United Nations Environment programme

Desertification Control

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

Number 10, May 1984

- The United Nations Conference on Desertification (UNCOD) was held in Nairobi from 29 August to 9 September 1977.

- This was the first worldwide effort ever initiated to consider the global problem and responsibilities posed by the spreading deserts.

- 95 States, 50 United Nations offices and bodies, 8 intergovernmental organizations and 65 non-governmental organizations participated.

- The United Nations Conference on Desertification prepared and adopted a worldwide Plan of Action to Combat Desertification (PACD) with 28 specific recommendations.

- The Plan of Action was approved by the United Nations General Assembly at its 27th session on 19 December 1977.

- Recommendation 23 of the Plan of Action invited all relevant United Nations bodies to support, in their respective fields, international action to combat desertification and to make appropriate provisions and allocations in their programmes.

- Recommendation 27 gave the responsibility for following up and co-ordinating the implementation of the Plan of Action to the United Nations Environment Programme (UNEP) with its Governing Council (GC) and Administrative Committee on Co-ordination (ACC).

- Immediately after approval of the Plan of Action, the Desertification Branch was established within the UNEP Office of the Environment Programme to serve the Executive Director and ACC in carrying out their tasks in the implementation of the Plan of Action.

- One of the main functions required by the Plan of Action from the Desertification Branch was to prepare, compile, edit and publish at six-monthly intervals a newsletter giving information on programmes, results and problems related to the combat against desertification around the world.

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Desertification Control Bulletin

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COVER PHOTOGRAPH.

This lava plateau in the UNESCO/IPAL study area of Northern Kenya was once probably covered by soil. Over centuries of tree-felling and overgrazing the ground was stripped of vegetation and the soil was washed and blown away. (UNEP/Daniel Stiles)

Desertification Control

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

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

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Harvest of dust

Dr. Mostafa K. Tolba, Executive Director and Secretary General of UNCOD

Almost seven years ago the world's nations agreed to a sweeping Plan of Action to halt the process of destruction we call desertification. UNEP has just completed a two year assessment which reveals that the global threat posed by desertification, far from diminishing, has actually increased in severity.

Currently about 35 percent of the world's land surface is at risk and the livelihoods of the 850 million people who live there are directly threatened. Three quarters of the 45 million sq. kms that make up the world's drylands, which includes the sub-humid tropics, is already affected, between half and a quarter severely so. That is the measure of the problem facing the world community. The international community must act now if we are to avoid shortages leading to chaos on a scale hitherto unknown.

In many ways the term "desertification" is misleading. The popular image of sand dune encroachment is only a minor part of the problem. Sometimes thousands of kilometres away from the margins of the Sahara, Gobi, Atacama and the other so-called "true" deserts, desertification is taking place. The situation has been acurately likened to a skin disease in which existing eruptions worsen and coalesce with new outbreaks of the disease. And as with any disease, treating the symptoms is secondary to tackling the causes.

In the case of desertification the main cause is not drought as many still believe, (drought tends to exacerbate the problem) but human over-exploitation of lands through over-cultivation, overgrazing, poor irrigation practices and deforestation. And in turn, the underlying causes of these reside in bad management, rural neglect and in political and economic forces resulting mainly from the world's inequitable financial arrangements and terms of trade. To this extent the developed world, the least victim of desertification, must accept a much greater responsibility and contribute to a shared effort in combating this global menace.

But the certain knowledge that humans are responsible for most of the problem gives us hope that desertification can be halted. Unlike some environmental problems we know not only the causes, we also have the solutions, some of which have been applied and are working well.

Dr. Mostafa K. Tolba, Executive Director and Secretary General of UNCOD

This message of warning and hope is the one UNEP will convey to the representatives of probably more than 75 nations who will attend a special two day session of our Governing Council in Nairobi (May 16-29). The delegates will be presented with the findings of UNEP's assessment of the progress registered in applying the Plan of Action to Combat Desertification (PACD) agreed by the 94 nations attending UNCOD in 1977. They will also be presented with a set of practical recommendations which, if applied properly, could go a long way to improve the situation by the year 2000. The goal set by UNCOD to stop it completely by then has been shown to be no longer feasible.

Our conclusion is that the 1977 Plan of Action remains essentially viable. Indeed, given the main finding that the problem has grown in severity the Plan is many times more relevant today than in 1977. The Plan of Action and the goals it set have provided us with a yardstick to judge nations' performance in tackling the problem of desertification. Without the awareness it stimulated (who beyond the environmental community had heard of the term "desertification" before 1977?) and the—admittedly—patchy national and international action it inspired the problem would be a great deal worse.

We can point, for example, to the success of the UN's Sudano-Sahelian Office (UNSO) in co-ordinating action in the Sahel, to government, non-governmental and community-inspired agro-forestry projects; to the work of country-to-country, international and UN aid schemes which are promoting soil conservation and so on. A radio reporter sent by UNEP to report on the situation in Indian State of Rajasthan returned with one success story after another.

But anxious as UNEP may be to promote the successes, to show that desertification can be defeated, such a tendency is tempered by the facts revealed by our survey. We have found that a total of 3,475,000,000 hectares of the world's range, rainfed cropland and irrigated land—an area approximately the size of North and South America combined—is affected by desertification. Currently each year some 21 million hectares is reduced to a state of near or complete uselessness. Projections to the year 2000 indicate that a loss on this scale will continue if nations fail to step up remedial action. Surely a haemorrhage of productive land at such a rate must lead to catyclism?

One that is already occuring in the poorer developing nations, and one that will inevitably spread to the industrialised nations, some of which —notably Australia, USA and

USSR—are experiencing severe desertification problems of their own. If these nations with all their vast resources and know-how are in difficulties, how much greater are those of their under-privileged neighbours?

The main difference between UNEP's understanding now and seven years ago of the nature of the problem is a more thorough appreciation of the universality of its impacts and causes which extend well beyond the drylands most immediately affected. Desertification results not only in the loss of a nation's productive resource base but also in the loss of valuable genetic resources, increase in atmospheric dust (which could have as yet unknown consequences on the global climate) disruption of natural water recycling processes, loss of markets—the list is long.

Such consequences of environmental despoilation are helping to destabilize nations. Desertification and the other threats to the planet's life support systems are causing social and political breakdown which in turn threaten our tenuous global security. In UNEP we believe that a failure to recognise this ultimate, environmentally-induced threat lies at the root of the apparent unwillingness of nations to tackle desertification, and resource exhaustion in general 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 last year it had received less than $50,000—all from developing countries. The special machinery the General Assembly set up to mobilize funds to tackle desertification has raised in its six years of existence only $26 million, 25 per cent of the minimum target figure. These sums should be weighed against the $4.5 billion needed annually over a period of 20 years to stop desertification. If this seems like a great deal it should be balanced with the UN's 1980 estimate which put the annual cost of agricultural production from land lost through desertification at US$26 billion. And this figure takes no account of what must be the very much higher social and other disguised costs.

From every angle—cost effectiveness, political and social stability, self interest, humanitarian concern—the case for a massive mobilization of resources to tackle the global problem of desertification appears overwhelming. UNEP says that this will not come about unless, and until, decision-makers and the general public alike develop a new perception of the nature of the threats. The meeting that UNEP is planning in May will help stimulate that required new level of awareness. Afterwards, it will need the help of the NGOs, sister UN agencies and the responsible media to sustain concern and pressure for action.

In the light of the experience gained in applying the Plan of Action, we have come up with a set of precise and eminently practical recommendations. Taken together, they call for a more integrated approach to dealing with desertification. National plans to combat land deterioration should be merged with plans for economic and social development but at the same time should have a clearly defined place and clearly allotted resources. A properly funded and well placed national machinery to combat desertification would act as a motivator in the overall governmental process ensuring that all development plans take account of desertification. It would also act as a point of leverage for raising funds from donor nations and multilateral organisations.

Experience over the previous six years has shown that a pre-condition for success in carrying out field projects is community participation. Our evaluation of such projects show they are far more effective than large downward-directed projects.

The success of NGO-run schemes which have tended to be small-scale and directed at community problems is, in particular, something which UNEP is keen to extend.

The 1977 Plan of Action recommended the establishment of a series of transnational projects, but in virtually all cases these failed due in part to strained political relationships. Desertification, like most environmental problems, pays no heed to national boundaries and the need for greater regional cooperation remains a top priority. UNEP is recommending the setting up of joint ventures along the lines of UNSO for 9 southern African countries and for South Asian and South American countries affected by desertification.

Three studies carried out in the period after UNCOD show that adequate resources do not exist to pay for anti-desertification programmes. UNEP is proposing a series of novel fund-raising schemes ranging from the establishment of a Trust Fund financed from gold-sales reflow by the IMF to the establishment of an Independent Financial Corporation to finance interest-free loans. Such measures are vital as financial returns on investment in schemes to halt desertification are nearly always long-term. These financial arrangments would also guarantee a measure of automaticity and predictability in the flow of funds.

Equally important is the need for a dramatic change in the priorities of bilateral and multilateral development assistance agencies. Far too much technical and financial assistance has gone to show-piece projects and into measures aimed at appeasing the more politically advantaged urban populations. By comparison rural populations which tend to lack political clout—especially in the more remote semi-arid regions- are all but ignored. And even when it comes to alloting funds for rural development, agro-forestry and other ecologically sound activities are nearly always at the end of the queue. For example, a recent breakdown of the assistance provided by the Club Sahel—the grouping of OECD donor nations set up after the Sahelian drought—showed that under two percent of the overall expenditure went to support such activities.

The irony is that many of the urban problems of developing nations have their origins in the countryside. Loss of land productivity has forced villagers into the town. it has also caused food shortages which result in food riots and other forms of unrest. But how often do we see newsmen and other commentators establishing the link with desertification? A prime example is the flooding which has caused so much damage and loss of life in India. That flooding is caused by siltation which arises from soil erosion. Soil erosion is a major cause and also a result of desertification.

It is the failure to perceive these linkages and interconnections which lies at the bottom of the failure to arrest desertification. When the minority in

government and among the general public who now perceive these linkages become a majority, one crucial battle in the war against desertification will be won.

We need, as Indian Prime Minister Mrs. Indira Gandhi said at the launch of the World Conservation Strategy to "once again put our ear to the ground so that the earth can whisper its secrets to us". We need also to listen to the inhabitants of the million or so villages of the developing world who are in the frontline. They know the problems and how difficult they are to solve.

UNEP has been involved in the making of a film in Ethiopia on the subject. We recorded a meeting of villagers, all of whom expressed their anger and frustration over their apparently hopeless position. One peasant remarked that less than ten years ago his harvest was good, but in the meantime his top soil had been washed away, he said, "now all I have is a harvest of dust." That Ethiopian peasant spoke for hundreds of millions more like him. This time we must listen or pay a terrible price.

A summons to action

The Background of the First General Assessment of Progress in Implementing the Plan of Action to Combat Desertification

by James Walls

In May, 1984, the Executive Director of the United Nations Environment Programme will deliver a solemn assessment to UNEP's Governing Council. In detailed terms, he will inform the members of the Council that the destruction and loss of productive soil is proceeding unabated throughout most of the world. He will state that this deadly process is even accelerating, especially in the developing countries.

It is the process called"desertification". It is an ancient process, one whose damaging effects can be traced throughout recorded history, but it is new as an object of scientific study. As an increasing threat in the modern world, it was the subject of an international conference held in Nairobi, Kenya in 1977. The United Nations Conference on Desertification (UNCOD) approved a comprehensive Plan of Action to Combat Desertification which summoned mankind to rid the earth of this menace by the end of this century. The Plan also proposed a number of actions that should be undertaken without delay. Thus the Plan of Action embodied two time frames, as expressed in these words in Paragraph 9:

> The goal is to implement the Plan of Action by the year 2000. The seven-year period 1978-1984 has been chosen for the implementation of the immediate actions required and as an indication of the time at which a first general assessment of progress could be made.

It is this First General Assessment of Progress that UNEP's Executive Director, Dr. Mostafa K. Tolba, will be presenting this month to the delegates of the of the 58 nations who compose UNEP's Governing Council. As the Plan states, the seven-year period of immedediate actions includes 1984, so that the assessment would not ordinarily be expected until 1985. That Dr.Tolba should have prepared this report a year in advance was in response to the urging of the Governing Council that he should "do so, if possible, earlier than the target date of 1985".

Moving the assessment ahead was a clear expression of a desire to stimulate action. It reflected an increasing uneasiness—within UNEP, in the scientific community, among informed observers everywhere—over the little that countries have accomplished in the years since UNCOD toward bringing desertification under control, as Dr. Tolba himself has been warning the world. The nations affected by desertification have somehow not managed to develop coherent national programmes for dealing with the problem, and there were puzzling questions about what was hindering them. The obstacles blocking effective action against desertification were not always easy to identify.

The Campaign against Desertification

How is it possible that countries are prevented from moving toward the defence and protection of their most fundamental resource?

No answer to this question is possible unless the issues involved are placed in perspective. The problem of desertification and the means of combating it must be located in the currents of recent history and situated within the complex of problems that characterizes the modern era. Indeed, the occasion of the First General Assessment is an opportune moment in which to pause and conduct such a review, just as UNEP, in preparaton for the assessment, has commissioned a set of studies on the status of the problem. These studies look back to the great drought which afflicted the African Sahel in the years 1968-73 as the event from which the global campaign against desertification took its rise.

The key finding of the studies was this: Desertification is the work of man. As far as present knowledge can decide, the degradation of productive soil is not accelerating as a result of natural causes. That is, it is not a result, for example, of a long-range shift in climate. Studies of desertification point to improper land-use practices as the instrument of the land's degradation. They conclude that the blame cannot be placed on environmental factors and that the land-user must deal with the environment as he finds it. Harsh and difficult environments are usually fragile and require special treatment. The alarming upsurge in desertification in the second half of this century, the very problem addressed by UNCOD, can be credited to an upsurge in bad land-use practices. As the Plan of Action put the issue (paragraph 13):

> Deterioration implies that activities undertaken in an area have become unsuitable. . .While solutions probably rest ultimately in education, social and economic advancement and the adjustment of population growth to the development of resources, the proximate solution centres on improved land use.

Implicit in this conclusion is a criticism of man. Also contained in it is the basis for hope that desertification can be controlled. There is little that human beings could do about large-scale shifts in climate and their impact on productive land. If, however, desertification is the work of man, then it is a process that can be contained and reversed, with the solution found in changes in human behaviour.

The Plan of Action to Combat Desertification

The 94 nations assembled for UNCOD approved a detailed, comprehensive Plan of Action to Combat Desertification (PACD) built around the distinctive land-use systems—pas-

toralism, rainfed cropping, irrigation, woodlots and forests, natural preserves, urban and industrial use. The Plan contained provisions dealing with climate, water management, ecologies, soils and the sociology of peoples affected by desertification. It called for action by nations, regional bodies and the international community.

United Nations conferences, beginning with the Conference on the Environment, held in Stockholm in 1972, have produced a series of plans of action, each of them directed toward a specific global problem. Among them, PACD set a precedent with its time frames, one a period for "immediate actions", the other the time needed to reach the "ultimate objective". As these were marked out in paragraph 10:

> The immediate goal for the Plan of Action to Combat Desertification is to prevent and to arrest the advance of desertification and, where possible, reclaim desertified land for productive use. The ultimate objective is to sustain and promote, within ecological limits, the productivity of arid, semi-arid, sub-humid and other areas vulnerable to desertification in order to improve the quality of life of their inhabitants.

First, desertification would be halted and locally reversed. Ultimately, rangelands and farmlands were all to be brought to a state of full and sustained productivity. The achievement of the immediate goal was clearly a stage essential for reaching the final goal, when desertification would be broadly eliminated from the planet. As paragraph 96 suggested, there should be no delay in getting started:

> A number of actions should be undertaken upon the adoption by the Conference of the Plan of Action to Combat Desertification and its subsequent endorsement by the General Assembly as the United Nations Plan of Action.

What these actions should be were specified in paragraphs 97-99 of the Plan. The "body designated by the General Assembly for implementing the Plan", which in the event would be UNEP, was to request and coordinate actions throughout the United Nations system, stimulate national and regional action, provide assistance in project design, suggest strategies for the financing of projects, and arrange for and co-ordinate publication, training and research.

Regional action would pursue the feasibility of the six transnational projects presented to UNCOD. The Regional Economic Commissions were to become promptly involved in post-conference technical workshops and seminars and in the elaboration of regional plans and proposals.

A principal purpose of both international and regional action was to spur the development of national action. Implementation of the Plan of Action was fundamentally "to be carried out by Governments through their national institutions" (paragraph 17). Thus, at the core of immediate actions were those which Governments were asked to consider (paragraph 97):

a) Establishment or designation of a governmental authority to combat desertification.

b) Assessment of desertification problems at country and provincial or sub-provincial levels.

c) Establishment of national priorities for actions against desertification.

d) Preparation of a national plan of action against desertification . . .

e) Selection among national priorities of those actions which could be taken . . .

f) Preparation and submission of requests for international support for specific activities within the above priorities . . .

g) Implementation of actions in accordance with national plans . . .

Although Governments would determine their priorities, the Plan of Action is clear in suggesting that immediate measures be directed toward bringing desertification to a halt. In any case, ending the advance of degradation was an objective that would have to be accomplished fairly quickly—in not much longer than, say, seven years—if all the provisions in the Plan were to be carried out, as proposed by the year 2000.

The Seven-Year Time Frame

Plans of action and the progress made in carrying them out are generally to be reviewed after some intermediate span of years, customarily set at one decade. A number of reasons suggested to UNCOD that the Plan of Action to Combat Desertification should be systematically reviewed well before ten years had passed.

The most compelling reason was to be found in the progressive character of the desertification process. As the degradation of land advances, its restoration becomes ever more difficult and expensive. At certain stages, feedback mechanisms come into play that seal desertification in place. After that, the process is reversible only with massive efforts or by action extending over periods of time that can be counted in generations. Land can be lost forever as its restoration becomes simply unfeasible from an economic point of view.

Also underlying the call for early review was an underlying concern over the financing of the PACD. Dr. Tolba saw this as an issue calling for the closest attention. Economists and financial analysts, convened at his initiative, succeeded in demonstrating that measures to combat desertification would be cost effective, bringing with them net economic benefits. Even so, a concern persisted about where funding might be raised. Desertification was after all a new issue appearing in a world beset with many interlinked problems, one in which development financing was already spoken for. Novel approaches to funding were brought forth and analyzed, including those, like international taxation, that would involve a measure of automaticity.

Recommendation 28, the last in the PACD, was directed toward questions of finance. It referred to "the traditional sources of financing, multilateral and bilateral assistance programmes, as well as the 'multi-bilateral' approach". The suggestion was made that the General Assembly should create a special account for the financing of measures to combat desertification. Also proposed (paragraph 104c) was the establishment of "consultative group/club or group-type financing":

> The Executive Director of UNEP should, immediately after the adoption by the General Assembly of the Plan of Action, convene a consultative group . . . which would meet as and when required, (and) would also assist in the co-ordination of activities undertaken with the resources mobilized by it.

Because it was newly brought to public attention, the problem of desertification needed reiteration if public awareness were to be sustained. Occasions for effective publicity would have to be sought. A review in seven years, as requested in the Plan of Action, would provide just such an occasion.

UNEP Takes Command

UNCOD wanted UNEP to administer the Plan:

> . . .the United Nations Environment Programme, with its Governing Council and the Environment Co-ordination Board, should be responsible for following up the implementation of the Plan of Action to Combat Desertification.

These words, contained in Recommendation 27, were approved by the General Assembly in its Resolution 32/117 of December, 1977.

Continuity was accordingly maintained as Mostafa Tolba became the co-ordinator of a Plan of Action whose first, working draft had been prepared under his supervision. Without delay, he acted to set up the requisite administrative machinery, this consisting of:

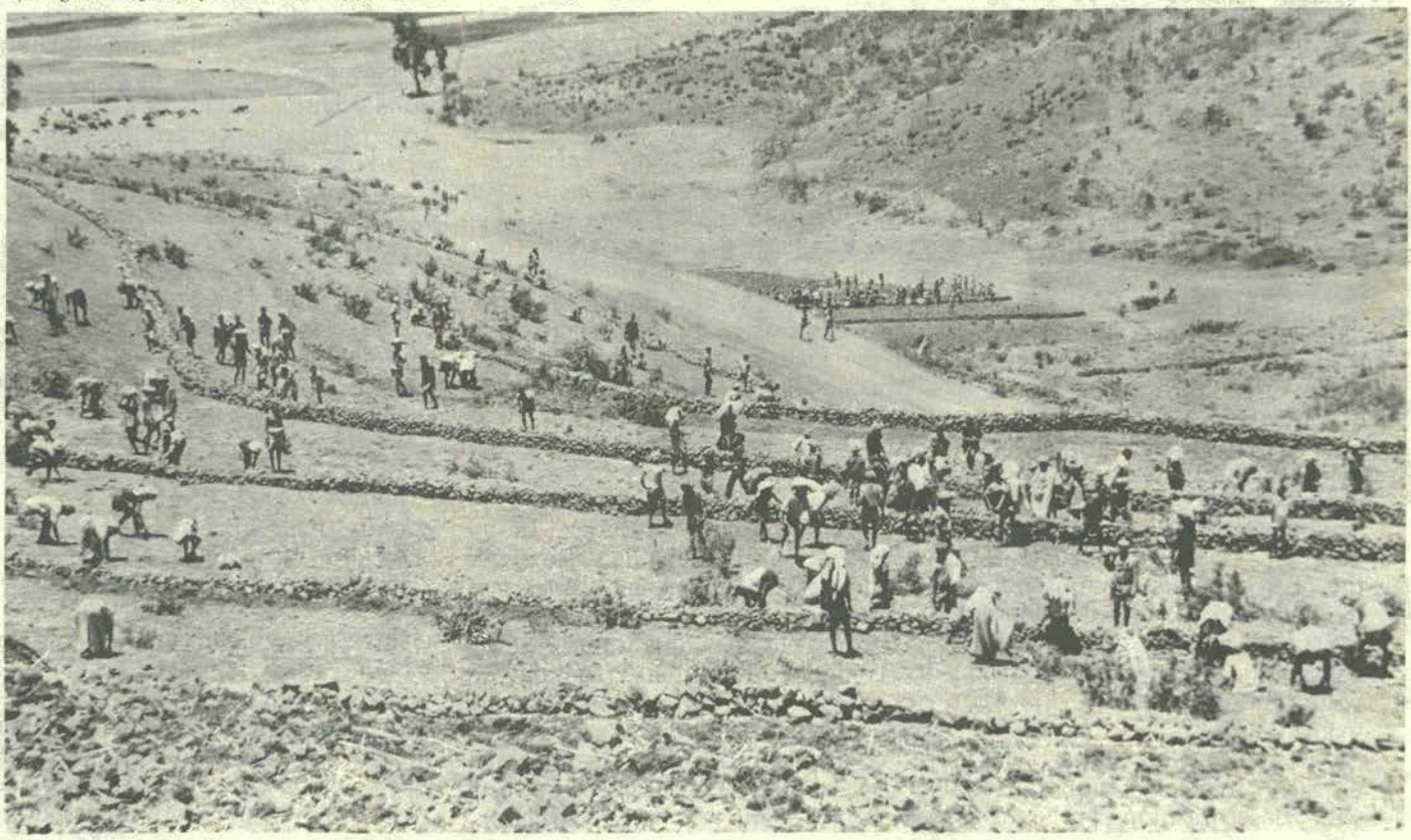
> A Desertification Unit (subsequently retitled Desertification Branch) established within UNEP in response to PACD paragraph 103.
>
> An Interagency Working Group on Desertification, representing all United Nations agencies with an interest in the problem, organized in response to PACD paragraph 102c-ii.
>
> A Consultative Group on Desertification Control (DESCON), analogous to a group/club while including representatives of Governments, established in conformance with General Assembly Resolution 32/172.

Supervision was provided by UNEP's Governing Council, to whom the Executive Director would report annually. Every other year, he would present a more detailed report on the progress made under the PACD for transmission to the General Assembly. The review function that was supposed to be carried out by the Environment Co-ordination Board was soon taken over directly by the high-level Administrative Committee on Co-ordination (ACC).

The General Assembly proceeded to establish a Special Account to which donor countries could contribute for financing the PACD. This was done in spite of the opposition in principle to special accounts expressed by a number of the major donors.

In any case, UNEP continued with a vigorous programme that included the UNEP/MAB Integrated Project in Arid Lands (IPAL) and the UNEP/FAO project on the Ecological Management of Arid and Semi-Arid Rangelands in Africa and the Near and Middle East (EMASAR). In 1978, responding to evidence that developing countries were short of experts in the new science of desertification, UNEP established international training courses in desertification control, which included field studies in

Anti-desertification projects are long term investments. Financial returns from increased agricultural production resulting from the terracing work pictured here in the highlands of Ethiopia will take many years to exceed the costs of the project itself. (UNEP/Charles Stewart)



China and the USSR. Within the year following the Conference, UNEP had given shape and substance to the global campaign against desertification.

Failures in reponse:
The emergence of obstacles to the Plan of Action to Combat Desertification

At the Eighth Session of UNEP's Governing Council, held in 1980, the Executive Director delivered the first of the biennial reports on the Implementation of the Plan of Action to Combat Desertification that were to be transmitted to the General Assembly. He announced (A/35/411, paragraph 80) that the implementation was not going well, that its progress: "is not commensurate with the magnitude of the problem, and there are still obstacles that hinder the full implementation of the Plan of Action. Productive lands are still being lost every year. Drought hazards still menace extensive territories and their societies."

The ACC's Assessment

What was the problem? Mostafa Tolba cited the Administrative Committee on Co-ordination in his search for reasons. The ACC had stated that co-operation needed to be strengthened within the United Nations system and that there were still gaps in the knowledge needed to combat desertification, especially in integrating multidisciplinary approaches that would include a socio-cultural dimension. Major constraints, as the ACC assessed them, also included these (*ibid*, Paragraphs 81d and 81a):

> Insufficient financing was seriously limiting the efforts of the United Nations system to implement the Plan of Action to Combat Desertification. There was an urgent need for external sources of financing to increase their assistance to anti-desertification projects. The United Nations Conference on Desertification. . .estimated that resources of the order of $400 million annually in addition to current development assistance, would be needed to halt deterioration. Funds of such magnitude have not as yet been forthcoming.
>
> Governments of countries faced with desertification problems or risks while confronted with conflicting demands and scarce financial and human resources, appeared unable at present to assign sufficiently high priority to desertification prevention or control, and had only to a limited degree included such measures in their national development plans.

A lack of money and of political will—these two factors were to be cited again and again as it became increasingly apparent that "immediate actions" called for in the PACD were, with a few scattered exceptions, not going to be undertaken—certainly not immediately, nor even by 1984.

A panel of financial experts convened by Tolba in 1980 estimated that it would cost a total of about $90 billion for a programme that would respond to the core portions of the Plan of Action. This meant corrective measures for all irrigated land, 70% of rainfed croplands and 50% of rangelands with the encroachment of sand dunes halted in critical areas. To carry out this programme by the year 2000, 20 years from the panel's deliberations, would require expenditures of $4.5 billion annually. A considerable part of the effort would be carried out in industrialized countries capable of paying their own bills. This still left an annual $2.4 billion to be provided to countries requiring financial assistance.

In comparison, how much was actually being expended? According to H.E. Dregne *(Evaluation of the Implementation of the Plan of Action to Combat Desertification,* report prepared for UNEP, 1983), the figures are not yet in on the amount actually spent on combating desertification from 1978 to 1983 inclusive, or the first six years of the Plan of Action. Nevertheless, Dregne played with such figures as were available to come up with some educated guesses:

> Progress in implementing the Plan of Action to Combat Desertification has been discouragingly slow. As much as $7 billion may have been spent for 1978 to 1983 (six years) on projects having a desertification component. Of that $7 billion, no more than $400 million probably was spent on activities designed to control desertification in the field. Most of the "desertification" project money went to road construction, buildings, water supplies, research, training courses and meetings.

As Dregne admitted, the expenditures that ate up most of the $7 billion could be considered as infrastructure items that may have been laying a basis for more concerted action in the field. But he was pessimistic on that score.

> . . .there certainly is no readily discernible indication at present that a sudden take-off is about to occur.

A total of $7 billion amounts to expenditures at an average rate of about $1.17 billion per year, of which, as Dregne estimated, an annual $57 million was spent in the field. At that rate, field expenditures were less than one-seventh of the amount needed to bring desertification to a halt, while total expenditure—which, in Dregne's view, was padded with items that should not have been credited to anti-desertification efforts—was about half of the amount needed to carry out the core portions of the PACD. Either way it followed that the Plan of Action was severely short of money.

The search for means of financing the Plan of Action was taken up by the expert group convened in 1980, as it was by another panel that met in 1981. The weak drawing power of the Special Account (which in six years attracted only $48,524) provided a melancholy backdrop to these financial deliberations. Undaunted, however, the expert groups proceeded to consider a wide range of possibilities, including:

- The international taxation of trade flows.
- Establishment of a trust fund from gold sales by the IMF.
- Links between development finance and special drawing rights.
- Taxes or parking fees levied on geostationary satellites.
- Levies on revenues from seabed mining.
- Levies on the Common Fund for Commodities.

The conclusions reached by the expert groups were summarized in *Evaluation of Institutional and Financial Arrangements,* a report prepared for

UNEP by Sir E.R. Richardson, Ambassador to the United Nations from Jamaica. After examining a variety of avenues for raising concessionary funds, the experts, as reported by Ambassador Richardson:

> concluded that the most practicable method was to approach capital markets on a commercial basis and to combine this with elements necessary for concessionary relending:

a) an interest subsidy element to permit interest rates to fall to acceptable levels, and

b) a system of supporting guarantees provided by governments and collaterals sufficient to carry credibility in the market place.

As the Ambassador pointed out: "The experts favoured the generation of the interest-free loans through an independent institution". This raised the complex question of an independent corporation, a project that since has come under serious consideration.

Sand dune fixation projects, such as this one in Libya, serve to prevent the covering of productive lands by moving sand dunes. (UN)

Lack of Will

On institutional arrangements on the part of nations, Ambassador Richardson had this to say:

> It is difficult to evaluate the effectiveness of national machinery for the reason that after five or six years of operation, only two national plans have been drawn up, one in the Sudan and the other in Afghanistan. It was assumed that national plans of action would be drawn up early. . .In practice, . . . a wide variety of projects and programmes have been initiated before national plans were drawn up.

Thus was the hope misplaced that national plans of action would be elaborated promptly, although, as Richardson went on to say, nine other countries have worked up plans in draft. In addition, a regional framework for coordination exists for the countries belonging to the Permanent Inter-State Committee for Drought Control in the Sahel (CILSS). They are Cape Verde, Chad, Gambia, Mali, Mauritania, Senegal and Upper Volta. In the Ambassador's unhappy assessment:

> . . .two national plans and nine draft plans constitute the meager results of five years of effort on the part of the Desertification Branch.

As Dregne pointed out, no national plan has as yet been put into operation, although Sudan is close to doing so. Behind this lack of planning is a general failure to establish or designate the governmental authority that would coordinate national action against desertification. Dregne listed the few who had:

> As a result of UNCOD and UNEP assistance,Afghanistan established a National Desertification Committee, Bolivia organized a Committee on Arid and Semi-Arid Lands, Sudan has a Desertification Control Co-ordination and Monitoring Unit, and Pakistan recently established the Pakistan Desertification Monitoring Unit.

This thin result cannot be attributed to any lack of action on the part of UNEP. The Desertification Branch has sent exploratory missions or planning and programming missions to Bangladesh, Benin, Botswana, Burundi, Lesotho, Nepal, Tanzania, Uruguay, Yemen Arab Republic and Yemen People's Democratic Republic, while UNSO, with UNEP support, has sent missions to all 19 of its countries. In addition, the Desertification Branch serves as a secretariat to DESCON, maintains working relationships with other elements of the United Nations system, keeps in contact with scholars and specialists throughout the world, conducts research and training and maintains a publications programme. In Richardson's opinion:

> It is suprising to find from the range of its activities that the Executive Director has not been able at all times to maintain the Desertification Branch at its full strength of eight professionals.

In his report to the 12th Governing Council, however, the Executive Director puts forward new proposals for strengthening the Branch.

Without coherent national plans and lacking adequate government mechanisms, countries have carried out little of what the Plan of Action proposed regardless of the impact on them being made by desertification. Assessments of the problem have generally not been made nor have national priorities been established. Thus it has not been possible to select among national priorities "those actions which could be taken," as the Plan of Action urges. The situation was summed up by Dregne:

> Governments do not see desertification as a high priority item. Rangeland deterioration, accelerated soil erosion, and salinization and waterlogging do not command attention until they become crisis items. Lip service is paid to combating desertification but the political will is directed elsewhere. There seems to be little appreciation that a major goal of many developing nations, that of food self-sufficiency, cannot be attained if soil and plant resources are allowed to deteriorate.

And yet Governments need only address their science advisers to find out that the struggle against desertification is of crucial importance. As Dregne said:

> The numerous conferences, seminars, workshops, articles and books on desertification, to say nothing of the early enthusiasm of DESCON and the Interagency Working Group on Desertification, give testimony to the interest and support that UNCOD generated. Professional societies such as the International Geographical Union and the International Society of Soil Science established working groups on desertification. Desertification became the focal point for the United Nations University arid and semi-arid lands programme. British Television included desertification in its educational programme for elementary and secondary schools. . Today, awareness is virtually universal among professional people and natural resource planners.

Between professional awareness and Government performance a gap exists that is not easy to explain. Dregne remarks on an official preference for "showplace projects and appeasing urban populations". That may be true, and yet one cannot escape the feeling that such preferences—indeed, the very lack of political will to confront desertification—are expressions of fundamental issues and circumstances. Holding back from vigorous action against all expert advice is too widespread a phenomenon to be accidental.

Other Constraints

It is of course true that campaigns against desertification rarely produce "showcase projects". Halting desertification maintains the land as it is and provides few occasions for surprise.

Then again, restoration is often a long-term effort when five years can mark a limit to advance planning on the part of governments. In a world dominated by short-term perspectives, the processes that reverse the degradation of the land progress inch by inch and sometimes with no alternative but to wait on the interminable work of nature. Such actions may have problems getting a hearing.

Restoration can be expensive. Even when doing nothing more than setting up enclosures, deferred income can add up to substantial amounts in the 20 or 30 years that a section of land may need for recovery. The great debate in the reclamation of the Gascoyne Basin, as described in the UNCOD Australian Case Study, concerned the loss of income that sheep farmers would suffer if pastures were fenced off. As this case study showed, it is not unusual that a Government, intent on reclamation, will come into direct conflict with those who gain their livelihood from the land.

Declining income, declines in taxes and reductions in agricultural product are often the first result of restoration efforts. In these and other ways, campaigns of reclamations involve hidden costs in addition to the funding expended publicly on projects.

That desertification is a late comer as an issue of global concern is in several ways an impediment to national action. To begin with, officials and planners have to make the requisite psychological adjustment to the emergence of a new challenge. Inevitably, a time lag will be evident before desertification begins to be taken regularly into account in national thinking. Secondly, the new challenge must elbow its way into a global complex of development activities to which all the available funding has already been assigned. Unless development financing shows a net increase, desertification projects have to displace other action which will already have an established institutional base. The fight against desertification will not compete on equal terms with other development efforts until it has an institutional base of its own. It must be able to command personal loyalties and offer interesting career opportunities.

An institutional base will be built around specialists in desertification studies. As this discipline is new, the specialists are in short supply. Complaints continue to be heard from Governments that they lack the essential personnel. This is credited by developing countries, in response to questionnaires, as one of the main reasons why they have so far been unable to make a proper response to the provisions of the Plan of Action.

The Persistence of Desertification

Campaigns against desertification in the few years since UNCOD have resulted in a number of local successes, notably in dune fixation and reforestation. In the absence of coherent planning, however, national action has often looked like a hit and miss affair. In view of the "meager results" of efforts to spur national planning, it is no wonder that desertification is still rampant on productive land in spite of the hopes raised by UNCOD. The extent of desertificaion six years after the conference was assessed by J.A. Mabbutt (*Assessment of the Status and Trend of Desertification,* Nairobi, 1983). As Mabbutt estimated:

> On the limited evidence available it would appear on a global average that in rangelands about half the area of the land so designated is likely to be severely or very severely desertified.

Almost 60% (335 million hectares) of rainfed croplands are affected by desertification to some extent—28% moderately, 20% severely and 11.6% very severely. On irrigated land, the situation is hardly better since:

> The amount of severely and very severely desertified lands may approach 50%. . . with very severely desertified (extensively abandoned) land accounting for as much as 20%.

Still another expression of desertification, as Mabbutt goes on to say "is the loss of forest cover in the areas worst desertified". To this must be added "an equivalent form of degradation in the arid rangelands" to be found in "the destruction of woody vegetation—shrubs and small trees—for fuelwood or fencing or as a consequence of burning".

Great numbers of people inhabit lands that are undergoing desertification. Mabbutt estimated their total:

> as 850 million, about 19% of the world total, and an increase of 35% over the total presented to UNCOD (628 million) on the basis of 1974 figures. (The increase) is partly explained by the inclusion of additional sub-humid lands in the drylands as now considered, but perhaps more importantly, by natural increase of dryland populations at between 2.5% and a little over 3% per annum. Neither the impact of the drought in the late 1960s and early 1970s, nor increasing out-migration, appear to have caused any significant slackening in the growth of population in desertified areas.

In fact, some dryland populations, as in Kenya, are growing at over 4% per year. Of the 850 million total, those affected by severe or very severe desertification add up to:

> 135 million of rural population ··· and almost 230 million of the urban population is included ··· Even allowing for the fact that the present assessment includes additional (subhumid) areas, and allowing for natural population increase in the interim, it would appear that the estimate of population severely affected by desertification as presented to UNCOD (78 million) was much too low, particularly as regards crop-based populations.

And that was the situation in 1983, according to the best estimate Mabbutt could make of it. The pressure leading to UNCOD, however, was based on the disturbing realization that the destruction of productive land was proceeding at an *accelerating* rate. In Mabbutt's analysis of the later situation, desertification was still continuing to accelerate in 1983.

> In the rangelands accelerating desertification is shown in five regions, two in Africa (the Sudano-Sahel and the southern African drylands), (one each) in West and South Asia, and (the last) in South America.

In the rainfed croplands, accelerating desertification is widespread in tropical areas of Africa, South Asia, South America and Mexico, where subsistence agriculture under pressure of close settlement is extending on unfavourable terrain or erosible soils under persisting unfavourable climatic conditions, with a high inherent risk of accelerated water erosion under intense summer rainfalls.

No examples of accelerating desertification of irrigated lands have been identified at regional scale; in these settings there tends rather to be a steady increase in the areas salinized or waterlogged until an unsatisfactory equilibrium has been attained, with its inevitable sacrifice area.

Of particular concern is the accelerating rate of disappearance of restricted cover, of forest and woodland, and also of shrubland vegetation in many dryland areas.

Factors Favouring Desertification

Mabbutt found many reasons why desertification is continuing its almost unimpeded destruction of land once useful for herds and crops:

> Climatic conditions in most of the drylands have been unfavourable in the period (since UNCOD) and have accelerated desertification processes whilst hampering combative measures; human and livestock populations have generally continued to increase, but productivity has failed to rise in the face of mounting pressures placed on resources; economic conditions have worsened during major world recession, and terms of trade have become increasingly disadvantageous to Third World countries; investment flows (into anti-desertification projects) have diminished, particularly in the face of the initial low returns to be expected from projects; and in several regions warfare and political strife have not only disrupted the continuity of actions needed to combat desertification, but have worsened the problem itself through the breakdown of livelihood systems and the displacement of populations in the areas most affected.

As to climatic factors, although drought in the Sahel is said to have ended in 1973, drought has persistently returned to that region—and to

Once desertification has reached the stage where the soil is gone, eroded away by water and wind as in this area of Mauritania, the land is irreversibly lost (UNESCO/P.A. Pittet)

other regions as well—to an extent that has brought a number of climatologists to a reconsideration of their former assessment that desertification was not resulting from climatic shift.

Unrelenting demographic pressure, often accompanied by pressure from livestock, is a factor continually cited by Mabbutt as he moves in his assessment from region to region. Paradoxically, people living in areas strongly affected by desertification are displaying the highest birth rates in the world. In many of the most affected areas (Franchophone Africa, north east Brazil, the countries of the Arabian Peninsula) authorities have opposed the family planning programmes that help to bring unrestrained population growth under control. In other drylands regions (Anglophone Africa, North Africa, South Asia), the family planning programmes that are permitted, even encouraged, have functioned with limited demographic impact.

Dregne suggested in his report that national apathy was the main factor blocking the transnational project for monitoring desertification in South America. Warfare and political strife, as referred by Mabbutt, have been a major hindrance to others. Prospects for monitoring desertification in Asia have had to confront, since UNCOD, war in Afghanistan and a revolution in Iran. Of the four projects located in Africa, Chad, caught in an endless civil war, was supposed to have been a participant in three of them. Accordingly, there is little difficulty in explaining why just two of these projects—the North African greenbelt and the management of regional aquifers—were the only ones to get started, even these without all their planned participants.

Desertification and Underdevelopment

Desertification is occurring everywhere in the world and the most highly industrialized nations are not exempt from it. The United States, for example, has had to face the degradation of its irrigated lands and increasing problems with its groundwater reserves. Two years after UNCOD, the US Secretary of Agriculture publicly chided farmers in the rainfed cereal region of the Great Plains for

Table 1. Desertification Trends 1977-84

Region	Rangelands	Rainfed Croplands	Irrigated lands	Forest & Woodland	Groundwater Reserves
Sudano-Sahelian	+ *	*	+ o	*	
Africa S of Sudano-Sahelian	*	*	+ o	*	
Mediterranean Africa	+	+	+	+	+
Mediterranean Europe	o +	+ o	o +	—	
West Asia	+ *	+	+ o	*	*
South Asia & China	o * + +	* +	* o — —	*	+
USSR in Asia	— +		+ o	—	
Australia	o	o	+	o	
South America	* +	* +	* +	* +	+
Mexico	+	*	+ o	*	+
North America	— o	o	+	—	*

Key

\+ continuing desertification
* accelerating desertification
o status unchanging
— status improving

Symbols placed above each other indicate opposing trends in the same area, with the upper symbol predominating.
Symbols in two columns indicate contrasting areas within a single region, with the left-hand column predominating.

their persistent recourse to bad land-use practices.

On the other hand, the United States has had considerable success in improving and restoring its forests and rangelands. The USSR has had similar success in Asia and has also effected improvements on its irrigated lands. In Mediterranean Europe, forests and woodlands have been brought into better condition. In Australia, the advance of desertification has generally been halted.

Where desertification is accelerating is in the developing world. Mabbutt's analysis is conclusive in this regard. His Table V clearly shows how tight the correlation is between desertification and underdevelopment (Table 1)

Mabbutt states that one must look beyond the projects in developing countries and their lack of success to the fact that destructive land-use practices are not only continuing but may even be encouraged by neglect of coherent planning. As Mabbutt said of the Sudano-Sahel:

> Demographic indices promise a continuing high rise of population growth for the region. . .(which) is therefore destined to experience a further massive increase in rural population and corresponding increasing in livestock numbers and in demand for fuelwood. This will impose increasing pressure on a fragile environment, and taken together with agricultural policies favouring mono-cropping and irrigation,. . .will maintain a very high desertification hazard throughout the region. . . In the arid and semi-arid rangelands, land-use pressures continue to increase locally through government sedenterization policies, (uncontrolled) spread of cultivation, political restraints on nomadic movement and the provision of perennial water supplies. Encroachment (of rainfed cropping) into grazing lands continues apparently unchecked.

The persistence of improper land-use practices suggests one reason why anti-desertification projects are not effective in the long term. To ask why such practices continue is to inquire into the very nature of underdevelopment, into that complex tangle of factors that includes unrestrained population growth, chronic shortages of skilled personnel and countries so desperate for export crops against adverse terms of trade that they are impelled—temporarily, as they would like to believe—to go on destroying their fundamental resource.

That the acceleration of desertification is embedded in the complex of underdevelopment was fully recognized by the Plan of Action. It was for this that PACD called for national plans of action that would be far-sighted, coherent and integrated into development planning. As the Plan states in paragraph 12:

> Given the interdependence of the development process, population change, relevant technologies and biological productivity, it follows that the effects of desertification on productive ecosystems can best be ameliorated if action takes into account all these elements. In other words, efforts to combat desertification must be part of a broad programme for promoting social and economic progress.

Concluding Comments

This is the disquieting background against which the Executive Director of the United Nations Environment Programme will be delivering his First General Assessment of Progress in implementing the Plan of Action to Combat Desertification. It is a background that is evident thanks to UNEP, which commissioned the studies that have enabled the situation to be assessed.

Events have shown that UNCOD was correct in asking for a seventh year assessment. For it offers an occasion on which the menace of desertification can be vividly, recalled, the means of combating it reviewed, a summons to action sounded again, and a new dedi-

Desertification causes poverty and poverty causes desertification. Forced off of desertified land, these people in Haiti crowd into city slums in search of work. (UNEP/Mark Edwards)

cation shaped that would pledge to fight it to the end. Pressures of land degradation have dictated that the seven-year review should be advanced, making it in effect a six-year assessment. Nothing has occured in recent months to cause Tolba to alter his words of one year ago where he said (UNEP/GC.11/10, p.11) that time:

> has passed with almost nothing to indicate a reversal in the deteriorating trends leading to more desertification and more loss of cropland and consequently less food for man and animals. That developing countries affected by desertification still continue to accord low priority to desertification in their development plans and in their bilateral assistance negotiations still constitutes ground for serious concern; available solutions cannot be applied to problems which are not presented for solution.

UNEP's Executive Director then asked his Governing Council to issue "a stern warning to all those concerned to take action before it is too late". He suggested (ibid, p.13) that the Council:

> draw the attention of all governments to the fact that the continuing threat and disastrous effects of desertification and its resultant lesser food production will, in the not too distant future, threaten the stability and perhaps the sheer existence of many societies.

What is now needed is for this voice—and this warning—to be heard. The General Assessment must be used as a fulcrum for gaining public attention, for a reawakening of the world to an awareness of the menace that is moving, like a thief in the night, through the treasury of our productive lands.

Recent climatic experience in the arid and semi-arid lands*

F. Kenneth Hare

Introduction

As I write these words I have before me an article by Henry Kamm in the *New York Times* for October 19th, 1983. It refers to the spread of drought through much of Africa, and to the desperate food situation confronting many countries—at least 22 states, according to the Director-General of FAO, M. Edouard Saouma. This list is actually even longer, according to Kamm. Nor is the situation confined to Africa. Similar problems have affected parts of South America, notably north-eastern Brazil. Until this past year, moreover, intense drought had affected much of eastern Australia and parts of Indonesia, with heavy economic losses.

About these reports one has a sense of *déjà vu*. They closely resemble the news stories of 1972-73. Then, as now, drought was seen as afflicting many parts of the less-developed world, especially in Africa. Then, as now, there were urgent calls for help from the countries affected, and from the officials of world agencies. The UN system responded with the 1977 Conference on Desertification, from which sprang PACD—the first concerted world effort to halt the spread of deserts, and to rescue from exhaustion the resources of the arid and semi-arid lands. It is alarming that ten years later, in spite of all our efforts, the news stories should be so familiar.

The painful fact is that drought has continued to plague the arid and semi-arid zones throughout the past fifteen years. The sense that the Sahelian drought ended in 1974, and with it the need for political concern, was illusory. Drought has continued through much of the Sahel, and has spread at times into parts of East Africa. In the past two years it has become intense in much of southern Africa, especially around the flanks of the Kalahari. In many parts of the continent 1982 and 1983 (especially the latter) have been among the worst in recent history. The past five years have also been dry in many parts of South America, and in some regions of inner Asia.

In most parts of the dry lands rainfall failure is a commonplace. Sometimes such failure extends over two or more consecutive years. Most of the droughts of the 1970s and 1980s were of this sort; they were hazards quite ordinary to the arid zone. Natural ecosystems take long dry spells in their stride. They are adapted to outwait even prolonged drought. When the rains return the systems spring to activity without any apparent change.

Unfortunately, the same is not true when the land is under stress. Rising human populations, with expanded food needs, put great pressure on the stabilizing elements in ecosystem structure—perennial vegetation, stable water-table, adequate streamflow and intact, fertile soil profiles. When drought strikes, such overworked land has lost much of its capacity to protect itself.

There is fear, moreover, that a true long-term desiccation may lie behind the recent drought years, at least in Africa. It is conceivable—though still unlikely, in the view of some professionals—that human interference may be prolonging and intensifying the dry spells natural to the climate. Feedback mechanisms have been identified that might initiate such adverse changes. These include the so-called *albedo hypothesis* which supposes that the reduction of vegetation cover raises surface reflectivity to solar radiation (albedo); This in turn intensifies subsidence in the overlying airstreams, and hence leads to the dispersion of cloud and the suppression of convection. A second feedback may be due to reduced water-holding capacity in soils, which would tend to reduce rainfall, especially within continents. A third possible mechanism is that the increased dustiness of the airstreams may alter both radiative and microphysical properties of the air in such a way as to reduce rainfall.

Drought in Africa

These effects have been most widely discussed in the context of African experience. Under normal conditions much of Arica's land surface is naturally dry. Before human interference there were enormous expanses of savannah, thorn forest, scrub and semi-desert, as well as the desert surfaces of the western Kalahari and the gigantic Sahara. Only in a broad strip across West Africa (south of about 8°N) and in the vast Congo basin were there extensive rainforest landscapes. In the past century most of these forest areas have been altered by clearance and cultivation, especially of the shifting kind. The savannah, dry forest and semi-desert areas have also seen a large expansion of cultivation and sedentary pastoralism, as human numbers have grown. Most of Africa's new countries, in fact, have such surfaces as the dominant environment. Even in normal conditions it would have been difficult to erect prosperous economies on such a base. And circumstances have been far from normal.

Several workers or groups have shown, in fact, that rainfall over intertropical Africa has declined appreciably—in some areas disastrously—in the 1960s and 1970s (the first decades of independence for many of the new nation states). Nicholson (1983) has analysed spatially-averaged rainfall in the main sub-Saharan belts since 1900. All four zones have shown similar features:

* This article is based on the author's monograph *Climate and Desertification*, as revised in 1983 for WMO and UNEP (Hare, 1983). it also takes into account the Report of the Expert Group Meeting on the Climatic Situation and Drought in Africa, Geneva, 6-7 October, 1983, held in response to a request from the Economic Commission for Africa (Resolution 14 (IV) of the Council of Ministers 1983).

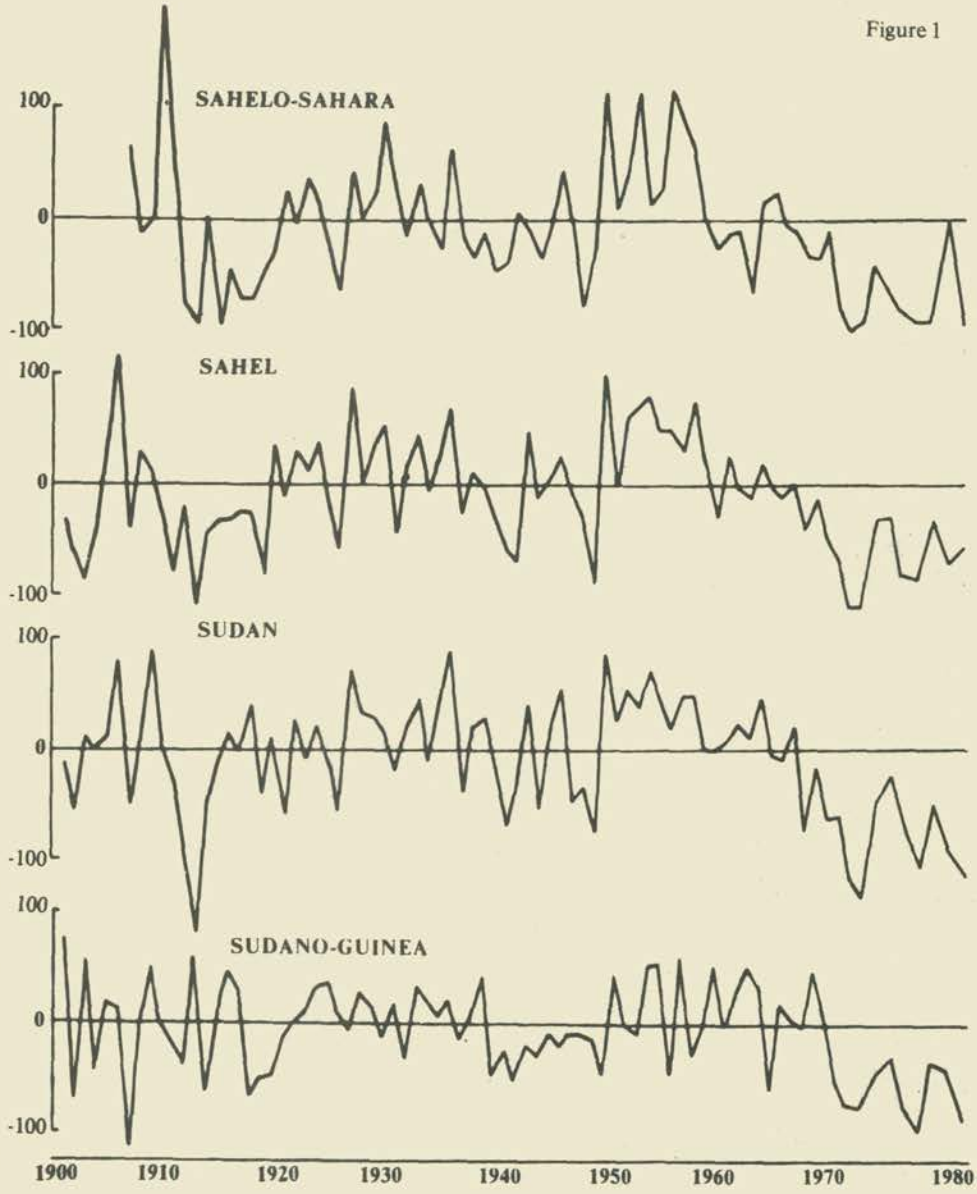
a) variable but decidedly above-normal rainfall in the 1950s, for most countries the last colonial decade;

b) a decline in rainfall that began about 1960 in the Sahel, and in the late 1960s in the Sudano-Guinean belt;

c) severe drought in the early 1970s (the "Sahelian drought" of popular accounts), followed by some recovery in 1974 and 1975; and

d) in the later seventies and early eighties, variable but below normal rainfall. 1981, 1982 and 1983 were especially dry in many Sahelian countries, as they were in parts of eastern and much of southern Africa.

Figure 1



Annual rainfall variation in four sub-saharan zones after (Nicholson, 1982). In the dry lands of West Africa drought recurs periodically as shown by weather records for the period 1900-1980. When the land is exploited to its limits during wet periods, it is seriously over-exploited in the subsequent dry spells, leading to land degradation and desertification.

Others (e.g. Motha et al, 1982) have confirmed Nicholson's demonstration that the Sahelian drought did not end in 1974, as usually claimed. Olivry (1983) has shown, for example, that the downward trend in the western Sahel (Senegal and Gambia) extended to the Cape Verde Islands, and showed no sign of recovery by 1981. Moreover there are other ways of demonstrating the effect. Sircoulon (1983), in an analysis of West African streamflow, wrote as follows:

> The Senegal, Niger and Chari rivers, coming from wetter regions to the south. . . have undergone a severe decrease of run-off during the last fifteen years. For instance, the mean annual discharge of the Senegal River at Bakel has been below normal since 1968 (excepting 1968 and 1974). The situation is almost the same for the Niger River at Koulikoro, and the discharge of the Chari River at Ndjamena has been systematically below normal since 1965. . .In the lower valley of Senegal, where the yield of sorghum is directly linked to the area of overflow (*wals*), since 1968 the annual maximum height of floods has been below the mean for 13 years out of 15. . .Lake Chad has shown a systematic decrease of level since 1963. At that time the lake surface covered 23,500^2, and the volume of stored water was 105 x 10^{9}m^3. In 1973, ten years later, the surface had been divided by three and the volume by four. Since this date, the lake has been cut into two parts. The northern part dries up every year, with only a small inflow through the "Grande Barrière".

In the light of such evidence, why did the impression gain ground that the drought had ended in 1974 and 1975? Why did the issue seem to lose urgency in so many capitals? And why have we made so little real progress in defending nature in the intervening years?

It is worth recalling, first of all, that UNCOD was held in Nairobi in 1977. By that time the regions affected had already suffered the tragic losses of 1972 and 1973. Adequate (but not abundant) rainfall had been experienced by many countries in 1974 and 1975 (Hare, 1977). To some extent the economies had adapated, and the news media had lost interest in the situation—as had, regrettably, many African leaders. Even the UN system, which ought to have had access to good synoptic evidence, seems to have relaxed its attention. Only those suffering further years of hunger and loss of resources, and those specialist UN groups close to the situation, were under no illusion.

The long term drought in the Sudano-Sahelian region is causing livestock losses and consequent reduction in food production. (UNEP/Daniel Stiles)

In any case climate is naturally variable. Severe drought may occur alongside good rains a short distance away. Successive years may be very different, especially in the dry lands. Hence different countries will have differing impressions of recent experience.

Appalled by the recent intensification of drought in so many countries, the Council of Ministers of the UN Economic Commission for Africa called for an appraisal of the situation by an expert group. At the latter's initial meeting in Geneva in October, 1983, organized by WMO, these differing impressions showed themselves at once (WMO, 1983). Spokesmen from Kenya were happy about the abundance of recent rains. Those from Nigeria also felt that the drought had relaxed. Yet, the AGRHYMET representative from Mauritania spoke of 1983 as an appalling climax to a disastrous decade. And there was news, too, of the continuation of drought in many parts of Ethiopia, and of the aridity of the past two years around the Kalahari—indeed, throughout southern Africa's inland areas.

These place-to-place differences are real enough, but they should not conceal the Africa-wide significance of the recent desiccation. Nicholson's (1983) spatial analysis demonstrates two more realities of the situation:

a) There is a surprising degree of spatial coherence in African droughts; rainfall departures from normal, that is, tend to have the same sign over wide areas, especially along east-west axes north of the equator.

b) Recent experience has shown that northern and southern African anomalies may march in step. Thus the decade 1950-59 was wet across most of northern Africa, and equally so south of about 13 S. The period 1968-1973 was intensely dry in northern Africa, and also dry south of 13 °S.

The march of drought around the continent in the past fifteen years has been extremely destructive. All regions have at some time or other seen failure of the rains, sometimes for several years in a row. East Africa has not been exempt. The fringes of the Ethiopian highlands, notably in Tigrai Province, have suffered acutely. So also has the western Sahel. The general desiccation of the past two decades has thus been erratic in distribution. Nevertheless it is a central fact in the political life of the continent. And it poses the question: will it endure?

Drought elsewhere: Teleconnections

Space prevents an equally detailed account of drought in other parts of the dry lands. The evidence nevertheless shows clearly that other continents have not been spared. The general assessment of the implementation of PACD carried out by the Desertification Branch of UNEP has provided graphic details of the effects in South America, the Middle East and Central Asia. Drought in western China has

severely affected efforts to control the massive desertification affecting the loessic lands of that area. Great distress has also been caused in the past few years by rainfall failures in north-eastern Brazil, notoriously prone to such events.

The southern hemisphere has, in fact, presented some of the most extreme effects. In Australia severe drought in 1972 affected many inland areas. There followed a dramatic reversal. Excessive rainfall in Queensland led to the filling of dry Lake Eyre, to shoreline levels almost unrivalled in the past 10,000 years. After 1975, however, drought returned to many areas. That of 1982 affected much of the continent, but became concentrated in eastern areas later in the year, and in early 1983. Immense damage was done to brushland by fires. Indonesia also suffered.

There has been speculation that the Indonesian-Australian drought may have been related to the major el Niño event in the tropical Pacific that began, atypically, in early 1982—and which endured well into 1983. This warming of the equatorial Pacific was the most extensive in recent history. It was associated, as usual, with a southern oscillation, i.e., a large-scale oscillation of atmospheric pressure over the Pacific and adjacent land areas, with associated changes in trade wind and monsoonal circulation. Major climatic anomalies accompanied this oscillation in south-east Asia, Australasia, South America, North America, and across much of inner Asia and the Soviet Union (Quiroz 1983; Gill and Rasmusson, 1983).

Unfortunately, we do not yet know enough about the relationships to make much use of them. They are examples of teleconnections, in which there is a correlation between anomalies or events in places quite remote from each other. For many decades it has been known, for example, that rainfall over monsoon India and Pakistan is correlated with the southern oscillation. Gradually, however, the nature of this correlation has changed with time (Ramage, 1983). Similar teleconnections exist between tropical Atlantic sea temperatures and rainfall in Brazil, and these have been tested in dynamical modelling exercises (Moura and Shukla, 1981). But a firm connection, usable in forecasting, between el Niño and rainfall in areas away from the Pacific rim has yet to be demonstrated.

Testing the feedbacks: modelling exercises

Interest in the Sahelian drought, until recently perceived to be a limited event in time (1968-1973), has stimulated considerable modelling activity among dynamic meteorologists. Hypotheses as to the origins of drought can only be tested by such exercises. Such work requires very large computers. It is not yet possible in most countries affected by desertification. This is one of the many reasons why the fight against desertification needs to be conducted internationally.

It was shown in 1975 (Charney 1975) that a sharp rise in albedo over the margins of the Sahara should diminish rainfall. The Saharan region, though very hot at the surface and in the lower and middle troposhere, is nevertheless a heat sink for the atmosphere; more energy escapes to space over the Sahara and parts of the Middle East than is received from the sun. The warmth of the troposhere is maintained by subsidence, i.e., sinking motion in the atmosphere.

Charney's argument, subsequently confirmed by three-dimensional dynamical modelling (Charney et al. 1977), was that increased albedo should accelerate the subsidence, and hence reduce rainfall still further (since subsiding air is dry). Others have tested this hypothesis (e.g., Sud and Fennessy 1982), and have found it to hold over other tropical deserts, too. It looks, therefore, as if processes that raise albedo should tend to diminish rainfall. Bare soil or rock has a higher albedo than grass, dry forest or scrub. Hence desertification does indeed tend to raise albedo. As Charney picturesquely put it, the desert feeds on itself. Albedo variations of the right sign have in fact been observed over the Sahel (Norton, Mosher and Hunton 1979).

Models of the sort used to test the Charney hypothesis are *general circulation models* (GCMs), which are based on systems of equations representing the laws governing atmospheric motion. Critical to the usefulness of such models are realistic boundary conditions, because these constrain the solutions obtained. The models can be run with altered constraints or boundary conditions—for example an altered solar constant, an increased carbon dioxide content, or a changed

Barren deserts have a higher light reflectivity-albedo- than vegetated land surfaces which probably accelerates subsidence, hence lowering rainfall. (UNEP/Daniel Stiles)

surface albedo (as in the above studies).

GCM experiments carried out in the United Kingdom show that among the most significant constraints is that imposed by soil moisture content (Walker and Rowntree, 1977; Carson and Sangster, 1981). One such experiment indicated that an initially dry land surface suppresses the formation of rain-bearing disturbances. This offers cautious support to the second feedback hypothesis—that a gradual desiccation of the arid zone is actually self-sustaining, because much of the rainfall comes from locally reevaporated rain (a view expressed by Lettau about the Sahelian drought, see Hare, 1983).

The third feedback—the effect of increased dust burdens over desertified terrain—remains less well supported, and has not been investigated by thorough modelling. The argument is that such terrigenous dust reduces incoming solar radiation at the surface, and warms the lower troposphere (by absorption of solar radiation). This stabilizes the atmosphere, and still further suppresses convection. It has also been argued that some part of this dust load may alter the microphysical properties of cloud. Though there is little doubt that dust loading has increased, for example over the Sahara and the deserts of north-west China, there is as yet no adequate testing of the above hypotheses, which are not given much weight by dynamic meteorologists.

Modelling of the sort described underlines a strong conviction of most climatologists—that the basic causes of drought are global, not local. Processes at work within individual countries can intensify the impact of drought—a point raised in the next section. But large-scale regional drought derives from the behaviour of the atmospheric circulation, which unquestionably responds to global controls. That is why the GCM, with all its complexity and high cost, is necessary to test ideas about the causes of drought.

The same is emphatically true of teleconnections, such as the alleged relationships between el Niño and rainfall anomalies elsewhere. Such relationships can be seen in statistical correlations, using only observed data. But they cannot be trusted unless we have good theoretical reasons for believing them to be real. GCMs offer the only reasonable way of testing such relationships. And to be most effective these demand international cooperation.

Surface conditions

The climate near the ground surface (the *microclimate*) is greatly affected by such things as vegetation cover, surface wetness and albedo. Removal of vegetation tends to raise daytime surface temperatures, and hence increases heat stresses for surface-dwelling organisms. It also reduces the ease with which sudden rains can percolate into the soil; on sloping ground the result is sheetflow or gullying down the slope, with erosion of fine materials. This erosion, together with the gradual loss of organic débris and fine soil particles, reduces water holding capacity. Desertification hence harshens the microclimate, making more difficult the reestablishment of biological productivity.

There is no doubt that the most useful defence against such microclimate harshening is *land use control*. If surface cover damaged by livestock or vehicles is allowed to recover, the microclimate will move back towards more equable conditions. Fenced land, where animal movement can be controlled, usually has much more continuous plant cover, and hence a better microclimate. Measures taken to control desertification do not merely restore plant cover and soil conditions; they also repair the microclimate. The latter is, of course, part of the overall ecosystem.

These ideas have been central to methods used in the Soviet Union for many years. Under the Soviet régime, major emphasis has been placed upon controlled land use practices in arid lands (Kovda, 1961). The deliberate planting of forest and shrub stands (e.g., Svintsov, 1982) has been an important part of such measures. But in most areas the required microclimatic changes can be induced by natural seeding or vegetative recolonization of the soil—if animals are excluded.

In many parts of the arid zone irrigation is widely practised, using groundwater or diverted streamflow. An important form of desertification is the *salinization* if such soils. This arises from the presence in the water used (or in the soil) of salts that are concentrated either near the surface or in pan layers. Kovda (1980) has given an exhaustive account of the measures necessary to control such changes, and to restore damaged land.

Drought does not directly affect such processes. But reduced rainfall in the source regions of the exotic streams used as water sources (such as the Indus-Sutlej, the Amu Darya, the Niger and the Senegal) may accelerate the process of salinization. It may also lead to rapid falls of the ground water-table, the flow of wells, and the productivity of groundwater oases.

The Carbon dioxide question

Since UNCOD in 1977 much attention has been given to the possible climatic effects of rising carbon dioxide (CO_2) concentration in the atmosphere. This rise results primarily from the combustion of coal, oil and natural gas in the industrialized countries, but the CO_2 released is rapidly spread worldwide. Any effects are hence expected to be global. They may be compounded by rising concentrations of other "greenhouse" gases, notably methane (CH_4), nitrous oxide (N_2O) and various industrial pollutants (like the chlorofluoromethanes).

It is natural to ask what effect these changes may have on lands affected by desertification. The following points can be made:

(a) Carbon dioxide, now about 343 parts per million by volume of the air, is increasing at about 0.4 per cent per annum. At probable rates of increase of energy consumption, and assuming an important part for fossil fuels in meeting that increase, CO_2 concentration will double in the latter half of the next century.

(b) doubled CO_2 concentration will, at equilibrium, probably raise tropical temperatures by 2 to 3 deg. Celsius. Other greenhouse gases may increase this by 1 to 2 deg. The effect will probably be unmistakable by the end of the century. Some authorities be-

lieve that the global rise of temperature over the past century is the CO_2 effect at work.

Like the albedo hypothesis, the CO_2 effect has been widely tested by GCM experiments. It is reasonable to expect that warmer conditions in low latitudes would increase evaporation from the oceans, and hence intensify the whole hydrologic cycle. If evaporation increases, so must rainfall—somewhere. Unfortunately the GCMs are not precise as to location. One experiment (Manabe and Stouffer, 1980) does indeed suggest a slight increase (of order 2 to 5 per cent) in tropical rainfall for doubled CO_2, but also suggests increased evapotranspiration. 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. Control of disease might well become more difficult. And irrigation costs would probably increase.

There is, on this view, no reason yet to fear the CO_2 effect too greatly. On the other hand there is little hope that it will be beneficial. A firmer judgement may well have to await confirmation that the effect is actually in progress. As usual, more research is needed. CO_2 is now very high on the research agendas of UNEP and WMO. In a few years these bodies may be in a stronger position to recommend concrete action. That moment has not yet arrived.

Treating the problem

What measures can be suggested to assist PACD from the climatological standpoint? It is highly unlikely that humanity will be able to control climate, but it is very possible that we shall learn to modify it on the local scale. Are there concrete steps that affected countries can take?

One negative conclusion reached by meteorologists has been that attempts to increase rainfall during drought periods by cloud seeding are unlikely to succeed. Weather modification as a whole has turned out to be difficult to achieve, and still more difficult to confirm. Similarly attempts to modify climate by flooding desert basins (as in the Sahara, or inland Australia) are most unlikely to repay the effort. The great dry lakes of the arid zone are flooded naturally from time to time, but reevaporate. Planting green belts, though desirable as a means of halting soil drifting, is also unlikely to affect large-scale climate.

Nevertheless, much can be done by affected countries to lessen the impact of adverse climate:

(a) the most useful and obvious step is to control land use, as suggested above. It is often not realised that a central purpose of such control is to improve the microclimates on which natural vegetation and crops depend. Desertification control, the title of this journal, is, among other things, micro-climatic control.

(b) in addition, all vulnerable countries should equip themselves with drought plans, in effect a practical strategy to protect people, lands and resources against future drought. Even if the present harsh conditions in so many countries are relieved by abundant rain, drought will undoubtedly return. The technical and institutional means of combating such drought are also fundamental to the struggle against desertification.

(c) a central part of any such plan is to ensure that national meteorological and hydrological ser-

The most obvious step to take to lessen the effects of adverse climate is the control of land use. Here in Tunisia scientists study degradation of spontaneous vegetation in order to understand natural land productivity, from which land-use planning can be formulated. (FAO/G. Tortoli)

vices, and international ventures such as AGRHYMET in Africa, have the needed resources to do their work.

It is the unfortunate fact that meteorological and hydrological services in many parts of the arid zone have seriously deteriorated in recent years. In part this arises from adverse climate, which has so weakened the economies of many countries that the latter feel unable to provide the money required. But one does not combat disease by firing the doctors. Neither can one expect to overcome drought by closing weather stations, or by abandoning hydrological measurement of streamflow.

The recent Expert Group on the Climatic Situation and Drought in Africa considered the latter problem (WMO, 1983), and made recommendations that are equally applicable to other stricken areas:

(a) African governments should take prompt action to provide necessary resources to their national meteorological services. These services should ensure that:

(b) the necessary meteorological data are observed regularly and disseminated promptly to the operational and research communities. Special emphasis should be placed on necessary observations of rainfall, the upper atmosphere and hydrological values; and that

(c) the necessary data are available to detect impending drought conditions, and to warn governments of the situation.

What of the future?

We seem to have arrived at a critical moment in the history of mankind's relation to climate. For the first time we may be on the threshold of man-induced climatic change. The human economy is releasing into the atmosphere substances that change its optical properties, and hence the manner in which it receives and uses solar energy. It is even possible that the most catastrophic consequences of all-out nuclear war might be a drastic cooling of climate, with consequent destruction of much of the world's biota (Crutzen and Birks, 1982).

Yet one must maintain a balanced view. The large-scale climate of the earth seems not to have been greatly altered by mankind's centuries-long removal of forest, wastage of soil carbon and release of carbon dioxide. Even though post-glacial times—the past 10,000 years—have seen drastic reductions of rainfall in some subtropical and tropical areas, temperatures appear not to have fluctuated greatly. But the effect of a doubling of CO_2 may well be greater than the post-glacial fluctuations. Can nature suppress the expected effect by some heat storage process we have not yet identified? This question has not been firmly answered, though most authorities believe that the CO_2 warming will happen, perhaps delayed for a few decades by the heat capacity of the ocean.

Seen in this perspective the recent climatic stresses in the dry lands also appear to need a balanced appraisal. One school of thought—certainly dominant among professionals—says that the high incidence and prolonged duration of recent droughts are simply aspects of a natural fluctuation, due to some deep-seated oscillation of the general circulation of the atmosphere (and maybe the ocean). Proponents of this view point out that prolonged desiccations have affected Africa before. On this view the situation will right itself; the long-term stability of climate will override the protracted drought. The author has himself witnessed such a correction in Australia. In many parts of the interior—notably around Alice Springs—the intense drought of 1972 was the culmination of a 20-year downward trend of rainfall. Local residents were gloomily predicting the abandonment of much rangeland. Yet the rains of 1973-74 reduced these same regions to a quagmire. Tropical drought is often ended in this exaggerated fashion.

Nevertheless there is apprehension that human misuse of the desert fringe is indeed producing a lasting decay of the arid zone climates. As we have seen, there are plausible hypotheses (supported by modelling experiments) that blame the albedo and soil moisture feedbacks for the intensification of drought in Africa. There is yet no way in which climatologists can decide whether this desiccation will continue—or whether it will eventually be overriden by the general circulation. There are now many more climatologists who are prepared to say that desiccation will continue than there were at UNCOD in 1977.

In any case this question, though crucially important, does not really alter the need for intensified action to combat the effects of drought, and to try to foresee the latter. Even if the African droughts are indeed only an unusually prolonged fluctuation, they have still wrought untold damage. And it is certain that they will recur time after time in future generations. The same is true of Brazil, Australia and inner Asia.

Hence the drought-prone countries of the tropical world, especially those dependent on rainfeld agriculture and pastoralism, must at all costs preserve the scientific capability of monitoring and if possible predicting the needed rain. It is tragic that they have allowed their scientific services to deteriorate. They must continue their efforts to bring destructive forms of land use under control. And they must contrive, somehow, to develop effective strategic plans to combat droughts as they recur-and recur they will.

It is imperative, too, that the UN agencies concerned with this problem maintain their alertness. As we have seen, much of the required effort must be conducted internationally. The work of UNEP and its allies absolutely demands the support of all countries who can contribute. It is vital that the return of adequate rains in some areas not weaken this effort. The combat against desertification will take generations to complete—and even then the problem will still need vigilance.

REFERENCES

1. Carson, D.J. and A.B Sangster (1981). The influence of land-surface albedo and soil moisture on general circulation model simulations. *Numerical Experimentation report*, 2, U.K. Meteorological Office, Bracknell, England, pp. 5.14-5.21
2. Charney, K. (1975). Dynamics of deserts and drought in the Sahel. *Quarterly Journal of the Royal Meteorological Society*, 101, pp. 193-202.
3. Charney, J, W.J. Quirk, S.-H. Chow and J. Kornfeld (1977). A comparative study of the effects of albedo change on drought in the semi-arid regions. *Journal of the Atmospheric Sciences*, 34, pp. 1366-1385.
4. Crutzen, P.J. and J.W. Birks (1982). The atmosphere after a nuclear war: twilight at noon. *Ambio*, XI, pp.114-125.
5. Gill, A.E. and E.M. Rasmusson (1983). The 1982-83 climate anomaly in the equatoral Pacific. *Nature*, 306, pp. 229-234.
6. Hare, F.K. (1977). Climate and Desertification, in *Desertification, its Causes and Consequences*, , ed. Secretariat, United Nations Conference on Desertification, Oxford, Pergamon Press, pp. 63-120.
7. Hare, F.K. (1983). *Climate and Desertification: A Revised Analysis*, WMO and UNEP, World Climate Programme report WCP-44, Geneva,. 149 pp.
8. Kodva, V.A. (1961). Land use development in the arid regions of the Russian plain, the Caucasus and Central Asia, in *A History of Land Use in Arid Regions*, ed. L.D. Stamp, UNESCO Arid Zone Research Publications XVII, Paris, pp. 175-218.
9. Kodva, V.A. (1980) *Problem of Combating Salinization of Irrigated Soils*, Centre for International Projects, Moscow, 274 pp.
10. Manabe, S. and R.J. Stouffer (1980). Sensitivity of a global climate model to an increase of CO_2 concentration in the atmosphere. *Journal of Geophysical Research*, 85(C10), pp. 5529-5554.
11. Motha, R.P., S.K. Le Duc, L.T.. Steyaert, C.M. Sakamoto and N.D. Strommen (1980). Precipitation patterns in West Africa. *Monthly Weather Review*, 108, pp. 1567-1578.
12. Moura, A.D. and J. Shukla (1981). On the dynamics of drought in north-east Brazil: observations, theory and numerical experiments with a general circulation model. *Journal of the Atmospheric Sciences*, 38, pp. 2653-2675.
13. Nicholson, S.E. (1983). Sub-Saharan rainfall in the years 1976-80: evidence of continued drought. *Monthly Weather Review*, 111, pp. 1646-1654.
14. Norton, C.C., F.R. Mosher and B. Hunton (1979). An investigation of surface albedo variations during the recent Sahel drought. *Journal of Applied Meteorology*, 18, pp. 1252-1262.
15. Olivry, J.C. (1983). Le point en 1982 sur l'évolution de la sécheresse en Sénégambie et aux Iles Cap-Vert. Examen de quelques séries de longue durée (débits et précipitations). *Cahiers O.R.S.T.O.M. Série HYDORLOGIE*, XX, pp.47-69.
16. Quiroz, R.S. (1983). The climate of the "El Niño" winter of 1982-83—a season of extraordinary climatic anomalies. *Monthly Weathe Review*, 111, pp. 1685-1706.
17. Ramage, C.S. (1983). Teleconnections and the siege of time. *Journal of Climatology*, 3, pp. 223-231.
18. Sircoulon, J. (1983). M.S. report incorporated into WMO (1983), see below.
19. Sud, Y.C. and M. Fennessy (1982). A study of the influence of surface albedo and July circulation in semi-arid regions using the GLAS GCM. *Journal of Climatology*, 2, pp. 105-125.
20. Svintsov, I.P. (1982). Reclamation of sands by afforestation, in *Combating Desertification in the USSR: Problems and experience*, USSR Commission for UNEP, Moscow pp. 91-113.
21. Walker, J. and P.R. Rowntree (1977). The effect of soil moisture and circulation and rainfall in a tropical model. *Quarterly Journal of the Royal Meteorological Society*, 103, pp. 29-46.
22. WMO (1983). *Report of the Expert Group Meeting on the Climatic Situation and Drought in Africa*, Geneva, October 6-7, 27 pp.

Desertification in the Sudano-Sahelian region 1977-1984

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It seems just a short while, but nearly seven years have passed since the UN Conference on Desertification and it is time for a first assessment of what has happened. This paper reviews the situation in the nineteen countries in which the responsibilities for overseeing the anti-desertification programme has been delegated from UNEP to UNSO.[1] They form a belt extending across Africa from Cape Verde to Somalia but include some countries such as Guinea, Guinea-Bissau, and Gambia which lie largely outside the Sudano-Sahelian climatic zone.

The environmental and economic background

While it is clear that desertification is an underlying phenomenon, only emphasized or de-emphasized by the pattern of the drier or wetter years, progress against the problem does have to be set in the weather and climatic context of the period.

At the time of the 1977 conference, there was some confidence that the worst of the drought had passed and that the task ahead would be helped by better rainfall. That optimism has proved unfounded for large parts of the region. About 60 percent of the region has continued to experience rainfall totals well below the long term average, while the remainder has experienced normal or near normal precipitation. In 1982 and 1983, rainfall conditions generally worsened and drought crises currently afflict nine of nineteen countries.

Other background conditions are also an important part of any assessment of progress against desertification, especially population change, livestock numbers and general economic, social and political conditions.

Population estimates for the area suggest two percent to three percent national annual increases, with numbers in the arid and semi-arid areas increasing at similar rates. National increases of 15 to 20 percent in total population between 1977 and 1984 are common. Estimates of dry-land population are available from some countries and suggest increases of 19 percent for Upper Volta, 14 percent for Ethiopia and Somalia but only 5 percent for Chad.

Total population in the Sudano-Sahelian region is estimated to have increased from 191 million to approximately 236 million between 1977 and 1984. Urban populations have grown more rapidly than rural. Rates of growth of seven percent per annum are common, resulting in a 60 percent or greater increase over a seven-year period. Population increases have increased the demand on the natural resources base and the areas suffering from desertification have thus been additionally stressed. The growth of urban populations, especially where the towns are located in arid and semi-arid areas, create a heavy demand on the supply systems which feed them and on the surrounding areas for fuel and energy.

Livestock numbers are hard to estimate, but on-the-ground information suggests that herds, especially of small stock, had reached pre-drought size by 1983 and appear to be still growing in the western part of the region. In Sudan and Somalia, herd sizes have continued to increase. The cattle population in the region as a whole is expected to increase from 94 million in 1977 to over 109 million by 1984; the population of sheep from 82 million to 103 million and the goat population from 98 million to 113 million. The growth in animal numbers creates a direct burden on rangeland which already is judged to be substantially overstocked though there is very little direct data on the spatial distribution of the increased livestock herds or of their specific impact on the natural resource base.

The economics of the nineteen countries have not prospered over the past seven years. Cape Verde and Nigeria have had three to four percent annual growth, Kenya and the United Republic of Cameroon about three percent, but of the rest, eight have had growth of between zero and one percent and seven have experienced a deterioration in their economic position. Clearly a combination of circumstances; the global economic situation, the difficult internal production conditions and the particular position of the group in the world economic hierarchy, have been at work. In addition to chronic budget deficits, limited financial and human resources to carry out or keep supporting basic development activities, the ability of several countries to address adequately the problems of desertification has been hampered over the past seven years by international and internal strife and by major influxes of political or economic refugees into countries or regions not able economically to absorb them.

In summary the background conditions of environment, economy and politics have not been condusive to rapid progress in the fight against desertification in the last seven years.

The data-base for an assessment

The intervening years since the 1977 conference have not seen a much greater availability of hard data. A special data gathering effort was made for the assessment on which this paper is based. UNEP circulated a questionnaire to all countries asking for a range of specific information and the responses yield some useful but not easily comparable information. In addition, reports, papers and personal communications from individuals in

1. The nineteen countries are: Benin, Cape Verde, Chad, Djibouti, Ethiopia, The Gambia, Guinea, Guinea-Bissau, Kenya, Mali, Mauritania, Niger, Nigeria, Senegal, Somalia, Sudan, Uganda, United Republic of Cameroon and Upper Volta. Under the auspices of a joint UNEP/UNDP venture, UNSO provided assistance to these countries, on behalf of UNEP, in implementating the Plan of Action to Combat Desertification. For the purposes of this report, these countries will be referred to as the Sudano-Sahelian Region (SSR) countries.

COUNTRIES OF THE SUDANO-SAHELIAN REGION

UNEP, UNSO, FAO and other agencies of the UN; CILSS, Club du Sahel, CIDA, the Netherlands Ministry of Development Co-operation and many other individuals experienced in the region, all contributed to the information used in this work.

The assessment

Despite the efforts summarized below, there is little general indication that the fight against desertification is being won. A few battles have been won especially against sand dune encroachment. In many countries including Mauritania, Senegal, Mali, Chad, Sudan, Niger, and Somalia the problem is judged to have become significantly worse in the last seven years. This is not an unexpected finding for even if all the projects attempted had been well focused, completed and successful, they would only have addressed a small part of the problem in this short time frame.

For the assessment, desertification was divided into five main processes: Sand Dune Encroachment, Deterioration in Range lands, Forest Depletion, Deterioration of Irrigation Systems and Degradation of Rainfed Agricultural Areas. For each of these categories an estimate of the current rate of desertification and its change since 1977 was made. This qualitative assessment is summarized in Table 1. Even though the numbers derived are but illustrative, it is salutory to note that of the 94 specific indicator boxes in the table, 51 indicate situations of moderately increasing problems and 25 indicate situations of seriously intensifying desertification problems. The remainder (18) show stable conditions. The general assessment in this table indicates a moderately worsening situation in 12 countries and a seriously worsening situation in 7. The picture is a somber one but realistic according to the judgement of most field observers. But as was indicated earlier, some significant advances appear to have been made.

It is therefore essential, in the coming years, to increase the flow of resources for desertification control activities in order (a) to respond adequately to the magnitude of the problem, and (b) to reach a threshold where the cumulative, positive impact of desertification control activities can stop, if not reverse, the accelerating degradation of the natural resource base of these countries. Some advances have been made in the last seven years. These include new institutions and the strengthening of existing institutions to help combat desertification; widespread increases in the awareness of the problem of desertification and increases in donor assistance to the Sudano-Sahelian countries.

Progress in the last seven years

Awareness, institutional development, improved donor support, improved project design and some limited project successes are the brighter spots in an otherwise gloomy picture. A greater awareness of the problem of desertification has been a clearly identified, almost universal, advance

Charcoal is produced in the rural areas for sale in the town and cities because it brings a higher price and it is lighter to transport than wood. It is, however, a leading cause of deforestation here in the Sudan. (Earthscan/Mark Edwards)

TABLE 1

RATE OF DESERTIFICATION

Countries	Sand Dune Encroachment	Deterioration in Rangelands	Forest Depletion	Deterioration of Irrigation Systems	Rainfed Agriculture Problems	General Assessment
Benin	o	*	*	o	*	*
Cape Verde	*	*	o	*	**	*
Chad	**	**	*	**	**	**
Djibouti	*	**	*	*	NA	*/**
Ethiopia	*	**	**	*	*	*/**
The Gambia	*	*	**	**	*	*
Guinea	o	o	*	*	**	*
Guinea-Bissau	o	o	*	*	*	*
Kenya	o	**	*	o	*	*
Mali	*	**	**	*	*	*/**
Mauritania	*	**	**	*	*	**
Niger	*	**	*	**	*	*/**
Nigeria	o	*	**	o	*	*
Senegal	*	**	*	*	**	**
Somalia	*	*	*	**	*	*
Sudan	**	*	*	*	o	*
Uganda	o	**	o	o	*	*
United Rep. Cameroon	o	*	*	o	*	*
Upper Volta	o	*	*	*	**	*

KEY: o =Stable, * =some increase, ** =significant increase

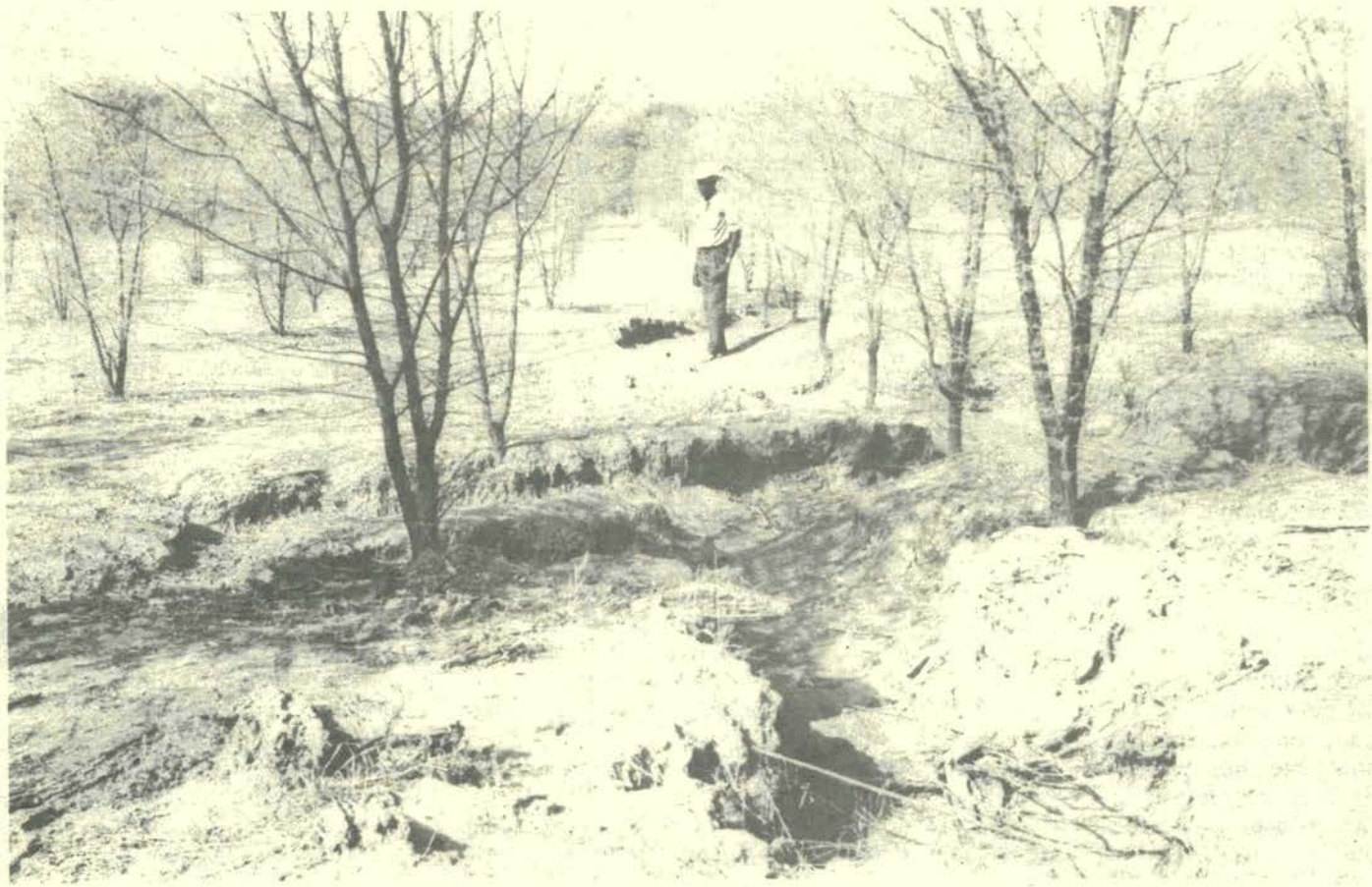
SOURCE: United Nations Environment Programme 1982 and analysis of questionnaire letter that was sent to colleagues.

in the last seven years. Analyses of speeches by Presidents and senior government officials in the SSR countries and of country planning documents, makes it clear that at this level the importance of the problem is understood and the needs are frequently well articulated. Outside the region donors and researchers have also become much more aware of the general problems involved.

Institutional developments include the establishment or strengthening of international institutions (expanded role of UNSO, Desertification Branch of UNEP, Institut du Sahel) and new emphasis for national institutions such as the US Academy of Sciences (Academy Committee on Sahel), for USAID and the bilateral assistance programs of Canada, Denmark, Finland, Italy, Norway, Sweden and the Netherlands. Within the affected countries, helpful institutional adjustments have taken place including, for example, new emphasis in the Institute of Environmental Studies at the University of Khartoum and in the Institute of Development Studies at the University of Nairobi. In Somalia, the National Range Agency has taken on extensive responsibilities specific to the problems of desertification. In West Africa the Senegal-based Environment Training Programme (ENDA) addresses itself to the issues of environmental development of arid ecosystems in its publications, educational seminars, and research. The Institut National de Recherches Agronomiques du Niger (INRAN) is also active in applied research on drought-resistant seed varieties for the Sahelian zone.

Another major achievement of the last seven years has been the very considerable increase in donor assistance to the SSR countries. Before 1975, assistance to these countries was about US $1,700 million annually, 28 percent of total African assistance. In 1980 assistance to these countries totalled over US $4,700 million, over 34 percent of total African assistance. The dearth of finance for anti-desertification activities, however, is still a major constraint. Within this major donor effort, there has been some focus on issues related to desertification and drought. Out of a total of US$4,700 million received in development assistance annually by the SSR countries, an estimated US $150 million or about 3.5 percent is allocated directly to desertification control. On the other hand the total financial requirements for implementing PACD in the SSR countries are estimated at US $320 million annually at 1980 rates, excluding sand dune stabilization and the protection of woodlands. The ministries usually responsible for negotiating with donors are the ministries of planning and finance. These ministries often do not place high priority on projects to combat desertification and emphasize projects, often in urban areas, which yield early financial returns. This fact has some influence on the relatively small percentage of donor assistance which is allocated to desertification control activities.

Donor assistance in forestry in the Sahel ($160-200 million), in dryland agriculture projects and in technical assistance have all been helpful. The continued focus on expansion of major river basin development and large-scale irrigation may not be so helpful. Much will depend on whether or not the environmental management lessons of past irrigation experience have been learned. The World Bank



Even with a tree and shrub cover, if the ground cover has been removed by overgrazing erosion can occur, as shown here in Upper Volta. (CTFT/P. Sarlin)

initiative in Sudan on rehabilitation of the Gezira Scheme is a very important new focus on desertification-related priorities.

Projects related to desertification include sand dune fixation, reforestation and community woodlot-type projects, projects providing substitutes for fuelwood, range management and water provision, monitoring, training, planning and more general resource management assessment. Other projects address the establishment of new livelihood systems which relieve pressure on dryland ecosystems. The success rate of anti-desertification projects is difficult to determine at this stage as many have not been properly evaluated and monitored, and others are still in progress and desertification control projects generally have long gestation periods. This is to be expected after the short time period which has elapsed since 1977. However, some important preliminary findings can be established. Projects which define clearly focused technical and quantitative objectives and have available packages of technology are amongst the easiest to implement and perhaps because of this, projects involving sand dune fixation have a good record of successful or partially successful implementation, especially when they have involved local populations.

Reforestation and community forestry projects have had a mixed record, though about US$200 million has been spent on forestry. A few projects, where wise land allocation decisions involving both professional and local viewpoints have been followed by good technical implementation and continued local involvement, have been conspicuously successful. Other projects often characterized by top-down decision making, unwise location and lack of local involvement, have not been successful. Careful build-up on the basis of successful projects seems the only logical course to follow. This area has been extensively reviewed and the lessons of experience are clearly written. How can they best be followed? Range management and water provision projects have not been comprehensively reviewed but a sample of projects have been analyzed. The record here appears to be mixed but weighted on the negative side. We have still not developed ways of mixing the clearly available technical knowledge of range management with the socioeconomic setting of African drylands. There are also still problems of co-ordinating water provision in drylands with complementary land use and resource management systems.

Monitoring of desertification has begun in a few localities, for example, in the Sudan. Prototype monitoring activities have begun using LANDSAT imagery compared over time, for instance, in Ferlo in Senegal. The AGRHYMET programme in the CILSS member countries is an important effort in systematizing the data gathering process for meteorological information. The GEMS (Global Environmental Monitoring System) project was established in 1972 after the Stockholm Conference. It is involved in rangeland monitoring in several of the SSR countries, particularly Kenya, Senegal and Benin. While these efforts are important and in process, much more needs to be done, if possible, in a systematic and low cost way.

Some conclusions

The recommendations of the Plan of Action to Combat Desertification were comprehensive and soundly based. In some ways, they may have been too comprehensive so that too wide a range of actions could be said to be involved in the programme. Given the lessons of the last few years, it is clear that there is need for a long sustained set of activities and the more focussed these can be, the more effective they are likely to be.

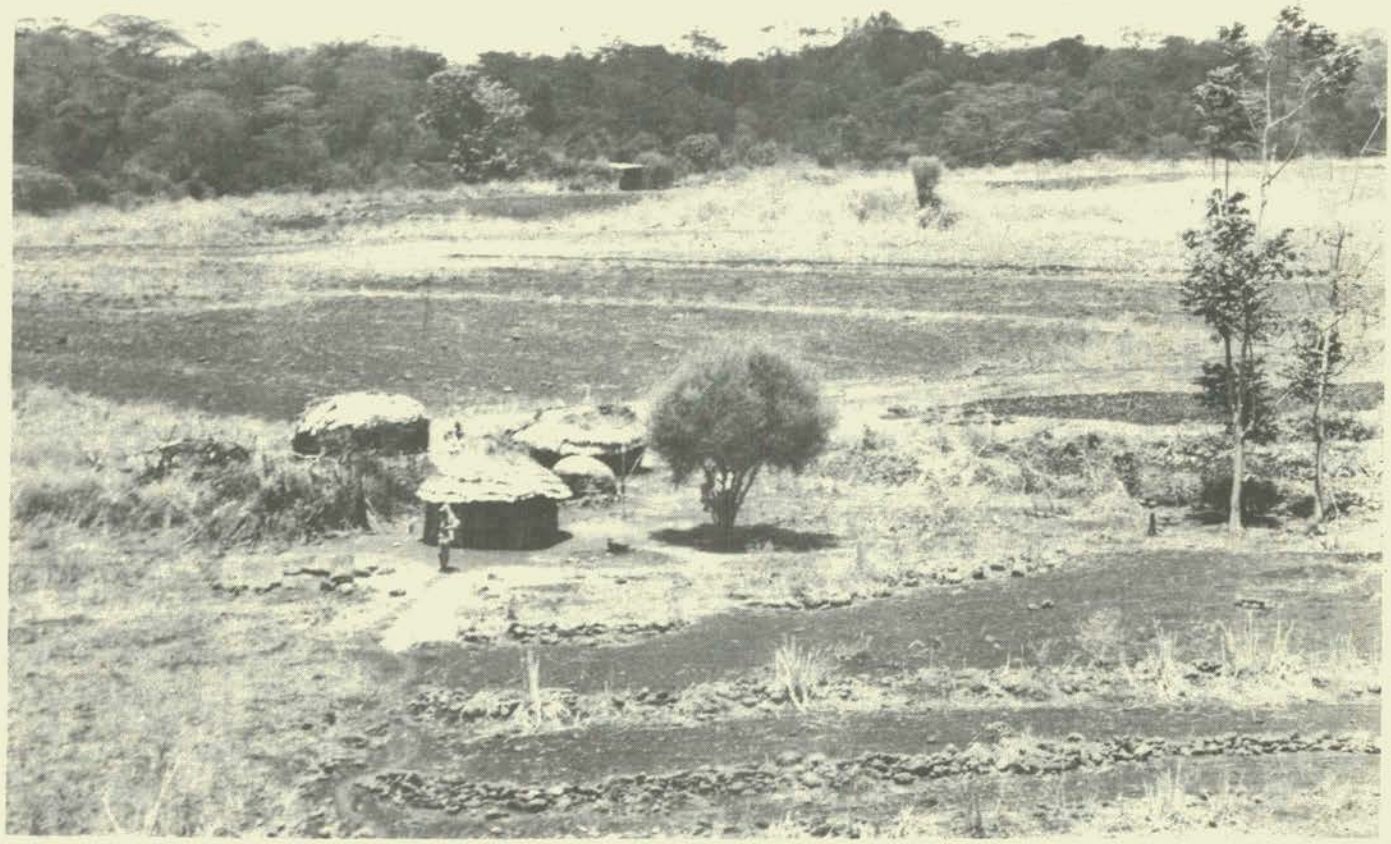
An important overriding issue is the mode of management of natural resources. Traditional systems are not working as effectively as they did in the past and new systems, whether government or private sector, have not been effective in replacing them. Much more needs to be done on working out practical implementable guidelines for management of water, land and vegetation resources. It is most likely that these will have to involve a mix of central and local, private and public agencies. Donors can be especially helpful in helping to evolve appropriate prototypes.

Project planning needs to consider more closely the local community situation. Some agencies, especially UNSO, have made efforts to involve local participation in projects. Host governments and officials have had varying responses to these initiatives, as local government systems are sometimes not well adapted to community involvement. Despite the additional management and control problems that might be encountered this approach needs to be encouraged.

While the problem of desertification is urgent, it is important to emphasize the long time frame needed for full implementation of projects. Ways should be sought to incorporate this long term perspective with the shorter time span for projects preferred by donors and host governments alike.

Most countries of the Sudano-Sahelian region, with UNSO's support, have embarked or are planning to embark on the preparation of desertification control plans and/or strategies, integrating these into their national economic and social development plans, to come to grips more systematically with the problems of desertification. A number of them also have established or plan to establish special machinery co-ordinating, monitoring or implementing desertification control programs. These represent a first concrete planning attempt and give national recognition to the importance of desertification control, but the plans and strategies still need further development and most importantly financial support.

While this assessment has revealed a difficult on-the-ground situation, the most important fact to emphasize is that the problem of desertification in the Sudano-Sahelian region was created over decades and even centuries of misuse of natural resources. It is equally clear that a long period of sustained focused effort will be needed to begin to deal effectively with this problem. The past seven years have created the possibility of progress but that progress has hardly begun.



Deforestation in highland areas is reaching critical proportions as forests are cleared to make way for cultivation. Here on Marsabit mountain in Kenya forest reserves are being illegally chopped down to settle dispossessed pastoralists and Ethiopian refugees. (UNEP/Daniel Stiles)

Combating desertification and rehabilitating degraded production systems in Northern Kenya: the IPAL project

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Goals and operation of the IPAL study

Objectives

The Integrated Project in Arid Lands (IPAL) was established in 1976 by UNESCO in collaboration with UNEP in recognition of the importance of the arid lands of northern Kenya both for the support of their indigenous people and in the economy of the country as a whole, and because these lands are gravely threatened by desertification through improper use. The project was set up as a pilot operation to carry out investigations into the processes of environmental degradation in the arid and semi-arid region inhabited by pastoral nomads and the causes of these processes. An important focus of the IPAL research has been to predict the ecological and socio-economic consequences for the pastoralists of continuing degradation.

In the light of its findings, IPAL is intended to contribute to the design of more rational resource management activities directed towards achieving a sustained balance between production and consumption, taking into account the requirements of the growing and increasingly settled population. It is hoped where possible to demonstrate practical modifications and alternatives to the traditional livestock-based economy which could permit rehabilitation of already degraded lands. Equally important in this regard is the use of project findings in education and training and their dissemination for promoting rational management.

Since most of the changes and processes being investigated need continuous monitoring, one of the project objectives is to provide the substantive basis for the establishment of an institution in the Marsabit District for continued monitoring, research and training relevant to the management of resources in the arid zone of Kenya. Furthermore, the project will include in its final recommendations considerations of the infrastructural basis for the proposed management strategies.

Working Hypothesis, Content and Approach

Man can justifiably be regarded as the dominant biotic element in the grazing land ecosystems by virtue of his overwhelming impact upon them, exerted largely through his domestic animals. Any improvement of the present situation is contingent on his active participation in remedial measures. The ongoing work of IPAL in its final research phase (1980-1983), sponsored by the Government of the Federal Republic of Germany, therefore includes a programme of research on human ecology in its broadest sense. In addition to augmenting the existing knowledge on the more purely biological and livestock production aspects, such studies bring into focus the many socio-economic and socio-cultural factors which have a strong bearing on the process of desertification in northern Kenya.

Figure 1 illustrates in a simplified way the structure, major areas of research and working hypothesis of IPAL. This hypothesis can be summarized as follows: that, through research and training, improved land use systems can be devised to reverse the trend of land degradation and to sustain land production for the needs of a growing (and partially sedentarized) pastoral population of northern Kenya.

The interrelationships indicated in Figure 1 give an idea of the complexity of the problems encountered in the study area. To prepare concrete recommendations and management plans for an integrated development of this arid and semi-arid area in northern Kenya, in-depth studies are called for on a large spectrum of topics, ranging from the climate, soils and vegetation of the area to the chemical analysis of plant species in the diet of the different types of livestock, to studies on the perception by the pastoralists of the changes taking place and on their aspirations for the future. Consequently, IPAL's work requires the collaboration of a considerable number of disciplines such as plant and animal ecology, veterinary sciences, physical and human geography, range science, social anthropology, demography, agricultural economy, hydrology, climatology, etc. An international group of senior scientists has been recruited by UNESCO to carry out and supervise on a full-time basis the major bulk of the survey and research work, data collection and interpretation as well as experimentation. Many more research workers, mainly Kenyan nationals and residents, have been contracted temporarily to conduct specific studies or carry out specific tasks.

The project has its own experimental herds of camels, cattle and small livestock. The project headquarters, including laboratories and seminar rooms, have been set up in the outskirts of Marsabit town. In addition six field research and experimental stations, distributed throughout the study area, are in continuous use.

A special difficulty in a research undertaking such as IPAL, is to avoid that the various researchers or disciplines work in isolation and do not communicate with each other. It is important that there is a feedback between all studies undertaken and an integration of the results. Particular attention needs to be paid to the interfaces between disciplines and to the system interrelationships between population, culture, technology, resources, environment and develop-

ment. A key role of the scientific co-ordinator of the project is to fulfil the function of "integrator". However, the co-ordinator-integrator will not succeed if all other scientific collaborators do not have an aptitude for team work and the breadth of outlook necessary to understand the implications of their work for others, and vice-versa.

Demonstration and Training

It is part of the MAB approach that the research workers should develop a continuing dialogue with the local populations practising the land use under study, as well as with the government authorities responsible for development plans and their execution in the region. Another characteristic is the linking of field research and *in situ* training. In following this approach, a number of demonstration, education and training activities have been organized within IPAL, too many to be enumerated here. Two examples are enclosures demonstrating the impact of livestock and the rate of vegetation recovery, and fences made from bamboo available in neighbouring areas. Meetings with elders (*barazas*) are organized frequently. As most of the pastoralists do not read or write, the project is testing the most effective way of communicating information to these people. In co-operation with the Kenya Ministry of Information and Broadcasting, a 15-minute radio programme is broadcast twice weekly in the Rendille language.

Figure 1

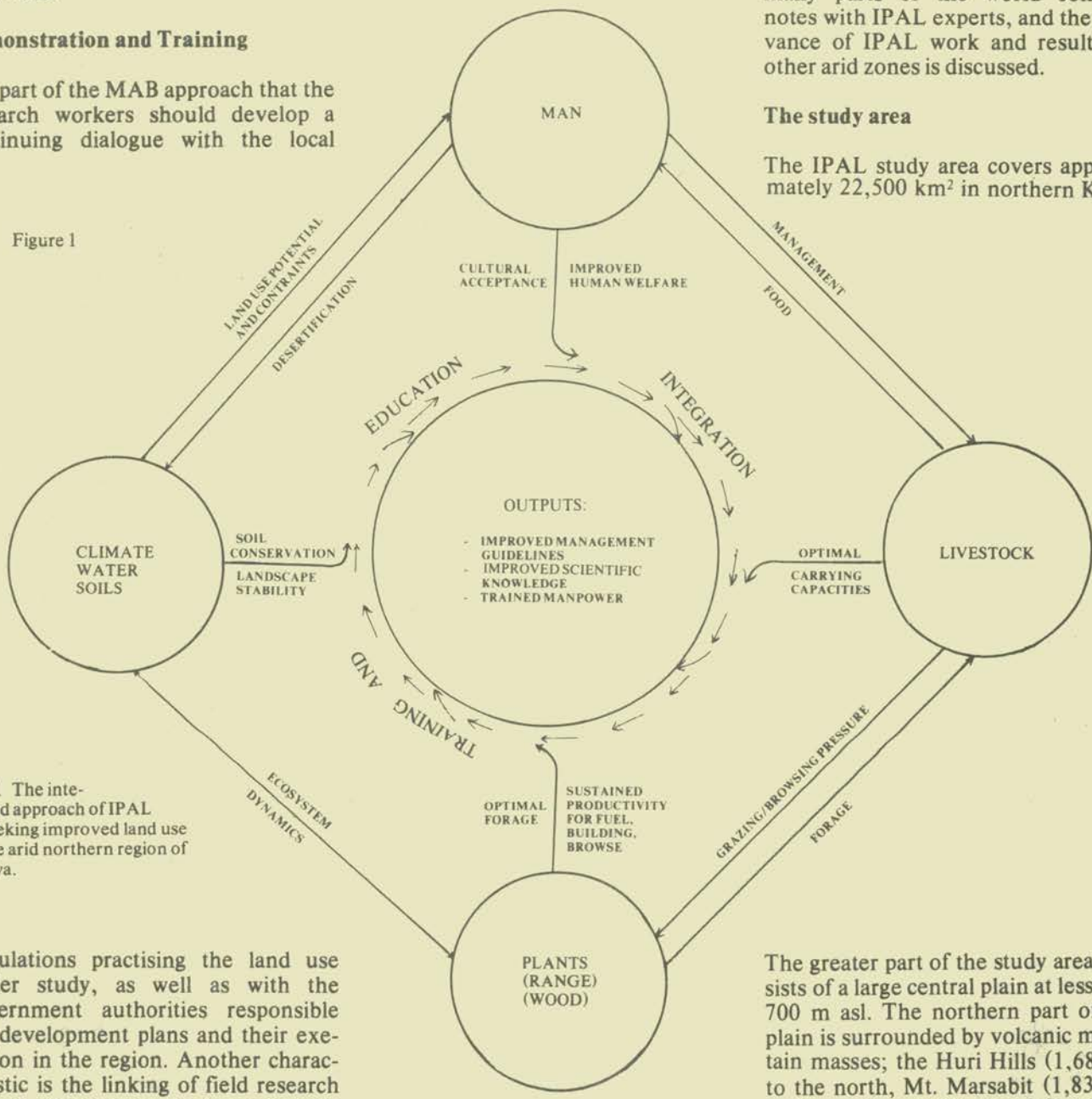


Fig. 1 The integrated approach of IPAL in seeking improved land use in the arid northern region of Kenya.

The effectiveness of these broadcasts is being analyzed. Seminars are organized from time to time for planners, administrators and decision-makers. In-service training for field assistants and graduate study programmes with the University of Nairobi are among the ongoing training programmes.

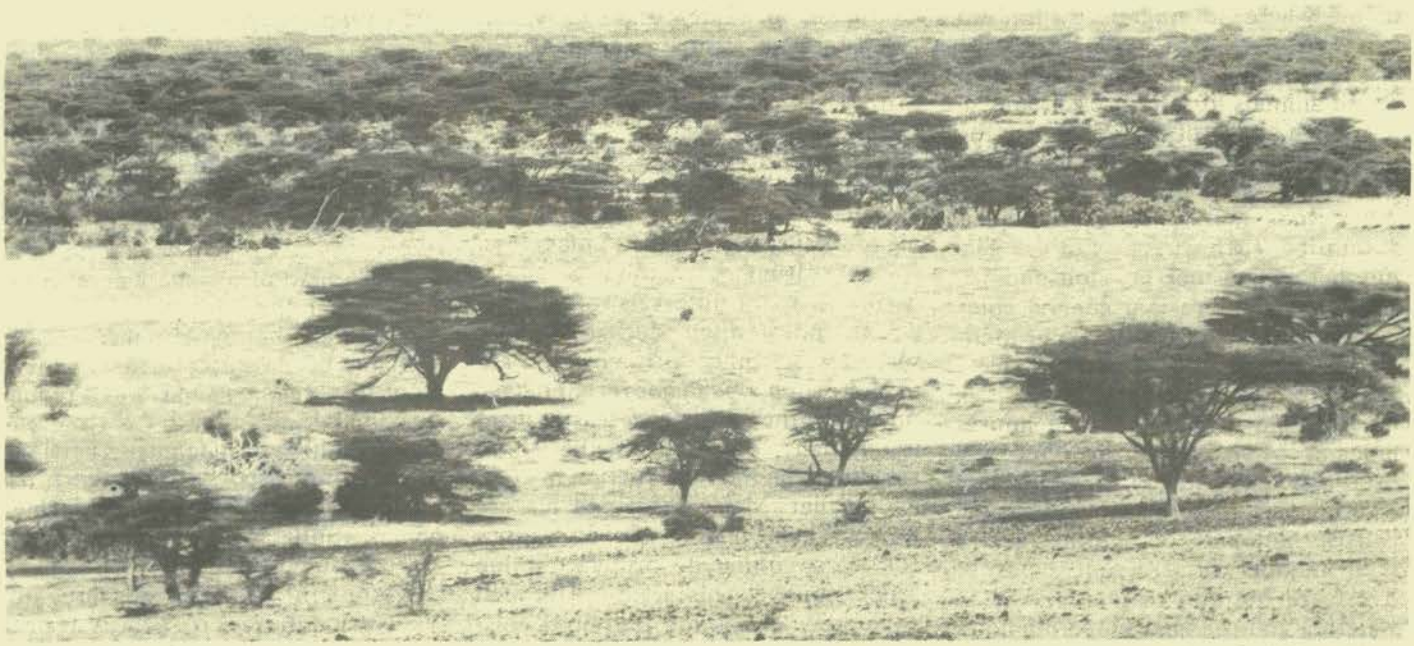
One of the objectives of IPAL is to generate results relevant not only for northern Kenya but for the Sahelian zone in Africa south of the Sahara as a whole, and to some extent for arid and semi-arid zones worldwide. To this end, international orientation seminars are organized, during which scientists and land use specialists from many parts of the world compare notes with IPAL experts, and the relevance of IPAL work and results for other arid zones is discussed.

The study area

The IPAL study area covers approximately 22,500 km^2 in northern Kenya

The greater part of the study area consists of a large central plain at less than 700 m asl. The northern part of this plain is surrounded by volcanic mountain masses; the Huri Hills (1,685 m) to the north, Mt. Marsabit (1,836 m) to the east, and Mt. Kulal (2,295 m) to the west. In the south and south-west, the area is bounded by basement complex.

Rains are unreliable and occur in two seasons, mainly in April-May (long rains) and November (short rains). Average annual rainfall amounts to 150 mm in the central plain and about



The IPAL study area contains a variety of environment zones. In the foreground is Acacia/Indigofera broken woodland followed further out by Chalbi Desert barrenland. The hills in the distance are the Chari Ashi, covered by bushland, which lie below Mt. Kulal. (UNEP/Daniel Stiles)

700 mm at Gatab (1,867 m) on the slopes of Mt. Kulal. In the desertic and subdesertic country percentage deviation from the long-term mean is normally in the range of +75 per cent, but can exceptionally reach +200 per cent. When the project started, only very few data on rainfall and indeed other abiotic and biotic variables of the environment were available. To fill gaps in information, a network of 42 rain gauges and other measurement sites have been set up, building on the existing three sites for which rainfall information was available for a decade or more.The first detailed vegetation survey of the study area has also been carried out within the framework of the project. Vegetation ranges from patches of evergreen mountain forest on the top of Mt. Kulal, through the semi-arid *Acacia tortilis* woodlands and the arid *Acacia reficiens* shrublands and *Indigofera spinosa* dwarf shrublands to the sparse annual grasses (mainly *Aristida mutabilis*) of the lava deserts (Herlocker, 1979). There are only seasonal rivers. Water from most of the land in the study area drains into the old saline lake bed of the Chalbi Desert in the north of the area.

There are four major "desert" plains, the Chalbi, the Karoli, the Hedad and the Kaisut, each distinct in its degree of soil salinity and its vegetation.

Changing patterns of nomadism

The study area is to a large extent congruent with the Marsabit District area. Marsabit town (about 5,000 inhabitants) is the outpost of modern Kenya and of the national government in the region. With the exception of some rainfed fields in the immediate neighbourhood of Marsabit town and of missionary stations at altitudes with sufficient rainfall, no cultivation is practised in the study area. Hence, livestock herding by traditionally nomadic pastoralists is almost the sole land use.

The major ethnic groups are the Rendille in the south and the Gabbra in the north. The Turkana have their home ranges between the western slopes of Mt. Kulal and Lake Turkana. The Samburu predominate in the more elevated and mountainous regions south of Mt. Kulal. Finally, there are also the Boran, who like the Gabbra moved into the area from Ethiopia in the late 19th Century when they were being attacked from the north by Menelik's armies. Their home ranges are now around and north of Marsabit mountain (Sobania, 1979). Population numbers are relatively small in absolute terms, but population increase has been considerable over the last 30 years (Table 1).

Status and Trends in Livestock Population

Each ethnic group prefers a particular habitat and consequently the type of livestock adapted to that habitat. Table 2 shows the type of livestock kept and the habitat of ethnic groups in the IPAL study area. As might be expected, camel herding is favoured by the groups living in arid environments, whereas cattle become more important in habitats with higher rainfall.

Aerial survey of livestock and wildlife indicate that there are almost 400,000 ungulates in the study area, of which all but 3 per cent are domestic livestock. Although most of the livestock are sheep and goats, when expressed

in terms of Tropical Livestock Units, they contribute only 18 per cent of the total while cattle comprise 40 per cent and camels 36 per cent (Table 3).

It is within the pastoralist households that decisions are made on how many animals are kept, where to water them, where to migrate, whom to choose as stock associates, how to divide stock among family members, which animals to sell for cash, and so on. In the case of the Rendille, the mean size of a household comprising normally at least three generations is 7-8 persons, that is 4 children and 3 or 4 adults (Mburugu, 1981). The number of livestock per household is so high that there is a general complaint about labour shortage and an insufficient number of children. Table 4 shows the mean number of livestock in a sample of 113 Rendille households in the area of two small recently established permanent settlements (Korr and Kargi). The work burden consists not only of herding such a high number of different types of livestock, but the tasks involved in watering and milking, preparing night enclosures, herding the animals there, treating sick animals, etc. According to their respective food preferences, different types of livestock should normally be kept in varying range areas, which increases the labour needs considerably. One noteworthy observation is the considerable seasonal variation observed in the food habits of camels and smallstock. Smallstock surprisingly appear to eat more browse in wet seasons compared to dry season (Field, 1980).

Stock breeding provides the pastoralists with staple food, i.e. milk and milk products, blood and meat. Slaughtering of smallstock for meat, unless for a special ritual occasion, generally occurs only at intervals of several weeks, more often during the dry season when other forms of food are in short supply. A major recent departure from the subsistence pastoralism traditionally practised in the IPAL area has been the introduction of grain in the diet. Maize meal and tea are now a regular feature of the pastoralists' diet, initiated through famine relief supplies of grain. Although some free distribution of grain by missionaries has almost become a permanent feature of the "economy" of the area, there has also been an increased selling of smallstock in order to meet the need for money with which to buy increasing amounts of maize meal, tea and sugar. A specific study on trade among Rendille has revealed a 25 per cent offtake of smallstock for sale in 1979-1980.

Changes in land use and settlement patterns

Through the siting and realignment of political and administrative boundaries, the development of forest reserves and national parks, and the establishment of commercial ranches, and through the influence of missions and several other modern institutions, there has been restriction in the movement of nomadic people and a reduction in the area they formerly occupied. Traditional antagonisms between tribes compressed some of the tribal groups into a fraction of their former ranges, until further encroachment was prevented some forty years ago by Government. Antagonisms are still present and the lack of security against intertribal livestock raiding and bandi-

Although human numbers are low, population growth has increased markedly in the last generation. What will all of these Rendille children do when they grow up? (UNEP/Daniel Stiles)

try is a further cause of restriction in the movement of people and the occupation of grazing lands. Over 25 per cent of the IPAL's study area is not used, owing to problems of security. The resulting additional pressure upon the more secure areas aggravates their over-exploitation.

In addition to reduced home ranges, another important trend of far-reaching consequence for land use is that of the increasing sedentarization of the nomads in the IPAL area. Centres of human and livestock concentration have arisen and have recently tended to expand rapidly around certain springs and wells, and especially around the boreholes which have been installed. While the presence of freshwater is the most important factor in such concentrations, several other incentives contribute to their expansion. Many of them have become the sites for shops, schools and medical and famine relief centres.

Table 1. Estimated population numbers of the different ethnic groups (after Lusigi, 1981)*

	1949		1979
Boran	1,500		3,700
Gabbra	5,000		15-20,000
Rendille	6,000		13,000
Samburu	320	(1927)	1,200

* These are the population numbers within the study area. Numbers are larger when all of northern Kenya is considered. — Eds.

have occurred frequently in recent historical times. Formerly these droughts were not as serious in their consequences as they are today, since the populations in the arid regions were sparse. With the recent increases in population, droughts have become more serious, claiming the lives of large numbers of livestock and, where they shared the grazing lands, wildlife effects upon the vegetation of the consequent concentrations of people and livestock are most marked.

Although it is normal traditional practice to disperse from such concentration areas when the rains come, there is an increased tendency for part of the population—especially women, children and the older men—to remain

Table 2. Habitat and livestock of tribes in IPAL study area (from Kruuk, 1980).

Tribe	Most common habitat in IPAL study area (Herlocker, 1979)	Livestock kept[a]		
		Sheep and goats	Cattle	Camels
Samburu	Mountainous woodland and bushland	**	**	—
Rendille	Bushland and dwarfshrub, annual grassland	**	**	**
Gabbra	Annual grassland, dwarfshrub, barren land	**	*	**
Turkana	Annual grassland, barren land, dwarfshrubs	**	*	*

[a] ** many, * some, — absent

However, of greatest significance is the fact that these centres offer security from intertribal livestock raiding. Each of the concentration areas becomes a nucleus of denuded land, which spreads in widening circles as the people are obliged to go farther for grazing and for the wood they need for fuel and for the fences for their livestock night exclosures. This accelerates the rate of localized desertification.

As in many other arid regions of the world, the northern part of Kenya suffers from periodic droughts which as well. After periods of drought the production systems do not recover fully. Some families lose the bulk of their herds, which may have been small in the first place, and many become destitute and reliant upon famine relief. The supply of famine relief food has become a permanent feature of the economy in Marsabit District. During serious droughts, such as that which occurred in north-eastern Africa and the Sahel between 1968 and 1976, pastoralists become wholly dependent upon the few perennial water supplies and the destructive behind, keeping with them the livestock they need for milk. The unproductive animals (known as the *fora* herds)—males, castrates and barren females—continue to be taken away into the surrounding country by the young men largely following traditional nomadic practices.

Dynamics and role of woody vegetation

As a result of the rising human populations, there are increased demands upon the woody vegetation. In addi-

Table 3. Estimated livestock and wildlife densities km^{-2} total populations and equivalent in Tropical Livestock Units (TLU)[a] (after Lusigi, 1981)

Species	Head km^2	Total Population	TLU	Per Cent
Sheep and Goats	12.48	287,040	26,095	18.3
Cows	2.47	56,810	56,810	39.8
Camels	1.80	41,400	51,750	36.3
Donkeys	0.05	1,150	1,150	0.8
Oryx	0.08	1,840	920	0.6
Zebra	0.06	1,380	1,380	1.0
Giraffe	0.07	1,610	3,220	2.3
Grant's Gazelle	0.20	4,600	460	0.3
Gerenuk	0.05	1,150	115	0.1
Ostrich	0.09	2,070	690	0.5
TOTAL		399,050	142,590	100.0

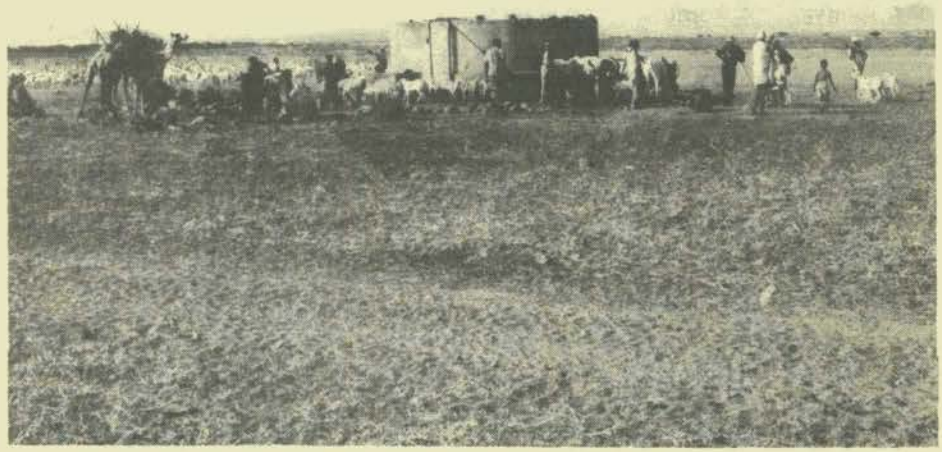
One TLU equivalent to one 250 kg cow. Other TLU equivalents as follows:

Giraffe 0.5, Camel 0.8, Donkeys and Zebra 1, Grant's Gazelle and Gerenuk 10, Oryx 2, Sheep and Goats 11, Ostrich 3.

tion to the usual wood requirements for building and for fuel, the pastoralist people in northern Kenya use large quantities in constructing night enclosures (*bomas*) to keep their animals together at night and to prevent depredations by carnivores. These bomas are built at permanent and temporary camps. In the latter situation they may be occupied for as short a time as a week before the livestock are moved to a new area and a new boma is constructed. In the semi-permanent settlements, an accumulation of ticks and other parasites usually necessitates the burning of the boma periodically and the movement to a site that may be as little as one hundred meters away. It is this practice that appears to have the greatest impact upon the woodlands of northern Kenya and is one of the most serious causes of desert encroachment in the region. Rendille people living in permanent settlements use on average about 785 kg. of wood (oven dry weight) per household per year for fuelwood and the construction and maintenance of dwellings and bomas. The Rendille, who still have a more traditional nomadic lifestyle, use on average 1,060kg. per household per year. Dead wood is preferred for fuelwood whereas for the other purposes most of the wood is cut (Walther and Herlocker, 1981).

Table 4: Mean number of livestock per Rendille household by type of stock (from Mburugu, 1981

Camels	12.9
Cattle	11.3
Sheep	42.5
Goats	43.5
TOTAL	110.2



The land around this bore hole cistern in Gabbra country has become completely barren due to human and livestock concentrations. (UNEP/Daniel Stiles)

This Rendille village has settled semi-permanently near Kargi because of the proximity of water and shops, and because the people feel secure from raiding. The people here and in other similar settlements, however, have stripped the land of all vegetation and desertification is radiating outwards. (UNEP/Daniel Stiles)

In order to provide the data necessary for the future management of the tree populations, especially with a view to preventing further depletion and providing an adequate sustained production for the support of the human and livestock populations, two main lines of enquiry are being followed by IPAL. The first concerns the measurement of biomass and production of the main woodland communities, based upon both ecoclimatic zonation and upon human and livestock distribution. The second concerns the establishment of the baselines for a programme of monitoring trends in the tree populations. The two lines of study overlap since levels of biomass and productivity are likely to be important criteria in assessing change. A third line of enquiry which has been followed by Walther and Herlocker (1981), and which should be extended, is the measurement of human requirement for wood. The fourth line concerns the production and consumption of browse in the support of livestock populations.

As a first approach to the measurement of the biomass of wood present in the study area and of its distribution in relation to ecoclimatic zonation and human distribution, a study has been made of the species composition, age group and density structures of the main woodland and shrubland communities in the region. Data on the dimensions and weights of the different components of the important tree species are being obtained through a programme of destructive and non-destructive sampling based upon the woodland station at Olturot in the IPAL study area. Although the programme is still in progress, sufficient data have already been obtained to provide preliminary values for the composition and biomass density of the very extensive *Acacia reficiens* shrublands in their relatively unexploited condition, to provide standard values for this type for assessing the status of the more exploited shrublands in the inhabited areas.

Samples of at least 20 of each of the 10 most important tree and shrub species in the *Acacia mellifera* and *Acacia reficiens* shrublands have been measured in two 20 ha study plots. These measurements have been supplemented by a further series obtained in the course of transect sampling (described in Lusigi, 1981) which have together provided size measurements of over 300 trees, from which regressions have been drawn relating crown diameter and area to stem diameter and basal area at ground level; the two are highly correlated.

Summary of broad recommendations

Although it may seem somewhat premature to offer recommendations before the finalization of IPAL and before a very thorough evaluation of the project's findings, it would be inappropriate at this juncture not to provide some indication of the broad management measures that we see as necessary to provide the basis for rehabilitation and managing the resources of Marsabit District. The following is a list of these preliminary recommendations, which should be seen in the light of an integrated management scheme for inclusion into the government's planning for the district.

(1) Disperse, using all means possible, the livestock populations widely across the district, in order to reduce the impact of grazing and wood cutting in the settlement areas and make full use of the plant resources available but currently not used because of insecurity.

(2) Institute a co-operative lives-

tock management system on an ethnic group basis, to be co-ordinated with settlement schemes and rural industries.

(3) Designate areas of strictly controlled management close to settlements, where the grazing of livestock and cutting of wood will be prevented or reduced to a minimum in order to promote the rehabilitation of the vegetation.

(4) Provide artificial fencing materials, as a service, where livestock concentrations occur and are likely to cause the depletion of the woodlands through boma construction.

(5) Appoint, within the co-operative livestock management scheme, local qualified and experienced range management officers to regulate rotational grazing, with the agreement and participation of the herdsmen.

(6) Improve considerably the security measures against banditry and intertribal livestock raiding, in order to make it possible to use the present underused area.

(7) Provide, when the dispersal of livestock becomes possible, a system for transporting milk rapidly to the settlements from the dispersed milking herds.

(8) Introduce planned watering points, with control of water availability, to assist both in the distribution of livestock and reduce congestion in present concentrations.

(9) Provide an outlet for surplus livestock, by greatly improving livestock marketing facilities.

(10) Raise the price of animal products on the markets above their present artificialy low levels, as a stimulus to the economy of the region.

(11) Continue research and monitoring on the status and trends in the ecology and social conditions of the region.

In conclusion, it is hoped that the strategies for coherent and integrated development of the arid lands of northern Kenya elaborated by IPAL will be implemented on a practical scale in due course. While trying to meet the needs of the former nomads for improved human welfare and their aspirations to benefit from and participate in the overall socio-economic and technological development of Kenya, it should not be forgotten that under the prevailing climate sustained agriculture is not possible over the greater part of the region. Animal husbandry will inevitably remain the basis for the economy. Thus, sustained development in the area will have to be based on an ecologically sound range management, even if other sectors such as tourism might also help one day to reduce the pressure on the land. Ecologically sound range management is defined in terms of the long-term carrying capacity of rangelands not being exceeded. It will only be possible to increase human welfare to pastoralists and to stop desertification if the mobility and dispersion of livestock can again be increased considerably, and if the overall number of livestock can be better controlled through a greatly improved marketing system.

REFERENCES

1. Field, C.R. (1980). Summary of livestock studies within the Mt. Kulal study area. In UNESCO (Ed.), *Proceedings of a Scientific Seminar.* Nairobi, 24-27 November 1980. IPAL Technical Report A-3. UNESCO, Nairobi, pp. 89-120.
2. Herlocker, D. (1979). *Vegetation of Southwestern Marsabit District, Kenya.* IPAL Technical Report D-1, UNESCO, Nairobi.
3. Kruuk, H. (1980). *The Effects of Large Carnivores on Livestock and Animal Husbandry in Marsabit District, Kenya.* IPAL Technical Report E-4. UNESCO, Nairobi.
4. Lamprey, H. and H. Yussuf (1981). Pastoralism and desert encroachment in northern Kenya. *Ambio*, 10(2-3), 131-134.
5. Lusigi, W. (1981). *Combatting Desertification and Rehabilitating Degraded Production Systems in Northern Kenya.* IPAL Technical Report A-4, UNESCO, Nairobi.
6. Mburugu, E.K. (1981). *Factors Related to Stock Ownership and Population Movements, and Perceptions on Land Pressure and other Environmental Changes among the Rendille in Marsabit District.* Mimeographed. IPAL report. UNESCO, Nairobi.
7. Schwartz, H.J. (1980). Understanding the ecology of a nomadic system of livestock production. *Impact of Science on Society*, 30, 279-288.
8. Sobania, N. (1979). *Background History of the Mt. Kulal Region of Kenya.* IPAL Technical Report A-2, UNESCO, Nairobi.
9. Walther, D. and D. Herlocker (1981). *Wood Requirements of the Rendille in the Korr Area of Marsabit District, Kenya.* Mimeographed IPAL report. UNESCO, Nairobi.

Poverty, population growth and desertification

by Erik Eckholm

Desertification produces poverty. The declining productivity of dry-zone croplands and rangelands has its most severe impacts on scores of millions of the world's most wretchedly poor—especially the villagers of semiarid Africa and South Asia. Depending quite directly on the soils and forests about them, these people see their prospects for a better life dry up along with the natural resource base.

Yet—and herein lies the supreme challenge, both for the afflicted people and for the international community—desertification cannot be reversed unless these same people are given a chance to improve their lot. Poverty in turn produces desertification, and the fight against mismanagement of the land can succeed only as part of a more general attack on underdevelopment. Desertification is not a mysterious or detached technological problem; in most cases the term describes the ecological dimensions of a development process gone bad, a process that fails to provide people with a nondestructive way to make a living. The contributions of human population growth and migrations to the problem can only be understood in this broad context.

A usually concomitant of poverty in the modern era is a high rate of population growth. For many poor groups, modern conditions have meant at least moderate reductions in death rates but not, for a variety of well-known reasons, a commensurate drop in birth rates. The result, in arid and semiarid zones as elsewhere, is unprecedented numbers of people trying to meet their basic needs for food, fuel, housing, and social betterment. Too often, the resulting intersection of economic and political forces, technological changes (or inhibitions to technological change), ecological constraints, and rising human numbers results in damage to the land's productive capacity. Put otherwise, growing numbers of people are forced by circumstances—for the most part beyond their own control—to undercut the ecological basis of their future welfare as they struggle to survive today. Demographic increase is clearly a major dynamic factor, but its impact is exerted only in conjunction with the other forces and changes at play.

For the most part, research increasingly reveals, traditional dryland societies developed farming and pastoral systems that were well attuned to ecological realities. Cropping rotations, pastoral movements, range-management strategies and farmer-herder exchanges generally evolved in ways that allowed sustainable use of the land and aided group security when the inevitable drought struck. But the traditional systems were normally predicated on rather stable human numbers living in far lower densities than are building up today—and with far higher death rates than are acceptable today.

In the absence of appropriate technological advances—indeed, often in the presence of outside interventions that have made things worse—the climb in human density has in many areas meant ever-greater land degradation. Though the particular problems and potentials vary widely, certain common themes emerge from reports on desertification from many different impoverished regions. Where once the person-land ratio permitted lengthy fallows, for example, today these vital periods of soil rehabilitation are often shrinking, with disastrous consequences both for soils and for the trees that formerly covered the land during the rotation cycle. The decline in fallow is not accompanied by adoption of more intensive agricultural techniques that maintain soil fertility during more continuous cropping of the land; rather, traditional techniques are simply used more extensively, pushing fallow periods toward zero and pushing cultivation onto marginal lands. Thus the CILSS and Club du Sahel reported in 1980 that, in the West African Sahelian zone, "Rain-fed cereals production, which provides the foundation for feeding the Sahel, has continued to develop by extending areas cultivated (instead of) through intensification of production. . . Also, yields are getting lower which is a sign that at least in certain regions land is over-exploited."[1]

Similar processes have been documented to the east in, among other places, Sudan's Northern Kordofan province. There a well-balanced twenty-year rotation cycle of gum arabic trees (*Acacia senegal*), food or oilseed crops, and fallow has begun to break down as the cropping period is extended. Due to low soil fertility, crops on some overstressed lands wither even in years of good rainfall; once-productive soils have become useless sand. And the shortened fallows, combined with illegal woodcutting for charcoal that is sold in towns, have reduced the numbers of the valuable gum arabic trees.[2]

The problem of shortened fallows without compensating technological advance is not confined to the Saharan fringes; nor is it confined to semiarid lands. As a recent FAO report concludes: "In millions of square kilometers subjected to shifting cultivation by hundreds of millions of farmers in Asia, Africa, or Latin America, the period of fallow has dropped to two or three years, and no longer allows the soil to recover its fertility. Yields fall, the farmer gets poorer and the young leave the land. The degraded soil which no longer even has time to rebuild a thin plant cover is abandoned; erosion causes further damage, for once the degradation process starts, it tends to accelerate rapidly."[3]

The extensive spread of cultivation and decline in fallow periods are often accompanied by increased scarcity of fuelwood for cooking. Where once fuelwood needs could be gathered from natural woodlands and the vegetation regrowing on idle farmland, ever-longer wood-gathering journeys

The kind of future that this woman's baby will have depends on economic and social development. Development cannot be effective if land and resources continue to degrade. (UNEP/Daniel Stiles)

and overcutting of vegetation become necessary. Fuelwood availability tends to vary widely, even within the same country, but many examples of emergent scarcity and hardship—especially for the women who do most of the wood collecting—have been documented. In northern Ghana, for example, one full day is now required to gather three days' worth of wood. Women, often with children on their backs, may walk five miles to their husbands' bush farms to gather headloads.[4] In some densely populated parts of Upper Volta, trips of four to six hours, three times a week, are required.[5] A recent survey in rural Kenya revealed that women can devote up to 20-25 hours per week to fuelwood collection.[6]

The spread of sedentary farming also eats into village grazing areas, causing local overgrazing, and into the expanses on which nomadic herders have relied in their finely tuned migrations. In western Rajasthan, India, the cropped area expanded (mainly at the expense of grazing land) from 26 percent of the total area to 38 percent of the total during the 1960s. Simultaneously the livestock population climbed.[7] In Niger, farming takes place on sites at least 100 km north of the legal (and ecologically sensible) limit, squeezing nomadic groups.[8]

A common phenomenon in regions suffering desertification is outmigration, especially of young people. Migration is in one sense a safety valve for rural population pressures, and remittances can boost the welfare of those who stay behind. But, whether they are pushed by rural degeneration, pulled by alluring economic prospects elsewhere, or a combination of the two, these migrants' departure to seek work in cities or foreign countries often has a harmful effect on agriculture back home. Usually it is the best and the brightest who leave, reducing the chances for agricultural innovation. Where heavy labour inputs are essential to the maintenance of terraces or other techniques, rural depopulation can itself cause a sort of desertification. Declining land productivity has been linked to labour shortages in such places as Mexico, Yemen, and Kenya.[9]

Efforts to pinpoint the contributions of demographic factors to desertification and draw policy implications have suffered much the same fate as efforts to pinpoint the impact of population trends on development generally: both analytical complexity and differences in political perspective inhibit wide agreement.

Some particular problems have bedevilled analysis of the population factor in desertification, among them the appalling lack of good demographic data for some of the affected regions of Africa in particular; the sheer complexity of combining social, historical, and ecological factors in one analysis; the extreme variation in conditions among different regions; and self-imposed ideological blinders of all fashions.

As background documents for the 1977 U.N. Conference on Desertifica-

tion made clear, areas around the world of roughly comparable ecological potential have sustained populations of drastically different densities and levels of welfare.[10] The importance of such factors as culture, technology, and trade patterns as well as climate and soils to any determination of an area's ecologically safe "carrying capacity" is readily apparent. Irrigation development, for example, can be a means of boosting an area's output dramatically—though it is feasible only in some places, and, experience indicates, often fails to live up to expectations. (In fact, ecological and social mismanagement of irrigation schemes accounts for a good share of the productivity losses attributed by the U.N. to desertification; and, through its role in the continuing spread of schistosomiasis, poorly planned irrigation development can involve health costs that, for the infected individuals at least, surely outweigh the benefits.)

The rise in human population is only one of many major changes from the past that are influencing land-use patterns in drylands. New economic links and pressures have often pushed farmers into growing new crops and altering farming systems. National and international political forces have undermined the autonomy and flexibility of traditional peoples. All told, the emergence of destructive farming and grazing patterns gives rise to fundamental questions with implications reaching far beyond the demographic sphere. For example, why, in a century of breathtaking scientific advances, has so little research been devoted to dryland grain and wood production? Why does a wealthy planet fail to provide the funds needed to take advantage of those solutions that are known, fail to help give the victims of desertification a more prosperous existence in which the idea of smaller families would have a chance of taking root?

The immediate pressures under which the underclass of the drylands lives render large numbers of children advantageous to the individual family, regardless of the implications for the society and environment. Until these pressures—which include the high infant and child mortality that necessitates many births to ensure that one or two babies will survive to adulthood, and the need for extra family members to help with arduous water and wood collection and other labour—begin to change, a steep decline in birth rates is improbable. According to one calculation, a couple living in the Sahel in 1970 could be 95 percent certain of having one son survive to the age of 38 only by bearing five live male babies—hence ten children.[11]

Upper Volta's Mossi Plateau, typical of Africa's more densely peopled drylands and a harbinger of things to come in many other areas, provides a tangible illustration both of the devastating effects of population growth under current conditions and of the many other interrelated challenges that must also be addressed. Here, as in many areas experiencing ecological decline, superficial appearances can mislead. Except where severe gulley erosion blights the view, lightly wooded, usually grassy landscapes punctuated by millet fields are common. But the grasses are mainly of inedible species. Most of the trees are disfigured; only species that provide essential nonwood products have been left standing, and closer inspection reveals their regeneration to be spotty because seedlings are nibbled by goats or uprooted during cultivation.

The "open spaces" turn out to be fully used. Nearly every bit of uncropped land is either lying fallow as part of someone's crop cycle or has been abandoned because the soil is useless. "The soils are tired," say villagers throughout the region. With yields dropping, they must clear larger areas. Young adults are lucky if they can get farming rights on hillsides or less fertile lands. Fields are cropped repeatedly with no fertilizers or manures applied; some formerly good fields are now stony, eroded wasteland. Storm waters rush off the devegetated land rather than soaking in, skimming off soil as they go.

In this context of agrarian stagnation and extreme underdevelopment, population growth is the final catalyst of resource destruction. With death rates still quite high, Upper Volta's rate of natural increase is estimated to be near 2 per cent, and will probably rise before it falls. On the Mossi Plateau, given prevailing technologies, almost any growth in numbers causes ecological distress. Ecologists have calculated that under current farming methods about thirty people per square kilometer can be fed without soil damage, and that natural vegetation can sustainably provide firewood to about twenty-five people per square kilometer. Today the population density has reached fifty per square kilometer in many portions of the plateau and surpasses a hundred in some.[12]

Heavy outmigration forestalls more overt disaster. Mossi people are moving to the less densely populated south and west of Upper Volta—where land-use conflicts are erupting and the same cycle of degradation looms in the future. Many of the country's young men have left to work in the Ivory Coast. The typical village is simultaneously overpopulated relative to current technologies and depopulated of the individuals most likely to innovate and reverse the downward spiral.

A better future for this and similar regions will depend on progress on many fronts at once. Farming systems that combine food production, forestry, and animal husbandry—systems that preserve soil fertility as they boost output—must be developed and adopted. Simple anti-erosion and water-conserving works on fields could raise crop yields. A comprehensive approach to development is essential, including provision of primary health care, household water supplies, basic education, and farm and forestry improvements as well as family planning. National commitments to improving the exploited role of women must also be part of the solution; as the main farmworkers and as potential childbearers, women need the opportunity to innovate that is now denied them.

Sound, decentralized rural development is more difficult than building a large irrigated estate or factory. It requires reforms in the structures and attitudes of government bureaucracies as well as an overriding shift in national priorities toward shared rural progress—unavoidably at the expense of both urban and rural elites. Among other things it can require alteration of the near-total past emphasis, in the agricultural sector, on export crops. Spurred by the colonial quest for raw materials and the postcolonial quest

for foreign exchange, the export-crop bias has meant a costly neglect of research and infrastructure for peasant dryland food production. Even in the late 1970s in the Sahel, after the bitter experience of the drought of 1968-73, rain-fed grain crops received a mere 3 or 4 percent of the $6 billion in foreign aid that poured into the region, according to the CILSS and Club du Sahel.[13]

Migration to cities can be an escape valve for rural crowding and poverty, but paradoxically the urban population explosion, too, can exacerbate desertification. In many poorer countries of Africa and Asia especially, most town and city residents cook with purchased wood or charcoal. Meeting this concentrated demand causes far more overt deforestation than the scattered wood scavenging of villagers. The most severe negative impacts of cities on the countryside are less direct. The disproportionate political pressures exerted by urbanities commonly result in food pricing policies that subsidize city dwellers at the expense of farmers—a major impediment to agricultural progress. Also, a disproportionate share of public investments in all sectors are made in and around cities.

Acknowledgement of the many variables that determine the relationship between population growth and desertification does not mean that no conclusions can be drawn about the desirability of incorporating population policies into the anti-desertification, pro-development struggle. In many countries, growth in human numbers is one of the key dynamic forces in the people/resources development equation. Common sense suggests that the extraordinary social and political reforms needed to put development on a more positive track will not come easily. Any easing of the demographic pressures—which in any case will continue to be stupendous—can aid the broader struggle, though of course it cannot substitute for other needed reforms. Just as it would be shortsighted for governments to ignore the many socio-economic influences on land-use practices and the way technology can alter productive potentials, so would it be shortsighted for governments to ignore, as many still do in practice, the demographic dimension of land degradation.

Future population prospects in many of the poorer countries suffering most from desertification must give anyone pause. The total population of the nineteen African countries served by the UN Sudano-Sahelian Office is projected to more than double in just the twenty-three years from 1977 to 2000, growing from 192 million to 406 million.[14] And, given the youthful age structure, the momentum for massive, rapid further growth will be great at that time. Yet right now, population growth in the region is outstripping food production and desertification is

These bags by the side of the road contain charcoal; each bag represents approximately one tree. The poor people of Africa destroy hundreds of trees everyday for their energy needs. (UNEP/Daniel Stiles)

rampant. The unprecedented demographic pressures are also having wrenching impacts on cultures. Family planning is no panacea, and in any case cannot succeed in the absence of improvements in health and economic reforms. But it makes no sense to accept fertility trends as a given as something outside the purview of public policy, especially when they are undermining progress in other realms. Because of the arithmetic of exponential growth and demographic momentum, governments must lay the groundwork now to help forestall catastrophic situations decades hence. By integrating family planning services and education into an accelerated primary health care campaign, they can shorten the time lag between perceptions of improved child survival and desires for smaller families. The direct health benefits of family planning for women and infants are also, of course, substantial.

Many of the world's poorest countries, and disadvantaged regions within many more, are barely making any economic progress. Some are, in per capita terms, slipping backward. This economic emergency, which both contributes to and is exacerbated by desertification, calls for responses of many kinds and on a global scale. It also means that to wait for some mythical future affluence to bring down the birth rate in impoverished regions may be futile. Under today's conditions—and especially considering our dawning awareness of the ecological dimensions of sustainable development—promotion of family planning needs to be one element in a total strategy for helping the poor to better lives and the land off which they live. It should not and cannot be a substitute for national and international economic reform. The only hope is to transform the vicious cycles of poverty, rapid population growth, and resource destruction into benign cycles, in which progress in each area facilitates progress in the others. This may be possible only through simultaneous attacks on all fronts at once.

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NOTES

1. Club du Sahel/CILSS, *The Sahel Drought Control and Development Programme, 1975-1979; A Review and Analysis,* Paris, Sept. 1980.
2. Turi Hammer, "Wood for Fuel: Energy Crisis Implying Desertification—the Case of Bara, The Sudan," Ph.D thesis, University of Bergen, Norway, Nov. 1977.
3. J.J. Bochet, "Management of Upland Watershed: Participation of the Mountain Communities." FAO Conservation Guide No.8, Rome, FAO, 1983.
4. U.S. Agency for International Development, *The Socioeconomic Context of Fuelwood Use in Rural Communities,* Washington, D.C., Aug. 1980.
5. Robert Winterbottom, "Reforestation in the Sahel: Problems and Strategies," presented to African Studies Association, Philadephia, Oct. 15-18, 1980.
6. B. van Gelder and G. Poulsen, "The Woodfuel Supply from Trees Outside the Forests in the Highlands of Kenya" Beijer Institute Fuelwood Project Working Paper, Nairobi, February 1982.
7. M.S. Swaminathan, "Our Agricultural Future", India International Centre, New Delhi, 1973.
8. E. Bernus, "A Case Study of Niger: the Eghazer and Azawak Region in Niger," prepared for UN Conference on Desertification, Office of Overseas Scientific and Technical Research, Paris, 1977.
9. *Population, Society and Desertification*, UN Conference on Desertification, Nairobi, Aug. 29-Sept.9, 1977.
10. *Ibid.*
11. John C. Caldwell, "Desertification: Demographic Evidence, 1973-1983". Background document to General Assessment.
12. Robert Winterbottom, personal communication; Jacques-Yves Marchal, "Système agraire et evolution de l'occupation de l'espail au Yatenga (Haute-Volta), "*Cahiers de l'ORSTOM*, Ser. Sci. Humaines, 14, no. 2, 1977.
13. Club du Sahel/CILSS, *op. cit.*
14. Leonard Berry, "Assessment of progress in the Implementation of the Plan of Action to Combat Desertification in the Sudano-Sahelian Region, 1977-1984." Background Document to General Assessment.

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