager les groupements d'agriculteurs de façon à ce qu'ils obtiennent des facilités de paiement pour des achats (foin, concentré), ou pour qu'ils assurent en commun la maintenance de points d'eau (pompage).
- recherches de meilleures techniques pour le creusement des puits de surface.

Projet D'amélioration des Productions Animales dans les Régions Arides

Ce projet, qui a été opérationnel à partir de 1979 grâce à un financement du Qatar s'est poursuivi grâce à une aide du Canada et du PNUD. Les principales actions ont été les suivantes:

- amélioration génétique des caprins. On étudie les potentialités de la chèvre locale et on effectue des croisements d'absorption avec des races importées (Alpine, France; Merciana, Espagne; Damascen, Syrie). Les résultats sont très intéressants et les produits sont maintenant commercialisés;
- sauvegarde des agneaux et des chevreaux pendant les années de disette (avec du lait reconstitué, des sous-produits agro-industriels locaux);
- essais de sevrage précoce des agneaux qui restent actuellement 4-5 mois sur la steppe et épuisent la mère;
- amélioration de l'efficacité de l'eau pour la production fourragère dans les oasis.

Le Projet IPAL - Tunisie

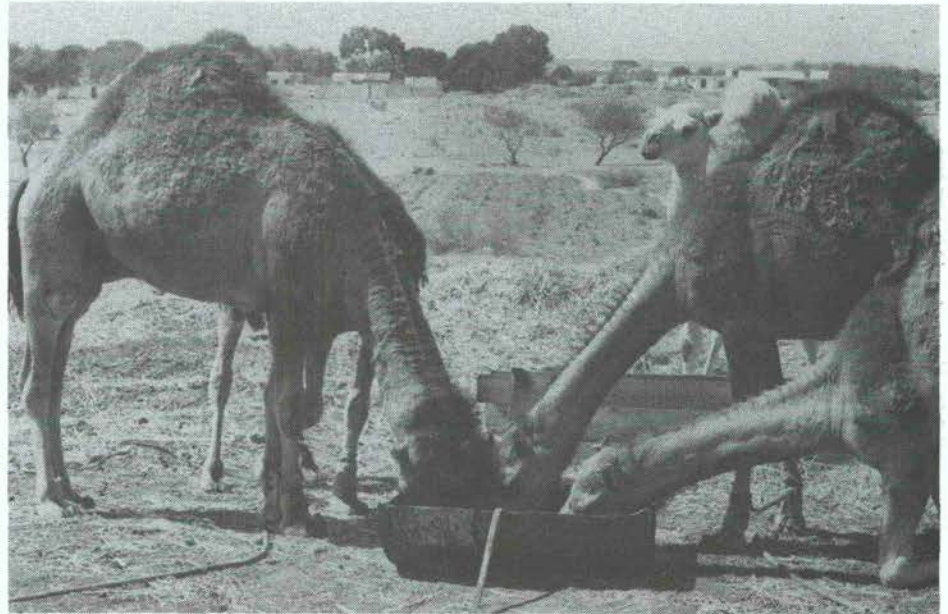
Ce projet qui a été entrepris par l'Institut

des Régions Arides avec l'aide du PNUE et de l'UNESCO, entre dans le cadre de la mise en oeuvre du "Plan d'action contre la désertification", adopté par la Conférence des Nations Unies sur la désertification (PNUE, 1977), ainsi que dans celui du Programme intergouvernemental sur l'homme et la biosphère (MAB). Ce projet a commencé effectivement en 1980 et s'est terminé fin 1983, par un Séminaire UNESCO/PNUE sur les problèmes de l'érosion éolienne dans les zones prédésertiques (IRA, 1983).

Les activités ont visé d'une part à apporter des solutions permettant de lutter efficacement contre la désertification et d'autre part à aider dans la réalisation des programmes de développement intéressant la partie méridionale du pays, qui est fortement affectée par ce fléau. Il s'agissait notamment de promouvoir les études intégrées dans le sud tunisien en vue de développer des méthodes et des techniques permettant d'assurer la régénération de la végétation et la restauration de la productivité du milieu.

Les principales actions du projet ont été:

- l'étude de la dynamique de l'érosion éolienne;
- l'étude du rôle des potentialités de la végétation naturelle pour l'amélioration des parcours et la lutte anti-érosive;
- l'étude de l'élevage du dromadaire (supplémentation de la ration; contrôle laitier);
- l'étude de l'impact des rongeurs sur le parcours (densité, consommation, lutte);
- prise en charge et amélioration d'un pastoretum;
- campagnes de sensibilisation aux problèmes de la désertification auprès des cadres du gouvernement, des paysans, des élèves des écoles.



L'étude de l'élevage des dromadaires a été entreprise dans le projet IPAL-Tunisie. (PNUE/Daniel Stiles).

Des résultats très intéressants ont été obtenus en ce qui concerne l'érosion éolienne (Khatteli: 1983), en particulier sur le mode de déplacement et la durée de vie des petites dunes. Mais surtout des dispositifs expérimentaux ont été installés pour mesurer l'influence de différents modes de travail du sol sur l'érosion et pour proposer des méthodes de lutte contre le départ du sable. L'accent a été mis sur des méthodes simples que devraient pouvoir utiliser le paysan lui-même (incorporation de débris végétaux aux cultures, cultures en bandes alternées, etc).

L'ensemble de ces résultats figurent dans le rapport final du Projet (UNESCO/PNUE, 1984).

Projet Pilote de Lutte Contre la Désertification dans le Sud Tunisien ⁽¹⁾

Ce projet, rattaché à l'IRA et financé en partie par le PNUE et l'UNESCO, a commencé en 1985 et vient de se terminer par un Séminaire UNESCO/PNUE qui a présenté les principaux résultats du projet (IRA, 1987). Il avait pour objectif d'aider à l'application des résultats obtenus par l'IRA et le projet IPAL. Les principales actions ont été les suivantes:

1) Recherche et expérimentation

- Etude de la dynamique de la végétation en relation avec le dynamique des sables mobiles; cartographie de zones sensibles; étude du cycle de vie d'espèces végétales fixatrices de sable.
- Remise en végétation sylvo-pas torale dans des zones pilotes.

2) Formation et vulgarisation

- Formation de chercheurs et de techniciens;
- Vulgarisation dans des écoles primaires;
- Journées d'information;
- Confection d'un diaporama;
- Organisation de séminaires.

Le projet a donc mis l'accent sur un point très important qui est la remise en végétation des zones arides. En effet, dans bien des endroits, la végétation naturelle n'est plus en mesure de se réinstaller d'elle-même.

(1) Tous les projets et activités du PNUE énumérés dans cet article ont été financés par le programme pour la lutte contre la désertification du PNUE. - Ed.

Cette remise en végétation concerne:

- les zones de sables mobiles qui sont souvent fixées artificiellement à grands frais;
- les parcours dont les semenciers ont disparu et dont le sol est assez profond pour justifier les efforts consentis;
- les zones recevant un léger appoint d'eau par ruissellement, trop petites pour être cultivées, mais où les arbustes fourragers peuvent être installés et produits.

L'expérimentation continue actuellement malgré la fin de l'aide financière internationale.

Réhabilitation de la Valeur des Terres à Pâturages et des Zones Affectées par L'érosion éolienne en Tunisie Présaharienne

L'organisme maître d'oeuvre est l'Institut des Régions Arides avec la collaboration du Centre Emberger (Montpellier) et de l'ORSTOM (Paris). Une partie du financement est assuré par la Commission des Communautés Européennes (CCE) jusqu'à la fin de l'année 1987.

Le but des recherches qui ont commencé en 1984 est de remplacer la végétation actuelle improductive par des espèces locales pérennes intéressantes. Il s'agit de collecter et de sélectionner les écotypes les plus performants et d'étudier leur disponibilité. On recherche des associations d'espèces ayant des enracinements complémentaires pour l'exploitation du volume de terre maximum du sol et pouvant tirer parti des infiltrations d'eau superficielles et profondes; associations qui devront aussi permettre une production végétale étalée dans l'année. De nouveaux équilibres entre la végétation et les herbivores domestiques sont aussi recherchés.

Il s'agit également de diminuer le coût de fixation des sables en utilisant les espèces locales qui ont une bonne dynamique dans les zones de sable mobile; recherche des moyens de favoriser leur propagation et

détermination des périodes durant lesquelles ces espèces peuvent être pâturées sans danger pour leur reproduction et la stabilité des systèmes qu'elles constituent. Les résultats obtenus sont encourageants.

Projet de Ceinture Verte à Travers les Pays du Nord de l'Afrique

Le protocole a été signé par cinq pays (Mauritanie, Algérie, Tunisie, Egypte, Lybie) en 1977.

La 1ère phase a été prise en charge par le PNUE et les pays signataires du protocole. Dans ce cadre, le PNUE a financé un projet de sensibilisation à la lutte contre la désertification dans le périmètre de Bir Lahmar (FP/1700-81-01). En coopération avec l'Institut des régions Arides, ce projet:

- organisé deux stages pour la formation de 40 techniciens chargés de l'action de vulgarisation et d'animation rurale, de manière à faire participer la population;
- organisé plusieurs stages recyclage concernant l'aménagement des parcours, l'utilisation de la télédétection, l'analyse des données, etc;
- entrepris des actions de plantations de brise-vent dans quelques parcelles cultivées et des actions vétérinaires.

Création d'une Banque de Semences pour les Espèces des Zones Arides dans le Sud Tunisien

Un projet concernant une banque de semences pour les espèces des zones arides vient d'être financé par le PNUE et le PNUD pour être mis en place à l'IRA. Ses objectifs sont: i) de mettre à la disposition des organismes de développement intervenant dans les zones arides tunisiennes, les quantités de semences sélectionnées et adaptées nécessaires pour l'amélioration des parcours, la fixation des sables mobiles et l'augmentation de la production des écosystèmes des zones arides en général.

ii) de définir les meilleures techniques de récolte, d'extraction, de conditionnement et de stockage des graines; iii) de former un personnel spécialisé en matière de production et de stockage des graines.

La création de cette banque de semences pour les régions arides exploitera les résultats de recherches, mené par l'IRA depuis quelques années en collaboration avec le Centre Emberger de Montpellier (France) et financé par la Communauté Européenne et le PNUE, dans le domaine de la sélection des espèces pastorales et fixatrices des sables pour les zones arides.

Ces graines, mises à la disposition des organismes de développement, servant à remettre en végétation des zones steppiques récemment défrichées pour une culture épisodique, où les semenciers des espèces pastorales ou fixatrice des sables de la steppe originelle ne sont plus présentes, et où l'épaisseur du sol est encore suffisante pour la production. Par ailleurs, la disposition de ces semences sélectionnées permettra l'accélération de la plantation des arbustes fourragers déjà en cours.

Il faut souligner l'impact régional que ne manquera pas d'avoir cette banque de semences grâce à des échanges avec les pays à climat comparable.

La Stratégie Nationale du Lutte Contre la Désertification

Les projets qui ont été brièvement analysés ci-dessus peuvent paraître trop nombreux et dispersés. Cela tient au fait qu'il est difficile d'obtenir une aide financière de longue durée. En réalité les actions abordées par chacun des projet se complètent; la continuité et la coordination étant assurée par le même organisme, l'Institut des Régions Arides. Les sérieux des travaux entrepris conduisent d'ailleurs les organismes internationaux à continuer leur aide actuellement.

Parallèlement, le Ministère de l'Agriculture a mis en place des opérations de mise en valeur par l'intermédiaire de ses Directions (Sols, Ressources en eaux, Conservation des Eaux et du Sol, Génie Rural, Forêts, etc). Des Officiers interviennent (Office de l'élevage et des pâturages,



Un projet PNUE/PNUD a commencé en 1986 pour la création d'une banque de semence à l'Institut des Régions Arides à Medenine. (PNUE/Daniel Stiles).

Office du Développement du Sud). D'autres Ministères ont également des projets de développement dans le Sud.

Afin d'éviter une dispersion des efforts, et devant l'ampleur de la tâche, il est apparu nécessaire au Gouvernement d'élaborer une "Stratégie nationale de Lutte contre la désertification". Au début de 1985, le Ministre de l'Agriculture a constitué une équipe, avec l'aide du PNUE, pour élaborer cette stratégie. Un coordinateur de la stratégie a été nommé. Pour la réalisation du document, les directives concernant l'établissement d'un plan d'action national contre la désertification (PNUE, 1978), ont été suivies en les adaptant au contexte tunisien.

Le document (MINISTÈRE DE L'AGRICULTURE/PNUE, 1985) fait d'abord le point sur l'état des connaissances en ce qui concerne les ressources naturelles du Sud tunisien dans les domaines touchant à leur utilisation pour l'agriculture, puis montre un diagnostic de la désertification dans ce pays. Il fait aussi un bilan des mesures entreprises par le gouvernement pour lutter contre la désertification: législation, mesures institutionnelles, organismes directement concernés, projets de développement et de recherche mis en oeuvre. Mais surtout la stratégie d'ensemble et les mesures sectorielles à prendre y sont exposés, ainsi que des recommandations techniques pour quelques secteurs. Une vingtaine de projets sont présentés en annexe du document, qui couvrent des actions, souvent déjà

ébauchées, mais qui demandent un financement additionnel permettant d'amplifier les activités dans la lutte contre la désertification et le développement du Sud.

La stratégie de lutte proposée s'applique principalement à la durée du Plan actuel (jusqu'en 1991), mais des orientations sont également données pour le long terme.

La stratégie de lutte proposée, tout en ayant sa spécificité concernant la conservation des ressources naturelles, met particulièrement l'accent sur les projets de développement. En effet, lutte contre la désertification et mise en valeur de ces régions très peuplées sont indissociables.

Neuf projets de développement s'appuient sur une série d'autres projets concernant, en particulier, l'inventaire et le cartographie des ressources, les recherches d'appui encore nécessaires, la formation, l'information et la vulgarisation, la création d'une banque de semences, et la surveillance continue.

D'autres actions sont proposées, qui n'ont pas été chiffrées et présentées sous forme de projets, car elles peuvent être réalisées dans le cadre des activités normales des organismes concernés. En particulier une des priorités suggérées est la mise en place d'une législation foncière nouvelle. Sur les terres privées, de loin les plus importantes en surface et en qualité la stratégie immédiate privilégie l'information, la sensibilisation, la vulgarisation. Après une

phase de démonstration dans des zones pilotes, qui aura dégagé les techniques facilement transposables, on peut s'attendre à l'extension de ces techniques grâce au développement des structures de vulgarisation et d'animation rurale. Beaucoup plus que maintenant les travaux de conservation du milieu naturel touchant au développement devront être effectués par les paysans eux-mêmes, grâce à des systèmes de prêts et subventions, grâce aussi à une législation foncière claire et adaptée qui aura "sécurisé" les paysans en ce qui concerne la pérennité de l'usage de leur propre territoire agricole.

Mise en Oeuvre de la Stratégie

Le Ministère de l'Agriculture a organisé à Djerba du 1 au 3 décembre 1986, en collaboration avec le PNUE, un séminaire sur la mise en oeuvre de la stratégie nationale de lutte contre la désertification. On y a présenté les principes et orientations de la stratégie. Les actions déjà entreprises ont été examinées, prioritaire. Un certain nombre des projets prévus sont déjà en cours et financés, soit en partie par des organisations internationales ou par des aides bilatérales, soit totalement par le Gouvernement.

L'évaluation des résultats de la stratégie est prévue, en particulier dans le projet "Etude de l'impact des projets de développement et de lutte contre la désertification: surveillance continue", dont le séminaire a souligné l'importance et le caractère prioritaire. Il est souhaitable que ce projet deviennent rapidement opérationnel.

Conclusion

On peut considérer comme exemplaire la démarche tunisienne en matière de lutte contre la désertification. Après une prise de conscience très précoce, dès les années 1970, le gouvernement a mis en place toute une série d'études scientifiques de base pour évaluer et mieux comprendre les processus de ce phénomène. La Tunisie a participé activement à la Conférence des Nations Unies sur la désertification de 1977 organisée par le PNUE, en présentant en particulier une étude de cas sur le sujet et en réalisant pour cette date une des premières cartes de sensibilité à la désertification sur l'ensemble de son territoire concerné. Grâce à la création d'un grand Institut spécialisé sur les problèmes

des régions arides, lutte contre la désertification et les modes de développement à mettre en oeuvre dans ces régions déshéritées.

Plus récemment, la réalisation d'un plan d'action national contre la désertification, conformément aux recommandations de la Conférence sur la désertification (PNUE, 1978), est une étape importante de cette lutte. La réalisation de ce plan, prévue jusqu'en 1991 est maintenant très engagée.

On peut penser aussi que le projet de surveillance continue de la désertification et des projets de développement, s'il est réalisé tel qu'il est prévu, constituera un modèle à suivre.

Il est certain que les actions entreprises sont insuffisantes encore actuellement pour lutter contre la dégradation de la productivité biologique dans ces régions arides très peuplées, où la population rurale peu fortunée ne peut prendre elle-même en charge la "conservation" pour le long terme. Une partie du territoire continue donc à se désertifier. Cependant il faut souligner l'énorme effort accompli par cette population, aidée par le Gouvernement, pour la conservation des eaux et des sols. Les travaux de rétention d'eau (petites levées de terre, banquettes, petits barrages, etc.) se sont multipliés dans le Sud à l'échelle individuelle, en raison principalement de la sédentarisation et de l'appropriation des terres. De grandes étendues devenues stériles, en particulier sur les piémonts, sont généralisées. Par ailleurs le programme d'utilisation des nappes profondes ou superficielles existantes permet, par endroit, une forte extension des périmètres irrigués. On peut parler, en Tunisie, d'un processus de "désertification" en cours.

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The (Apparent) Paradoxes of Desertification

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Desertification continues apace. The effort to combat it languishes. Even concern to contain it seems to dwindle. Donor agencies are unenthusiastic about project-components that deal specifically with desertification. According to one estimate they may have spent as much as \$10,000 million on projects "said to have a desertification component" since 1977 (Dregne 1985:31), but most of these projects were not directly concerned with the rehabilitation of degraded land or with preventing degradation. They were mainly concerned with public works, such as the improvement of domestic water supply and the construction of feeder roads, or with measures to increase rural income, such as seed-multiplication and the control of animal diseases; the primary objective was to improve living conditions in areas suffering from desertification. Some projects listed under the anti-desertification heading have actually tended to increase desertification, insofar as they made it possible for communities to increase the pressure on the land. In no case did these reports deal with the causes of desertification (Dregne, 1985).

Following more than a decade of scientific and public discussions, desertification is still out of control. It not only seems to defy the administrative and political measures that are taken with the aim of bringing it under control; it also frustrates our efforts to think clearly about it. As an objective problem it appears obvious, but intractable. As a topic of debate and analysis it remains vague and emotive. A review of the record of discussions, projects and the now extensive literature suggests that there is less than total agreement about exactly what we are dealing with. If we state it in terms of factors, it is difficult to be more precise than simply listing (for example) precipitation, soils, hydrology, vegetation, people, etc.; the precise relationship between the factors remains unclear. If it is

expressed in terms of processes, such as drought, deforestation, population pressure, technological intensification, and erosion, certain relationships become implicit but remain undemonstrated. After all, these processes do occur without desertification. In particular, we have not yet grasped specifically how the nature processes and the human activities are interrelated. If we could achieve a greater measure of conceptual clarity that would comprehend the physical, biological, social and cultural dimensions of desertification, we might have a better chance of achieving our short and long-term resource-management objectives. What follows is an attempt to clear away some of the confusion. While an article of this length is bound to be partial, it may nevertheless be valuable to address those aspects of the confusion that tend in most arenas to be ignored.

The international struggle against desertification began formally in December 1974 when the U.N. General Assembly called for a world conference. The International Plan of Action to Combat Desertification (PACD) was finalised at the U.N. Conference on Desertification (UNCOD) in 1977, and has been followed up and monitored at numerous national, regional and international meetings since. That so much effort should have been extended promoting awareness of desertification for so long, and the sum of \$10,000 million (though still much less than the figure required) should have been expended, without any interest being shown either in clarifying the causes of desertification, or in counteracting them, surely entails a paradox. Closer scrutiny of this paradox leads to the discovery of others. In what follows, I argue that some of these paradoxes are a function of our conventional approach to the problems; that they may be resolved by thinking out the problem more systematically from first principles and revising our approach; that it may in fact be futile to expect to win the struggle against desertification by confronting it directly; but that

we nevertheless have no option but to continue to confront it directly. Despite the apparent pessimism of this argument, I conclude on an optimistic note.

To begin with, the definition of desertification is elusive. It conveys immediate meaning, but each attempt to tie it down in exact scientific terms fails to find universal approval. This problem of definition is partly a consequence of the similar problems with "desert." The essential difficulty in defining "desert" has to do with the way Western science organises our knowledge. Is it basically a physical or a biological phenomenon? What is the priority of the climatic, edaphic and biological factors that together make a desert? This question is partly forced on us by our own scientific classification of information, of types of investigation, and above all of disciplinary professions. In the case of desertification, there is an added category: it is assumed that the process is caused by people, and that people could avoid it. But how, why and in what circumstances they cause it is assumed rather than investigated.

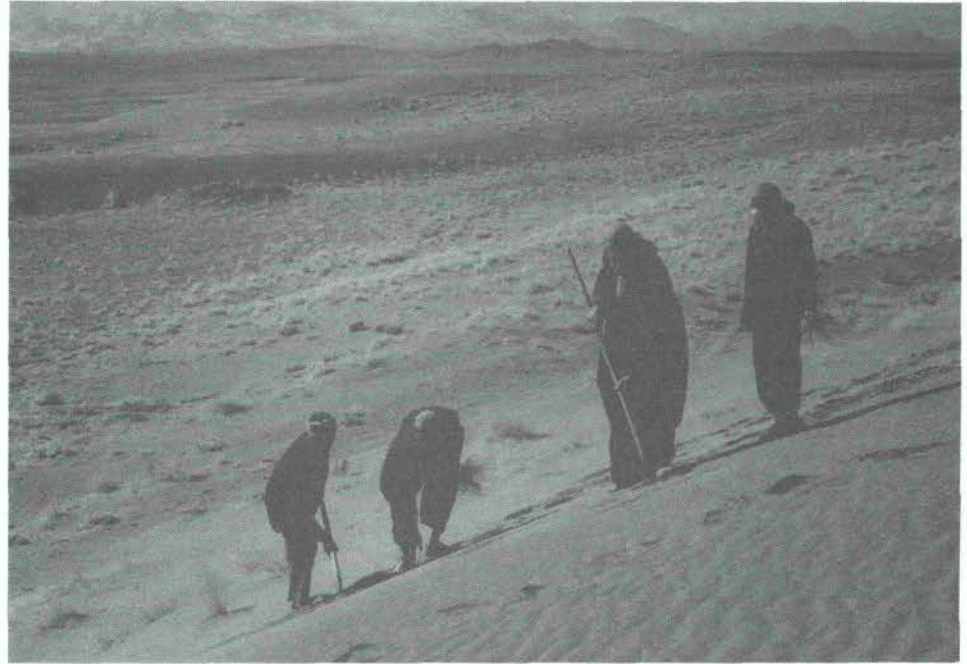
Only physical and biological scientists have so far attempted definitions of desertification. Although it is caused by people, we start from the paradox that the scientists who specialise in the study of human behaviour, motivation and values have shown little interest in it, and have as little scientific understanding of the natural processes involved as most natural scientists do of the human processes. The concept straddles two sectors of science—the "two cultures" of Western society. Since desertification is diagnosed from natural symptoms, the natural scientists extend their hegemony over the debate. There is so far no social-science definition of desertification. In fact, it is difficult to see how there could be, because it would seem to be a social definition of natural process! But natural scientists alone are unable to harness and put into operation the human resources necessary to deal with the problem.

We have known since early in the debate that an integrated (rather than a disciplinary or sectoral), approach is necessary. We need to work out how to conceptualise desertification in such a way that we integrate the social and natural dimensions of the problem within the concept. The biggest problem in (human) ecological studies generally today is that there is as yet no such integrative concept or framework. A resolution of the paradoxes of the desertification debate may help us on our way to developing one.

1. Desertification Is Both Absolute and Relative

Like deserts, desertification appears absolute. But it is of course in fact relative. Desertification is not new. It has been documented since classical times. It probably began with the domestication of plants and animals and the ensuing intensification of land use some ten thousand years ago. As soon as people began actively and systematically (as well as unconsciously and carelessly) to modify the renewable natural resources available to them the primary productivity of those resources has been slowly reduced. The process at first, was imperceptible. It spread out from a few core areas, like the Fertile Crescent. Progress continued to be relatively slow until recent times. In this connection it is interesting to consider why it is a major policy concern now.

The rate of desertification has increased disturbingly since the middle of this century. The reason for our recent panic about it lies not so much in its acceleration *per se* as in the interpretation that our vital interests are threatened. Until very recently there was always more land, and more resources. Since the beginning of food production (the Neolithic "revolution"), we have continually upgraded our productive technologies. We have produced larger and larger quantities per hectare, though generally, as Boserup (1965) has shown us, at the cost of increasing amounts of labour or other forms of energy. Until recently, it continued to be possible to expand into new lands if productivity declined. It was not necessary to think in terms of global limits to production, because most governments, and most communities, could still expand their own areas



Villagers work on government-sponsored projects to stabilise dunes by planting *Haloxylon* seedlings in central Iran. (Photo: B. Spooner).

of production. For most of us, this has now ceased to be possible. Whereas most individuals have always been constrained by the interests of their neighbours, it is only recently that most communities have become aware of the finiteness of the total of available resources. Now that we have been forced to think of the possibility of resources running out, let us look back over some historical examples of desertification, as well as some more recent examples, and see if we can make out any common features in their human dimensions.

The Indus Valley, divided since 1947 between Pakistan and India, provides a useful example, where large tracts of land have been desertified over the past 130 years through salinisation and waterlogging. The modern technology of irrigation was introduced from outside in the nineteenth century and developed by outsiders, but it was left to a mixture of local people and resettled families from neighbouring districts to practise it. These people had their own agenda in their daily lives and no understanding of the principles underlying the irrigation technology, which were anyway being worked out by trial and error by alien experts. The population lived then as now in cohesive kin groups, within which and between which individuals compete for land and water, for political following, and generally for honour. But the cohesiveness of the family groupings

conflicts with the co-operative relationships required for efficient management of land and water. The reason for the conflict is that the families were settled, and land and water rights were apportioned, with no attention to the need for co-operation along - rather than between - water courses. Social arrangements were taken for granted because it is generally assumed that all people are rational in the sense that they will recognise and adapt to ecological imperatives. (If this were true, we should presumably not have relative desertification, though we should still have absolute desertification!). Until the middle of this century salinised land was simply abandoned and new land was brought under cultivation. Now it is difficult to find new land.

Another pertinent example may be taken from the history of pastoralism on the plateau that extends over most of Iran and Afghanistan and nearly half of Pakistan. Here the biological succession of rangeland vegetation has been modified by the continuous, but fluctuating pressure of grazing for a period long enough to be significant in evolutionary terms, possibly as long as ten thousand years. Grazing patterns vary according to the competition for resources in the larger economy and the strategies of local shepherds. Desertification appears to have been a problem here for at least several centuries, but it has

recently accelerated. Independently generated change in food preferences, in the relationship of urban to rural values, in the cultural perception of nature and the range, and of shepherding as an occupation - all change the goals of the pastoralists and thus also the pattern of grazing pressure. But these factors are generated by the political economy of the cities, which are beyond the control of the pastoral populations.

Desertification is a matter of comparison with other places or other times or by other people. In each case there is also the problem of when in a long-term process it becomes desertification. What is an acceptable degree of human impact? When does it become a policy problem? Though the question is heretical - are we crying "Wolf" indiscriminately. There is a wide range of difference in the welfare of "desertification-populations." The same degree of desertification (measured in physical and biological terms) is acceptable in one locality and not in another, because of differences in the degree to which the "desertification-population" is tied into a larger diversified political economy.

The common variable in each of these two cases is the relationship between the "desertification-population" and the major centres of human activity to which they are economically and culturally peripheral and dependent. It is the way the communities are tied into the larger society that seems to be the primary human variable in the desertification process.

2. Desertification is Both Natural and Social

Desertification is a process that is recognised primarily through physical and biological symptoms and only secondarily through changes in welfare and settlement patterns of the people who may or may not be the same as those who caused it; they are usually not those who diagnosed it or developed remedial management plans for it. Each of these categories of people may or may not have the same appreciation of desertification in the abstract, because they have different interests. The people who are trying to stop or reverse desertification are in most cases not the people suffering directly, or even indirectly, from it, or even the governments of the territories at risk.

Interests are reflected in various ways. The people who suffer from desertification are interested in food and other economic relief in the Third World, or the benefits of the central national urban community in the industrialised world; they see it as an economic problem. Others, not immediately threatened by desertification, see it as an ecological problem and are worried about the finiteness of total global resources. It is a problem that has different meanings for different people, especially people in different social situations, and the difference is a function of the relationship.

In each case, although needs are expressed in terms of scarce material goods (economic or ecological), they reflect social differences the way the communities fit into a larger society. We must recognise that for human beings, social needs are primary. Individuals must satisfy their immediate needs and this must take priority over scientists' worries or long term-global ecological viability. The material and the social aspects of desertification, the damage to primary productivity and the harm to people, appear so obviously related: yet they are difficult to describe satisfactorily because the natural is supposedly universal whereas the social is divisive. Desertification, therefore, means different things to different people. It is only a short step from this to an acceptance of the equal validity of different people's rights in relation to a desertification process, irrespective of the interests of the global community. Once these rights are allowed, they may be difficult to deny.

3. Desertification is Both an Ecological and a Moral Problem

The social differentiation in the desertification debate reflects an underlying moral problem, that of the evaluation of self-interest and of its re-evaluation over time. The people who campaign against desertification implicitly make assumptions about the motivation of those who cause it. These assumptions are not scientific principles; they are made not by psychologists or social scientists, but by physical or biological scientists. People assume that all human beings are similarly motivated and that their motives have to do with short-term self-interest, and vary according to individual intellect, and access to informa-

tion. Desertification seems to be a material process caused by (irrational) human activity. Efforts to solve the problem of desertification so far have been by reorganising the way people think about it on the assumption that this reorganisation can be achieved by feeding information and controlling self-interest (by force or incentive, or some combination). But the people who suffer from desertification and whose activities in many cases contributed to it, are more concerned with the reorganisation and redistribution of resources (according to self-interest), and of the global economic and political order.

There is a moral dimension to the idea of desertification, an element of condemnation. Moral problems do not have scientific solutions. We can accept that other people have different values but we often have difficulty in accepting that they may have legitimate interests that conflict with ours. This is especially true in situations where we (as scientists) have more awareness than they as marginalised populations have. Morally, if we have more awareness, we have more responsibility. But we face a greater temptation to make decisions on their behalf according to our interests. The importance of the modern concept of rights is that it should help us to think of other people's self-interest on a level with our own. But it is very difficult to balance the rights of the individual relative to the group, of the group relative to the species, or the species relative to the system. This discourse has now been further complicated by a vagueness in the distinction between human rights and civic rights.

The situation is in fact even more complex that at first appears. We know that desertification is caused by a number of factors: overgrazing which in turn reduces primary productivity and the palatability of range vegetation; cultivation that exposes fragile soils to erosion; and irrigation that raises the level of water tables. But these are not types of behaviour. They are the results of a wide variety of different types of human behaviour for which we need to investigate much more carefully than has been done so far - the occasion, the motivation and the intention. Not only is there no specific type of behaviour or behaviour pattern that can be categorically associated with ecological degradation: in fact, positive patterns of

behaviour that we should wish to encourage for other reasons, such as entrepreneurship, are often most obviously at fault!

An approach that looks for types of behaviour, for example social indicators of desertification, does not lead to any resolution of our problem. Another common approach seeks to find differences in the perception of nature and natural resources. Despite differences in attitude towards nature and natural resources, for example, between the idea that we are stewards responsible to God for conserving what He has provided, and the idea that the material world is there for us to use as we will without giving any account of our actions, there is no evidence that any of these attitudes is unique to particular societies. It appears to be truer to say that in any society we might expect to find a variety of changing attitudes towards the exploitation of renewable natural resources and ecological responsibility (see Passmore, 1974).

At this level of analysis it may be stated with some confidence that there are no cultural ways of thinking and no specific social formations that are in any way causatively linked to desertification. However, there is a relationship between human behaviour and desertification. It must, therefore, be possible to make systematic, or scientific statements about that relationship. The fact that we have been unable so far to make such statements does not mean that the situation is hopeless. It means rather that we must try to find another way of asking the question. The argument here directs our attention towards the assessment of a much broader range of social and cultural criteria than have been used so far.

Instead of looking for types of behaviour, we should look carefully for common factors in the human conditions where desertification occurs. For example, "The Tragedy of the Commons" (Hardin, 1968), might be seen by some as such a factor, since this has been argued to be invariably associated in dry lands with some degree of desertification. The idea has enjoyed considerable influence. It states that where rights of access to a resource are held in common, not only is there no incentive to conserve, but each individual will be led to over-exploit on the assumption that if he does not, others will do so at his expense. It is, therefore, in his interests to get in before

others. The argument had already been made somewhat more sophisticatedly for Western society, for which it is more useful, under the title "The Logic of Collective Action" (Olson, 1965). It is an important and a persuasive argument, but in the case of desertification it can readily be shown that there are communities with common access that have not caused desertification, as well as communities with individual rights that have caused desertification.

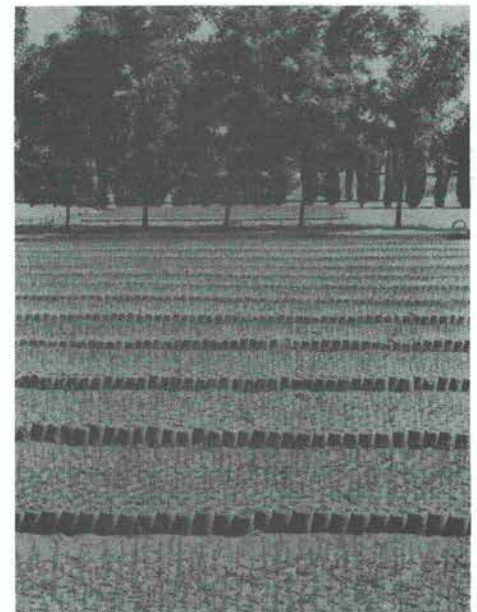
It is therefore empirically unwarranted to introduce as a matter of principle, individualised land use rights in order to minimise the risk of desertification. It becomes an excuse for saying that desertification is caused by people who are not like us. It may in fact be argued that individualisation of land rights in some cases disrupts community life and that this could in itself lead to desertification, since disruption of community life leads to depopulation. Several of the cases of desertification that were studied in the Turan Programme in Iran (Spooner and Mann, 1982:138-292), provided examples of desertification as a result of depopulation, rather than (as is generally expected), depopulation resulting from desertification. Some village communities had disintegrated as a result of the economic pull of the towns with the result that there was no one to maintain the investment in agricultural land and irrigation engineering and it was invaded by non-anthropogenic sand.

The conclusion here appears to be that in any case of desertification we should look at the range of human interests that are involved both in the desertification-population itself and outside, and ask what universal human motivation is directly implicated, and what is the distribution of relative political and economic power. The answer is invariably outside the desertification-population.

4. Desertification is Inevitable but Unpredictable.

When we call a problem "ecological," we immediately assume it can be solved according to natural laws. In some cases we may not yet know those laws, but we believe that they are discoverable. Such laws may be imperfectly understood, but knowledge of them is increasing fast and at

UNCOD we were told that such knowledge and the technology that goes with it is generally sufficient for our purposes. But when ecological processes lead to situations that we diagnose as problems, the cause lies generally not in nature, but in human activities. However, geology, geomorphology, climate, hydrology, biology, society, culture, economics, politics are all modelled in different time frames. The interaction of psychological, behavioural, cultural and historical factors that produces human activities is inadequately understood, and prescription of corrective measures is complicated by moral considerations which are involved in the relationship between the local population and the specialist or investigator. We arrive, therefore, immediately at a paradox in our (often unexpressed) assumptions that the natural component of a problem is determined by laws and is predictable, whereas the sociocultural component is not determined



A UNDP programme of reforestation is underway in the Baq'a valley of Jordan to combat soil erosion. (Photo: FAO).

by laws and is unpredictable. But human beings are part of the natural world! Natural processes can be understood in terms of rules; people are part of the natural world, but their behaviour is not susceptible to rules. We do not yet know how to relate human activity to either evolutionary or ecosystemic processes. We tend to treat it as ecologically intrusive, because it does not fit within the boundaries of physical or biological units. The resolution of this paradox is particularly difficult, and I shall

risk the argument that the paradox will resolve itself when we become more humble about our knowledge of physics and biology.

5. Desertification is Everyone's Business and No One's

The most obvious paradox is that everyone agrees that something must be done about desertification, but those who have the power to do something appear not to be giving it sufficient priority. The PACD, which was the principal product of UNCOD, produces more information than action. But our memories of UNCOD are growing dim. We are relying more and more on the official record, on the excellent documentation prepared by the Secretariat, or, perhaps even more so, on the re-documentation prepared for the scheduled seven-year review in 1984. However, there was much to learn from the deliberations of UNCOD, both formal and informal, that should not be forgotten, and we should not allow to be effaced from our memories by time and the official record.

UNCOD was a special event, perhaps more so than the other UN conferences, even Stockholm. As often happens in such international forums, the discussions were conducted on more than one level. While ostensibly they concerned procedures for the organisation of programmes to mobilise resources and combat desertification, many delegates were in fact bargaining about relations between the parties to the Conference. While most delegates saw the solution to desertification in the mobilisation of resources, many also blamed the incentives for exploitation of people and resources that they considered to be inherent in the present world economic order, and saw the solution in the reorganisation of that order. All the delegates accepted the ecological explanations of desertification and the direct technical solutions that were offered, but many were more concerned with ultimate causes and ultimate solutions: that of the economic and political conditions that generate land use decisions. The campaign to conserve resources can never entirely avoid stirring up a campaign to reorganise the distribution of resources (Spooner, 1982).

Desertification is the result of the marginalisation of people. At UNCOD the dele-

gates representing marginalised countries were telling us just this. We were not yet ready to hear it. (How could they possibly have anything to add to what the scientists were telling us?). But even if some of us may be ready to hear the message now, what can we do about it? Is there a political system in the world which never marginalises? Look at America, Europe, the Soviet Union, China. Even where their marginalised populations are not indigent, they are associated with desertification. The outlook is bleak. Yet there is another argument that suggests that the problem will gradually resolve itself.

Resolving the Paradoxes

Looking back over the past ten years since UNCOD, I think we have still not faced up to the most important problem. We talk about desertification in general terms. When we formulate it more specifically it becomes the problem of how to prevent it, halt it, or reverse it. We set deadlines. We assume we know why it has occurred, why it continues. But do we? I think it is possible to know, but I think that we have been conditioned not to ask the question.

The dust, so to speak, of UNCOD has now settled. There have been other United Nations Conferences. Desertification is one of a number of global problems. We can look at it more analytically than we were perhaps able to in the heady days of 1977 in Nairobi! Then the message was urgency. The awareness that had been growing since the intensifying Sahelian drought of the early seventies, vindicating those who had been warning of it since the fifties, had become a wave of emotion by 1977 that was only partly checked by the disagreement at the end of the Conference on how the necessary financing was to be organised. If we had been listening carefully then to the Third World delegates, we might have foreseen more clearly how the campaign would develop over the coming decade.

At Stockholm in 1972 there was an anti-conference. At Nairobi the anti-conference was an integral part of the proceedings, though it is not adequately represented in the published proceedings. UNCOD was a conference organised and run by people who had no doubt what the problem was and what had to be done about

it. They had the technology and the experience to apply it: what they needed and what the conference was to provide was "the political will and determination" to find the necessary financing and apply the technology. So far as specialists were concerned, it was a conference of ecologists. It seemed obvious that it should be, because desertification was after all an ecological problem.

Or was it? There had been attempts to get economics involved. Some had realised that in the long run ecology, however bad it looked, might not be enough to move political machines. It would be just as well to demonstrate that it made good economic sense to combat desertification. There was no doubt that it did, but it was desirable to come up with a good set of figures. As for social scientists, although a few came to the Conference, I do not know that any were sought by design and no statements were solicited from them. The International Science Associations' Nairobi Seminar on Desertification (SANSOD) which was held immediately preceding UNCOD, produced a Handbook of Desertification Indicators, which has a chapter on Social Indicators. The problem here was that very few social scientists were interested in ecological problems, or even in the effects of ecological problems on human life. Even if the organisers of this ecological conference had set out to involve social scientists, it is unlikely that they would have produced anything interesting. Social science was not ready for the problem.

Much has happened since to change that. The answers to the problems that have beset the PACD may have been there at UNCOD for those who were ready to hear them. What I have in mind are words I heard not from the ecologists or the Secretariat or the donor country delegations, but, if my memory serves me correctly, from some Third World delegations: that the overgrazing, overcultivation and overirrigation that cause the relative degree of degradation that we recognise as desertification, is a function of the marginalisation of people. But even if some of us may be ready to hear the message now, what can we do about it?

The problem seems so vast that it is difficult to continue to be optimistic after ten years of effort. A typical response is given

by two quotations from Dregne (1985 p.30 and p.33): "... the greatest hope for stopping and reversing desertification lies in making more intensive use of the best lands..... Pressures on marginal lands must be reduced. Given the growing population, the only feasible way to do so is to increase productivity on favourable lands. Traditional agriculture is a low-risk, low-yield food production system capable of functioning indefinitely at the subsistence level if the dependent population is small and has modest needs. Such a system, however, usually cannot cope with rapid population increase and with restrictions on freedom of movement within and between countries. Intensification of production through improved technology seems to be imperative to meet growing urban requirements." He continues by saying that: "The solution to desertification in arid regions is to increase productivity on the better endowed lands by targeting technical and financial resources there. The much maligned "trickle down" theory of economic development is the effective approach in desertification control. There is no future to expending scarce resources on the least productive areas." This approach may have good results, but for probably rather different reasons: it will not increase the dependency of the desertification-populations.

This argument suggests that there is very little we can do about desertification. There is another, not unrelated, argument that suggests that the problem will gradually resolve itself. The wave of political awareness that has been increasing at an accelerating rate since the middle of this century continues to spread. As it spreads it may solve some of the more acute marginalisation problems that underlie desertification on the global scale. De-colonialisation was a first step towards de-marginalisation. Alternatively, the more powerful nations could react and become more monopolistic, and the social situation could get worse, in which case desertification would get worse. But increasing the flow and the diversity and the quality of information about related natural processes and human activities is probably the best guarantee of a positive outcome.

So what should be the role of UNEP's DESPAC for the next ten years? The

answer I think is simple: to continue the work of the past ten years with even greater effort. The most essential need is to increase awareness of desertification and of the technical options for direct treatment of it — which has been DESPAC's most successful function. The indirect causes and responsibilities cannot be treated directly. We are nearing completion of a major project in exactly this style; it was begun by an Australian Government initiative in 1985 and jointly pursued since, by the Australian Government, UNEP and the East-West Center. The objective of the International Project on the Economics of Dryland Degradation and Rehabilitation is to show how certain basic techniques of development economics can clarify decision-making options at various bureaucratic and technical levels. The project is fully supported by ecologists, social scientists and economic planners. The final products will include an Executive Report aimed at increasing the awareness of senior officials, and a Technical Guide and a Case Study Reader aimed at project analysts. We are gradually clearing away the vagueness, emotion, even mysticism that has plagued the subject of desertification. As we form a clearer idea of what we are dealing with on the ground and in human relations, the apparent paradoxes will disappear and we shall make more significant progress towards a solution of the problem.

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c a l l f o r p a p e r s

RESTORING THE EARTH • 1988, a national conference on natural resource restoration and environmental planning, will take place at the University of California, Berkeley on January 13—16, 1988, initiated by the Restoring the Earth project of The Tides Foundation, cosponsored by the Center for Environmental Design Research, University of California, Berkeley. Proceedings will be published and distributed by the Center. The conference is to further the exchange of scientific information on restoration and to present the accomplishments and capabilities of restoration technology in resource management and planning.

Topics to be covered include restoration of coastal ecosystems and estuaries; rivers and lakes' streams and fisheries; rangelands, prairies, mined lands, forests and wildlife; atmosphere and climate; dry lands and agricultural lands; redesign of human settlements; and control of toxic wastes. The nontechnical sessions will include discussions of relevant policy issues, legislation, litigation, conflict resolution trends, and accounts of restoration successes.

Submit four copies of abstract (title and 200-400 word descriptions of proposed 20-minute presentations) asap but not later than October 15, 1987. Final text of accepted papers will be due November 30, 1987. Send proposals to Restoring the Earth Conference, 1713 Martin Luther King Jr. Way, Berkeley, CA 94709. Write or telephone (415) 777-9515 for list of sessions and preliminary agenda.

Photographs for *Desertification Control Bulletin* Covers

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

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

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.

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 remuneration.

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.

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

Audience

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

Language

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

Manuscript preparation

Manuscripts should be clearly typewritten with double spacing and wide margins, on one side of the page only. The title of the manuscript, with the author's name and address, should be given in the upper half of the first page, and the number of 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.

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

Line drawings of any kind should each be on a separate page, drawn in black china ink and double or larger than the size to appear in the bulletin. They should never be pasted in the text. They should be as clear and as simple as possible.

Photographs in the bulletin are printed black-and-white. For satisfactory results, high quality black-and-white prints 18 x 24 cm (8 x 10 in) on glossy paper are essential. 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 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, while articles longer than 4,500 words are not accepted.

A reasonable fee is paid for articles accepted for publication, and 25 reprints are provided to the authors.



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