UNITED NATIONS ENVIRONMENT PROGRAMME

DESERTIFICATION CONTROL

Number 7. December 1982

- 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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Cover: Saxaul growth in the Great Gobi National Park, Mongolia. Photo: Alain le Garsmeur

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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.

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ENVIRONMENTAL DEGRADATION AND DEVELOPMENT OF ARID LANDS

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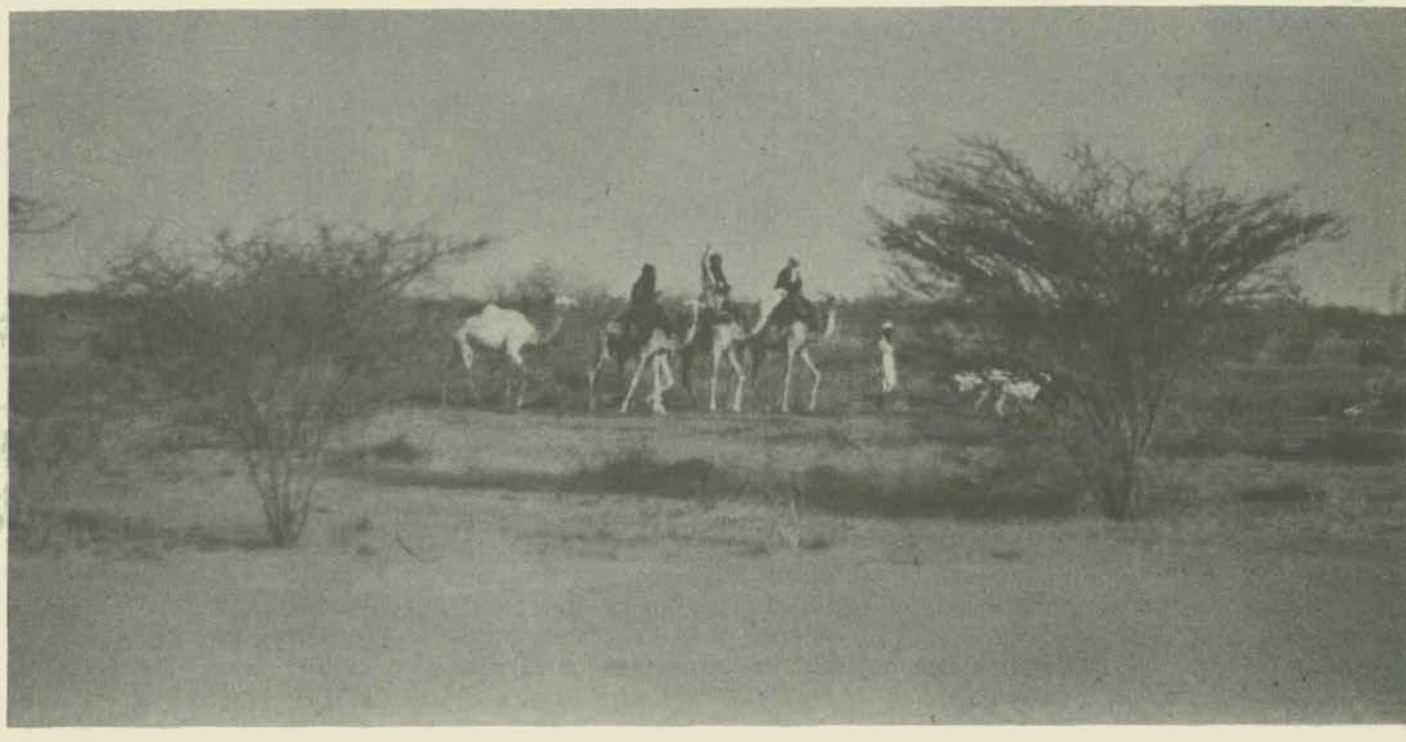
For the past two years the Office of Arid Lands Studies at the University of Arizona has been compiling handbooks on natural resource development and environmental problems in a number of developing countries, mainly in arid regions of the world. This project is sponsored jointly by the United States Committee of the UNESCO Man and the Biosphere Programme (MAB) and the United States Agency for International Development (USAID). The project represents the first stages of an attempt by USAID to integrate an environmental awareness into development planning.

A substantial proportion of development projects have had and continue to have adverse effects upon the environment, and USAID projects are no exception. It represents a major advance in the field of development activity that within the last decade such difficulties finally have been recognized, and steps are being taken to rectify them.

The handbooks, or more accurately "environmental profiles", prepared through the MAB project, are envisioned as the first part of a more thorough analysis of resource and resource management, environmental problems, and the interrelation of these with development planning. To date, environmental profiles on more than a dozen countries in the arid regions of Africa, the Middle East, and South Asia have been compiled. Natural resources of each country, particularly mineral, water, soils, vegetation, and wildlife, are surveyed; more importantly, the management and use of these resources are reviewed. Specific current and potential problems are identified to show which areas are or may become most critical in terms of environmental degradation.

The most common environmental problems found in every country profiled in the MAB project are degradation of natural vegetation cover, severe soil erosion, depletion of water supplies, and a number of environment-related health problems.

Northern Niger. Photo: J. Johnson, Office of Arid Lands Studies



A nomadic family near Agadez, Niger. Note the barren landscape. Photo: J. Johnson, Office of Arid Lands Studies

In most arid areas, expansion of agriculture depends upon the development of newly irrigated perimeters, and such projects usually lead to increased soil and water salinity. Countries with large irrigation schemes from great rivers, such as the Nile and Indus, also have to contend with waterlogging of productive soils. Overpumping of ground-water aquifers results in declining water tables, and sea-water intrusion in coastal areas. These types of physical problems, if not countered, usually lead to desertification, which in economic terms means loss of productive land and thus a decreasing productive capacity.

Physical aspects of environmental problems are covered in great detail in recent research on and discussion of desertification, including recent issues of ***Desertification Control***. By contrast, the socio-economic and institutional factors behind these problems have received much less attention. While it may be noted that overgrazing or land reclamation for agriculture are two of the major factors in depletion of vegetative cover and are thus factors in soil erosion, the tendency has been simply to blame the ignorance of the farmer or herdsman for the problem. However, farmers and herdsmen are quite often perfectly well aware of the detrimental effects of many of their actions. Traditional land-use systems were usually well adapted to fragile ecosystems and caused minimum damage to them. Very often rapid population growth and the intrusion of modern factors disrupt traditional systems, leaving the inhabitants with the choice between starvation or actions to increase food production even at the expense of degradation of the environment.

Making such choices sometimes involves institutions at the national level in many countries, to the extent that environmental degradation is, in a sense, actually planned. It is well known, for instance, that massive irrigation projects may well lead to soil salinization and waterlogging, depletion of ground-water resources, or increased incidence of certain diseases. However, the alternative of not initiating such projects and thereby courting massive food shortages is not an acceptable solution.

Such perspectives may not be readily apparent from analysis of the situation in individual countries. The trend becomes strikingly clear, however, when it is seen in nearly every country profiled. The four cases briefly reviewed here were chosen to demonstrate that similar institutional factors are behind a wide range of different desertification processes, at local, regional, and national levels.

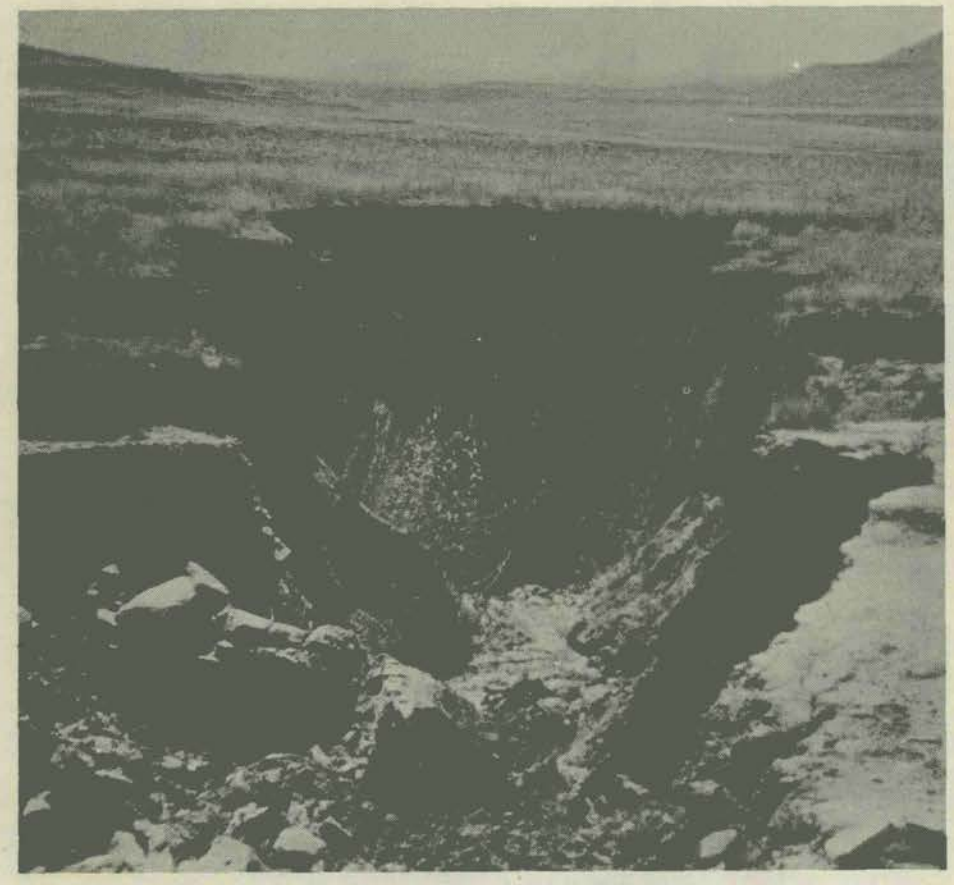
Rangeland Degradation in the West African Sahel

One of the chief causes of rangeland degradation cited in desertification literature is overgrazing. The standard explanation of the process is very familiar by now. The general outline is that pastoralists increase herd size beyond the carrying capacity of the available range resources. The animals consume forage vegetation faster than it can regenerate, and eventually inedible or no vegetation remains. With degraded ground cover, soil erosion becomes serious and any chance of restoring the range becomes remote because of massive topsoil loss.

A common variation presents nomads clustering at wells during times of drought, concentrating their herds in the areas around the wells. The range deterioration in the local areas centred on wells proceeds and these individual areas of devastation gradually expand and link up.

It is difficult to criticize this general model. The process has been examined in the Sahel and elsewhere countless times over the last several decades, and it does, in fact, usually proceed as outlined. However, the question is why the process happens. Is it really, as many have asserted, because the pastoral economy places such a high value on animal ownership that herders wish to go on accumulating animals even to the detriment of the environment? Should we believe that because most nomadic societies traditionally lack the concept of private land ownership, they think only of their own herd and do not care if the range vegetation is depleted? This kind of approach seems to be rather unproductive, a kind of "blame the victim for the crime" concept.

The most useful approach seems to be an examination of the pastoral economy over time to determine whether pastoralism has always brought about the kind of rangeland degradation which we see today. These pastoral economies have existed in the Sahel for millennia. It is not



An erosion gulley in a sorghum field, Lesotho. Photo: J. Wilkinson

likely, therefore, that the Sahel has seen throughout history the kind of serious environmental degradation which it has witnessed in the twentieth century. Historically, several of the most prosperous African kingdoms, including Ghana, Mali, and Songhay, arose in the Sahel. Their economies were based on long-distance trade, agriculture, and pastoralism, each sector mutually interdependent.

More importantly, agriculture and pastoralism were in balance with ecological conditions; rangeland degradation seems only to have been a problem at a few specific times. It is intriguing that these times are precisely those periods of chaos during which one state collapses eventually to be replaced by a successor. In other words, these periods of critical ecological degradation coincide with periods of severe social and economic disruption.

The current ecological problems in the Sahel can also be viewed as occurring during one of these periods of severe economic upheaval. The Sahel throughout the twentieth century has witnessed the gradual disintegration of its traditional trade, subsistence agriculture, and pastoral economy under the impact of the world market economy. As the cash economy penetrated, farmers had to shift to cash crops in order to raise the necessary money to pay taxes or to buy what they formerly obtained through barter. In many cases cash cropping, particularly in the case of peanuts, was imposed by the colonial regime to meet outside needs. To increase cash income, and to maintain food production levels, farmers were forced to expand cultivation into marginal areas, even though they usually knew quite well that these areas were not well suited in the long run to cultivation. Such expansion brought ecological degradation, but failure to expand meant less food to feed the family and less cash to provide other family needs. To farmers living at the subsistence level, this extra cash or food often translated into the difference betwen survival or starvation.

Pastoral nomads also lived at a subsistence level, and the necessity of paying taxes and buying supplies in cash meant expansion for them also. Expansion to the pastoralist, of course, translated into increased herd size. This in itself would have upset the delicate balance between herding and the environment, but changes in other traditional sectors also had direct impacts on pastoralists. With trade increasingly monopolized by Europeans, even the meagre incomes derived from the caravan trade were cut off. With crop production converting to cash crops for the European market, fodder prices inflated rapidly. Such factors increased the need to expand herd size. At the same time, agriculture expanded into the areas where the nomad used to pasture his animals, and he, too, had to move his larger herd to areas which were more arid and less suited to grazing.

Sometimes wells would be drilled in the more arid regions to provide drinking water for livestock. Of course, the nomads began to concentrate their herds around such wells, bringing even more rapid range deterioration in local areas. Planners began to wring their hands and wonder about the irresponsibility of the pastoralists. Should anyone, however, have expected the nomad to take his herd off into the desert to die of thirst?

The traditional herder is not the culprit. He knows perfectly well that the areas he has been forced into cannot sustain large numbers of animals in the long run. That is why he was not normally found in these areas until forced out of zones where pastoralism was economically and ecologically sustainable.

Soil Erosion in Lesotho

Some of the worst soil erosion problems in southern Africa are encountered in Lesotho, a small landlocked country of 1.2 million people surrounded on all sides by South Africa. The eastern portion of the country consists of high mountain ranges, reaching over 3,000 m in places. Although the eastern escarpment may receive up to 2,000 mm of rainfall annually, the intermontane valleys are comparatively dry and most of Lesotho falls within the sub-humid and semi-arid zones. The major population centres are in the western lowlands, an area of around 700 mm annual rainfall and prone to drought.

The basis for Lesotho's current status can be traced back to 1868, when the nation's first leader sought and obtained British protection against the encroachment of white

settlers to the west. As a result, Europeans were never welcome in the country and traditional land tenure systems remained fairly intact. Land ownership is vested in the king and is held in trust for the Basotho, who are primarily a pastoral and agricultural people. Chiefs and subchiefs allocate agricultural land, traditionally designating three fields to each household head. Communal pasture-land is open to all.

When Lesotho became a British protectorate, however, it was forced to cede the western half of the traditional Basotho homeland to European settlers. (The west bank of the Caledon River is now termed "the conquered territory" by the Basotho.) This was the beginning of a long-term trend experienced in much of Africa. As colonialism and European settlement became established, land shortages became acute for the traditional shifting agriculture and pastoralism of the country. On the remaining land, a vicious cycle was set in motion: overpopulation, intensification of land use, and progressive loss of soil productivity. The land was less and less able to support the increasing pressure on it, and masses of Basotho were forced into migrant labour, supplying the growing industries and mines of South Africa.

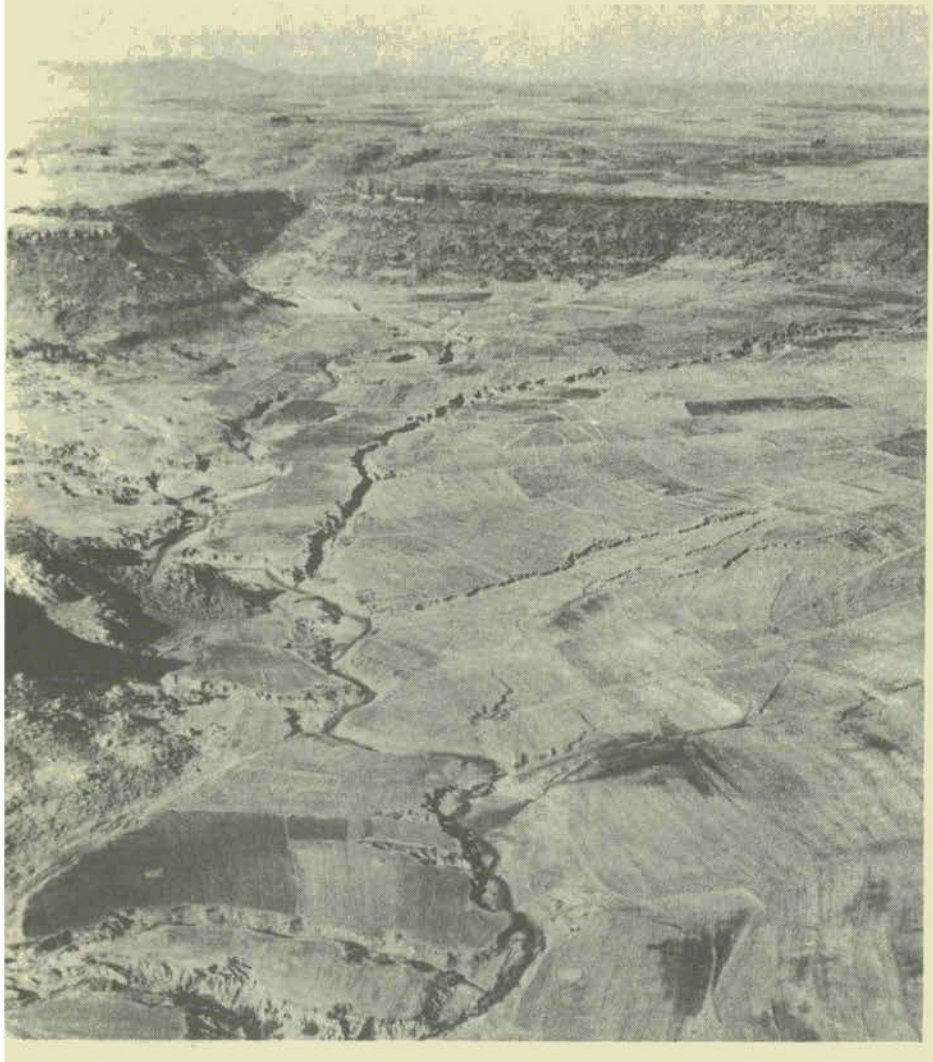
One result of the forced cession of territory west of Caledon was the migration of many Basotho to the remaining areas of Lesotho. By the 1880s population pressures in the western lowlands of the country were mounting, and people were forced to seek land in the previously very sparsely populated highlands, particularly the Orange River Valley. South African laws in 1912 and after 1950 which aimed at repatriating Basotho remaining in European areas, only added to Lesotho's population problems.

By the mid 1970s, Lesotho's population density was 59/sq km, far above densities in surrounding areas (South Africa: 33/sq km). Only about 3 per cent of the population was urban, so the vast majority of Basotho are still in the rural sectors (although not all work in agriculture; some migrate for employment to South Africa). In recent years Lesotho has experienced high unemployment rates as there is no longer available land to support the population in agriculture or pastoralism. Approximately 10 per cent of all Basotho households have no arable land at all, and the average number of fields per household of landholders is down to 2.3 from the traditional 3.

Soil and pasture productivity has continued to fall as a result of this intensification of use. Already in the 1930s one survey estimated that the carrying capacity of the country's natural pastures had been reduced to half of what it was formerly. In agriculture, fallow periods have been reduced or eliminated, monoculture cultivation has increased, and the use of dung as fertilizer has declined as fuel needs increased. New fields have had to be created to replace those whose soil had been exhausted. The only areas now available for new fields are on lands which are steep and highly prone to erosion.

Lesotho has declared the creation of such new fields illegal. However, enforcement is nearly impossible and the process continues, exacerbating the country's erosion problems. Nearly half of all cultivated areas suffer erosion, and about 12 per cent show severe erosion. It is estimated that sheet erosion causes the loss of 70 metric tons of top soil annually per hectare of arable land. Gully erosion has already caused the permanent loss of 4 per cent of Lesotho's cultivated land, and the country is losing an additional one per cent every four years to new gullies or the widening of old ones. This translates into a loss of about 1,000 hectares each year. The cycle of reduced productivity, the addition of new fields and increased erosion has resulted in the total cultivated acreage in Lesotho remaining relatively constant.

Aerial view of the Drakensberg Mountains showing the scars of soil erosion.
Photo: T. Fincher, WFP



Pasture lands have also suffered. Normal carrying capacities would require about 4 million hectares of rangeland for Lesotho's 500,000 cattle, 1.2 million sheep and 600,000 goats. Unfortunately, the country has only about one million hectares of grazing land available. This overstocking has resulted in severe depletion of vegetative cover throughout much of Lesotho, and invasion of many areas by semi-arid land shrubs from the Karroo Desert to the southwest. These shrubs are of little use for grazing, and furthermore, do little to bind soil in countering erosion.

A related phenomenon, found exclusively in the highlands, is the desiccation and erosion of peat bogs which occupy valley heads in the major ranges. These brilliant green bogs act as convenient watering places for livestock and therefore have suffered excessive trampling. The resulting compaction caused the bogs to dry out and they became prone to deflation by high winds. The reservoir capacity of these "sponges" is greatly reduced, and downstream areas are subjected to more intense flood peaks, lower dry-season flows, and increased silt loads in stream flow, all of which aggravate problems already occurring.

Lesotho, then, was forced into its present position partly by the direct application of outside political power over the last century. The farmers and herders did not choose to be crowded into a small country where they would have nowhere to go except onto steep, easily erodible, inhospitable mountains.

Local Agricultural Development and Desertification in Southern Arabia

Physical conditions in the Yemen Arab Republic (YAR) and the Sultanate of Oman have given rise to a wide variety of agricultural organizations. In the YAR, traditional systems in the Tihama coastal plain are based upon spate irrigation which diverts flood flow in the wadis traversing the coastal plain. These floods normally come only a few times a year at best, during the rainy season. Flood flow is captured by means of an elaborate network of weirs and barrages and directed by canals to fields lying along the wadi course.

In the highlands, the most distinctive feature of Yemeni agriculture has traditionally been the terrace. They comprise numerous, small, hand-constructed plots of flat land on steep mountain slopes. Terraces trap rainfall, and receive and retain runoff from upslope areas. They may be cultivated or used for grazing. In either case terraces allow production in Yemen's arid highlands which would otherwise go unused.

While the two major agricultural systems of the YAR are based upon the capture of surface runoff, traditional agriculture in Oman utilizes ground water. Again in Oman there are two main types of irrigation. In the Batinah coastal plain, shallow hand-dug wells are the primary source of irrigation. Draft animals draw water

The water table is so near the surface at Mohenio Daro that capillary action carries water up into the bricks of the ancient site, and evaporation leaves behind salt. Photo: M. Mahar, Dept. of Oriental Studies, Univ. of Arizona

by means of a hoist and bucket, and the water is dumped into a basin and channeled to fields or gardens.

In the interior of the country most irrigation water is obtained by means of a *falaj* (plural *aflaj*). One kind, called the *ghayl falaj,* uses a low bund or a short collector gallery to divert the perennial flow below the gravel surface of a wadi. Water is channeled to terraced or cleared fields along the wadi. The second kind, called a *qanat falaj,* is also known under a variety of names in other regions from North Africa to western China. It consists of horizontal tunnels dug into alluvial fans to tap the water table. A vertical shaft is sunk first to verify the existence of a suitable shallow aquifer, then the tunnel is excavated. Additional vertical shafts are used for ventilation, cleansing and maintenance.

These widely differing systems in Yemen and Oman have in common the fact that they are quite compatible with the arid conditions under which they have evolved. Spate systems, for example, utilize only flood water which would otherwise flow into the sea. Construction of a terrace system prevents soil erosion, and by trapping runoff, allows more water to infiltrate to water tables. Water is not extracted from the shallow wells of the Batinah rapidly enough to deplete water tables. *Aflaj* tap only renewable shallow aquifers for high quality water.

The systems also have the common feature that all are fairly labour intensive. In recent decades both Yemen and Oman have seen massive migration out of rural areas. Not surprisingly, the traditional labour-intensive systems have begun to break down. Diversion systems are not maintained and are eventually washed out or clogged. Terraces deteriorate and can no longer prevent soil erosion. Eventually entire hillsides are stripped of any productive capacity. This leads to increased flooding and sedimentation downstream, which reinforces the decline there. The flow of *aflaj* declines as they deteriorate, and land irrigated by them goes out of production.

The introduction of labour-saving technology may only compound the problem. For example, tractors are imported, and these damage field-containing walls. The worst offender, however, is the modern water pump.

Building a main drainage canal along the banks of the Nile within view of the Valley of the Kings, Egypt. Part of an irrigation system financed by the World Food Programme. Photo: FAO–WFP

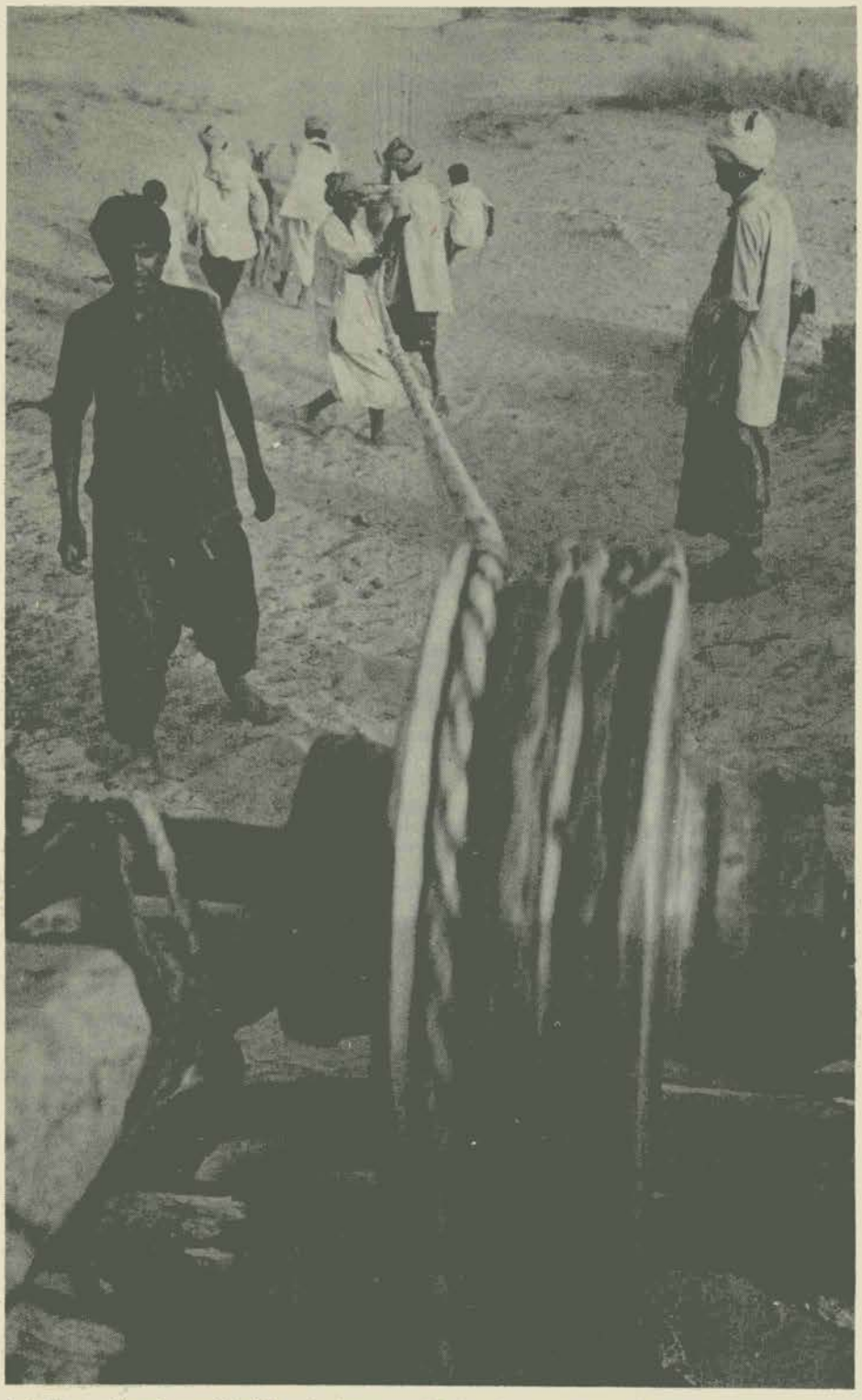
Neither Yemen nor Oman has any comprehensive regulation on water pumps, and the result is that water tables drop rapidly. In interior Oman, this leads to the failure of many *aflaj,* so that even more pumps are required. In the coastal plains of both countries, this has led to sea-water intrusion of coastal aquifers. The aquifer becomes polluted with salt water, soils become salinized, the land loses its capacity for agricultural production, and the desert moves in. Along the Batinah coast in Oman, for example, date palm groves are dying because of salinized water, even though the date palm is a relatively salt tolerant tree.

We might blame the ignorance or the selfishness of the farmer who goes off to work and leaves his land to the desert. Can we really fault him, however, for wanting a share of the benefits of modernization along with the rest of the world? Should we blame farmers who use pumps? It is well known that pumps induce problems with water quality and declining water tables. Without a pump, however, farmers often cannot irrigate at all because the traditional irrigation systems no longer function.

These dilemmas have reached the national level. Oman, for example, usually subsidizes pump purchases, and well-drilling projects are a major part of most government agricultural schemes. Descriptions of planned projects even include the acknowledgement that sea-water intrusion or dried up *aflaj* will result. The government is well aware that such policies pose long-term threats to the environment, but short-term problems require a response, and the international community has not yet come up with any better solutions.

Large-Scale River Irrigation Projects : Egypt and Pakistan

In both Egypt and Pakistan the dilemmas which we have noted can be examined best at the national level. Large-scale irrigation projects on the Nile and the Indus rivers have been the basis of agricultural development in these two countries. The key to desert reclamation schemes in Egypt was the Aswan High Dam which was put in use in 1960. By 1981, the dam had enabled Egypt to add over 1.2 million feddans (1 feddan = 0.46 hectare) to its cultivated area. It also allowed for conversion to perennial irrigation, which means that fields can be cropped two or even three times annually. These increases have re-



A pulley system is used to lift water in a goatskin bag from a well, 340 ft. deep, at Gadro. This single well must supply a population of some 6,000 persons. Photo: G. Di Majo, WFP

sulted in modest overall increases in Egypt's agricultural production, but per capita production has actually dropped.

Ironically, despite significant acreage increases, losses of a comparable order have come about as a by-product of the reclamation schemes. Extensive soil waterlogging and salinization have been a direct result of these massive irrigation schemes in Egypt. Fully 28 per cent of the country's agriculturally productive land has been affected to some degree. Average yields in affected areas have decreased an estimated 30 per cent, and some lands have been abandoned. In the region of Kom Ombo in Upper Egypt, for example, the ratio of new land irrigated to land lost to production is approximately 1:1.

Waterlogging and salinization occur because more frequent irrigation and extension of the canal network allows vastly increased seepage from canals as well as increased infiltration from fields. Water tables rise close to the surface of the land where they are constantly subject to evaporation. The result in waterlogged soils is salt buildup.

The Egyptian response in recent years has been directed towards sealing canals to prevent seepage and installing drainage tiles below field surfaces to facilitate drainage. These programmes are quite expensive and have required massive outside financing. The environmental problems which accompanied the Aswan Dam and subsequent irrigation development were actually predicted by many before the dam was ever built and a few suggested beforehand that the kinds of tiling programmes now being implemented should have been part of the irrigation expansion programme from the start. The predictions were borne out in the areas first reclaimed but irrigation expansion nevertheless went forward.

Many among the international community were quick in pointing out to Egypt the apparent folly of its actions. It would be more profitable, however, to examine the question of why Egypt undertook an agricultural programme when it had warning that environmental deterioration would be a significant negative result. Some have suggested that although the warnings had been offered, few people actually expected the problems ever to reach the present magnitude. It must, however, be pointed out that such consideration may have been almost irrelevant given the socio-economic context of the 1950s. Egypt was faced with a rapidly growing population. Agricultural output had to be increased if famine was to be avoided in the near future.

Egypt already had one of the highest yield ratios per unit land in the world, and therefore there were very limited prospects for increasing production through improvement of cropping methods. The only way to substantially increase production was to

expand the cropped area and crop more than once annually. For this, expansion of irrigation was necessary. The 1950s was also a period when Egypt's access to major funding sources was severely restricted. In essence, the government was left with only one realistic option: to proceed with limited funding, which would not allow for expensive environmental protection measures.

Pakistan is facing problems similar to those in Egypt. Development of the Indus and its tributaries for irrigation has been a primary factor in the country's agricultural development. It is estimated that nearly half of Pakistan's irrigated land is affected to some degree by waterlogging and/or salinization; in Sind Province the figure reaches over 98 per cent. Just as in Egypt, the government must continue to expand irrigation in order to keep pace with population growth, and so far, per capita agricultural production has just kept pace. Irrigation programmes continue with the full knowledge that waterlogging and salinization will result. In fact, nearly 40 per cent of the funds for water development in the Fifth Five Year Plan (1978-1983) are allocated to drainage and reclamation of waterlogged and salinized land, while irrigation receives just over 25 per cent of these funds. Over 100,000 tube wells have been installed since the early 1960s in an effort to pump out ground water rapidly enough to lower water tables. Just as in Egypt, it is doubtful that any other options are open to Pakistan. To cut back on irrigation expansion would mean that agricultural production would rapidly fall behind population growth.

Conclusion

These four brief examples do not by any means exhaust discussion of the socio-economic and institutional factors behind environmental degradation. The problems of firewood gathering, for example, could be added to illustrate the problem. Deforestation is a major contributing factor to desertification. Those who must gather wood for fuel know about deforestation; they know better than any that it becomes more difficult to find wood every year. But can planners realistically expect those dependent on wood for fuel to give up cooking their food or heating their houses in the interest of environmental protection?

We have chosen these examples because they illustrate that behind many very different causes of desertification lie exactly the same kinds of choice. Pastoralists, farmers, or government officials are usually aware that their actions are not the best possible solution to problems which they face and that they may, in fact, contribute to environmental degradation. Planners must recognize this point, and the world community must recognize that a great many of the socio-economic problems contributing to the desertification process will not be solved at the local or even national level. They are international in scope. We cannot ask a Sahelian nomad to pasture his flock more rationally. Within the options the world has imposed on him, he is already acting in the most rational manner possible.

The physical problems of environmental degradation and resulting desertification are well known and well researched. From a purely technical point of view nearly all these problems can be solved. The major focus, however, must shift away from action exclusively on the technical level. It is already increasingly recognized that behind nearly every environmental problem lies some socio-economic or institutional dynamic which must be addressed if there is to be any hope of lasting solutions. Many have already realized that desertification itself is not a local or national problem but a global one. The world must also recognize that the factors behind desertification are likewise international in scope.

NOTE

The list of countries profiled in this project includes the following: Cape Verde (1980); Egypt (1980); Gambia (1980); Lesotho (forthcoming); Mali (1980); Morocco (1980, revised 1981); Niger (1980); Oman (1981); Pakistan (1981); Senegal (1980); Sudan (forthcoming). Tunisia (1980, revised 1982); Upper Volta (1980); Yemen Arab Republic (1980, revised 1982); Zambia (1982); Zimbabwe (forthcoming).

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COMBATING DESERTIFICATION IN SAHELIAN CONDITIONS

Yakov Orev

Climatologists and ecologists are in general agreement that desertification is due to human economic activities rather than a result of a trend towards increasing aridity of the world climate. It is also agreed that climatic fluctuations in fragile ecosystems could hasten the process.

However, there is reason to believe that practical range improvement projects can be implemented, even on marginal lands, with a fairly good chance of success. There already exists a great deal of knowledge which has not yet been put to general practical use. For instance, one well-established principle is that the improvement of depleted rangeland requires a drastic decrease in, or in some extreme cases, complete exclusion from grazing for several years.

In the Sahel and similar regions, there are periodic droughts, but there are also rainy years, and these should be exploited for range improvement. Where there is a rainy year or two after the start of a controlled grazing scheme, it will quickly become apparent whether the depleted range still has some good plants which can supply the seed for range improvement. As is very often the case, if the area is taken under control or excluded from grazing altogether, the plants will soon colonize the empty spaces and in a few years the range will be restored and become suitable for systematic and moderate grazing.

In other cases, however, the native edible vegetation could have been so badly depleted that it becomes essential to introduce or reintroduce plants which will survive, produce seed and colonize the range. It is usually better to use plants which reproduce quickly and easily, and which are resistant to droughts and grazing even if they are of inferior palatability. Many such plants are known and there exists a good deal of experience in their use.

In areas with greater amounts of rainfall (500-600 mm summer rainfall), there may be problems of brush invasion. In the Sahel, where such areas form part of the cultivation zone, thick brush prevents the grasses from achieving their full potential. Brush removal, combined with exclusion from grazing, is an effective way under such conditions of ensuring recovery of grass cover.

Water is stored from one rainy season to the next. Evaporation is prevented by a floating rubber cover. Photo: author

These observations are based on the experience of the author in one country of the Sahelian zone. However, discussion with agricultural specialists from neighbouring countries indicates that in comparable areas with the same crops and grasses, the fallow lands are invaded by the same species of shrubs. This leads to the conclusion that within the zone there are large areas with similar ecological conditions and that experience can be transferred from one zone to the other.

To introduce better plants as sources of seed, small strategic areas with suitable soil and moisture conditions should be selected for reseeding. These areas should be fenced and sown with selected species. If the plants tend to disperse the seed through distribution by wind, the plots should be to the windward of the areas to be colonized, which should be rough surfaced in some way to catch the wind-driven seeds.

Where the seeds are spread through animal droppings, the fenced and sown plots should be moderately grazed only during the fruit-maturing season. The grazing animals should be bedded down in a different camp every few nights, in order to spread the seed and create new vegetation centres for further spreading. Once all the seed is consumed, the livestock should be withdrawn from the fenced area for the rest of the season. Progress in the spread and establishment of plant cover will determine when to begin regular, year-round grazing.

As is obvious from the above, range improvement can be a lengthy and

laborious process. Even under the best conditions, in areas where there is still some source of seed, it will still take several years to restore the rangeland.

One account of this process, published in the Journal of Range Management in the late 1950s, describes a range improvement programme carried out by a rancher in the western United States. He began by excluding one fourth of his ranch from grazing for a period of several years, reducing his herd somewhat and grazing them on the remaining three fourths of his land. After several years of exclusion and treatment, he put all his livestock on the improved one fourth, which was by then able to carry them all, and went on to improve the rest of his ranch. The carrying capacity was increased fourfold. This writer has had the same experience in various areas, demonstrating that there can be up to a fourfold difference between the productivity of a deteriorated or depleted range and an improved one.

Large-scale range improvement is often not only a technical problem, but has social and political aspects as well. This is particularly so when dealing with the rangelands of pastoral tribes where the withdrawal of range from grazing might entail reduction of the numbers of livestock, usually an unpopular suggestion. Friction with the pastoralists, however, can often be reduced through consultation with them and agreement with them on the withdrawal of grazing areas which are depleted, and yet possess, objectively, a high production potential. Often the reason for depletion of such areas is that they were highly productive and were grazed more intensively than other areas.

As such areas can produce very little for grazing at present, it should be easier to convince the pastoralists not to use them. When agreement is reached, the next step is to fence the area, to ensure exclusion of grazing for three to four years. The fences should be goat-proof, guarded and maintained, to be effective.

To carry out large-scale range improvement without straining the essential support of the pastoralists using it, a small proportion of their customary grazing grounds, as little as 10 per cent, should be withdrawn and fenced. In most cases, with the exception of particularly bad years, the pastoralist could graze their livestock on the remaining 90 per cent without reducing the number of their herd. Within three to four years, this 10 per cent of the area would be able to carry 30 per cent of their total livestock and this proportion would then enter the improved area. At the same time, another 10 per cent of the range would be fenced and enter the improvement process, while 70 per cent of the livestock graze on 80 per cent of the total area. After another three to four years, a further 30 per cent of the total herd would enter the second improved section and the improvement of a third 10 per cent of the range would begin, with the remaining 70 per cent of the total grazing area carrying only 40 per cent of the original herd. This remaining 70 per cent, now being more lightly grazed, would also begin to improve and by the time the next sections are fenced and excluded from grazing, they will have reached their full potential.

Direct sowing of Aristida *sp. and* Acacia tortilis *in wadi north-west of Khartoum, Sudan. Photo: author*

The first three steps contributing to the initial big improvement in a certain rangeland will take some 9 to 12 years. The most important socio-economic aspect of the suggested strategy, is that, all through this early and difficult period, the pastoralists will still use 90 per cent of their territory and will not need to reduce herd numbers, always a difficult thing for them to accept, both psychologically and physically, because their herds are their only means of existence. It should not be forgotten that many otherwise well-conceived schemes have failed due to the question of herd reduction.

Before grazing can begin in an improved area, water must be available. In the Sahel and similar areas, the practice has been to drill deep wells equipped with motor pumps for a year-round supply of water. Often this has led to severe overgrazing in the area within walking distance of the wells. Also as pumps often break down, such wells are closed down, sometimes for long periods because of maintenance difficulties.

A better practice would be to diversify the water supply. This can be achieved by digging ponds or building small earthen dams. In rolling topography it is usually not difficult to find suitable dam sites at every five to ten kilometres and in flat topography, suitable sites for ponds can easily be found at the same spacing. Where the soil is too porous, ponds or dam sites may need to be lined with a watertight membrane such as polyethylene. Plastic membranes are not too expensive and do not involve new or difficult-to-learn technologies.

The amount of water to be stored depends on the grazing area and livestock density. For instance, based on an easy walking distance of 5 km (as accepted in flat, dry areas of Australia) a watering centre would be sufficient for each 75 sq km (7,500 ha) grazing area. Assuming that a Tropical Livestock Unit (TLU) in the newly improved area would need one half hectare per month during the dry season

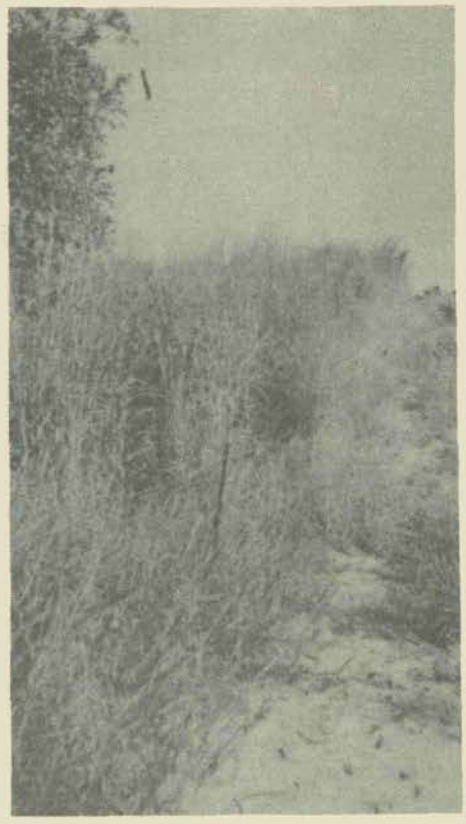
and that the animal would require about 1,000 litres (1 cu m) of water per month, 7,500 ha would accommodate 15,000 TLU months and water requirements would be 15,000 cu m.

This is quite a large concentration of livestock and when the water is used up after one month of grazing, the livestock would have to be moved to another area and the range rested. However, it would be better to construct several small ponds or dams of 1,000– 1,500 cu m capacity each on a denser grid. The principal advantages in this case would be easier construction, less livestock concentration, less walking to and from water, and better utilization of grazing land.

Each water point should be well fenced to prevent livestock from walking into the water and both polluting it and ruining the plastic lining where this is used. It would also provide the possibility of a supply of clean water for the human population. The fence should be stronger than ordinary range fences and the water point should be equipped with sufficient troughs and a simple means of relaying the water from the dam or pond to the troughs.

While nomadic herdsmen drawing water from wells with leather bags and bullock-drawn ropes may appear picturesque, this is backbreaking and time-consuming work. It can be made easier and faster by supplying hand pumps with instruction in their use. With a 1.5-inch hand pump, one man, working against a low head, can easily draw 3,000 litres of water in an hour, enough to water 100 thirsty cows. In the case of dams, it is also possible to draw water down to the watering troughs with a 50 mm siphon. However, this is not always advisable as it may lead to wastage of water.

Large numbers of livestock can also be provided with water through the use of animal power for pumping. However, the equipment required for this purpose is not easily moved from one place to another and is only practical for permanent watering points or where the improved range is to be used for sedentarization of the pastoral population.



Fence line effect. Photo: author

A sedentarization process can be envisaged even without what is commonly considered a permanent water source– a spring or well. It should be remembered that even a spring or a well can dry up in time of severe drought, whereas it is possible to store water in water-tight ponds for several years, provided that evaporation is reduced or prevented. Although this may not always be advisable as a first step, the long-term storage of surface water is entirely possible.

Most of the work of rangeland improvement can be carried out with traditional and established technology which is easy to teach and learn, and uses simple materials and equipment. Fences are built with pothole drivers, pliers and barbed wire. Digging ponds and building small dams can be done with a pick-axe and shovel, while seed can be collected and sown manually. In effect, most of the expense of range improvement is labour. While labour tends to be scarce in nomadic or purely pastoral areas, it is plentiful in cultivated zones, particularly during the enforced idleness of the long rainless season of the year. To take advantage of this, rangeland improvement projects could be started near the cultivation boundary on the edge of the pastoral zone, and gradually extended into either the pastoral zone or the non-arable soils of the cultivated zone.

It has often been said that to combat desertification and improve range productivity and utilization, it is essential to win over the pastoralists. This is a job for a multidisciplinary operation of range specialists, animal husbandry specialists, agronomists and anthropologists/sociologists. But one important and effective method of implementing it is through the establishment of demonstration projects. In general, and particularly in the case of pastoral populations, "seeing is believing".

Once such projects have been implemented and a visible improvement achieved, it is easier to bring the pastoralists to adopt this or some other more advanced range and livestock management practices. In some cases, however, more radical methods may be necessary. Even in those developed countries which practice semi-arid ranching on a large scale, it has sometimes required a great deal of research, effort, persuasion, and even coercion, to make the ranchers adopt better methods for their own ultimate good. In developing countries, as well, it may be in many cases necessary and important to use coercion for rangeland improvement.

THE DEFINITION, DIAGNOSIS AND ASSESSMENT OF DESERTIFICATION IN RELATION TO EXPERIENCE IN THE USSR

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The 1977 United Nations Conference on Desertification (UNCOD) defined desertification as the "diminution or destruction of the biological potential of the land, which can lead ultimately to desert-like conditions". The Plan of Action to Combat Desertification adopted by UNCOD refers to areas "where desertification is occurring now and others which are vulnerable to future desertification, including arid, semi-arid and sub-humid areas".

Such a definition of the substance and scope of the problem, though acceptable for the purposes of a political UN conference, is inadequate from the technical point of view, as it is not an operative definition in precise scientific terms.

First, it is not clear what "desert-like conditions" are. There are wide variations between natural deserts, with some being completely devoid of plant cover and others having fairly well-developed plant cover. Second, any degradation of a territory is understood as desertification under this definition including waterlogging of irrigated lands, construction of roads and settlements, and mining operations. Third, there is no distinction between desertification and periodic droughts. Finally, there are no clear-cut, measurable and objective criteria of desertification. Thus the adopted definition does not provide concrete and precise parameters for quantitative assessment, monitoring and control of the process.

For scientific analysis of the problem and for the elaboration of technical control measures, based on the experience of preventing and combating desertification in the USSR, it would be useful to utilize a definition which reflects more precisely the substance of the phenomenon:

> ***Desertification is a natural or man-induced process of irreversible change of soil and vegetation of dry land in the direction of aridization and diminution of biological productivity, which, in extreme cases, may lead to total destruction of biological potential and conversion of the land into desert.***

This definition is valid for both natural and man-induced processes of desertification. The terms used in the definition are themselves defined as follows:

- ***Irreversible change*** is such a change of soil or vegetation that requires either man's ameliorative interference or a very long (decades or even centuries) natural process for restoration of the initial state.
- ***Dry land*** is a territory in tropical, subtropical or warm-to-moderate arid, semi-arid or seasonal subhumid climate.
- ***Desert*** is a dryland which is almost totally devoid of vegetation and developed soil.
- ***Biological productivity*** is the annual production of biomass, expressed in ton/ha/year.
- ***Aridization of soil*** is a change of soil towards decreased ability to supply plants with available water.
- ***Aridization of vegetation*** is an increase of xerophilous species at the expense of the mesophilous community, together with general diminution of vegetation density and biological productivity.

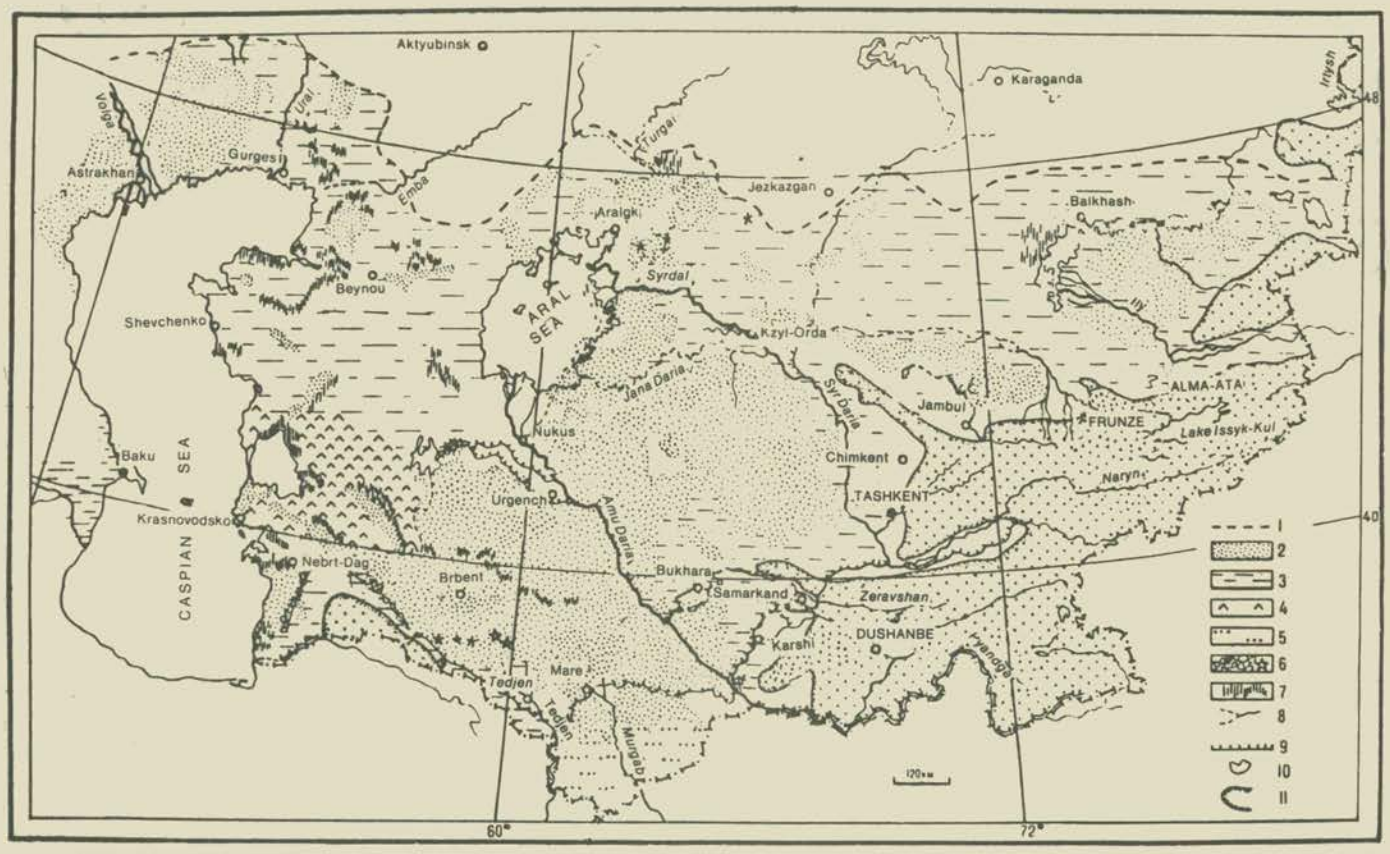
The above definition permits diagnosis of the existence and seriousness of the desertification process through the quantification of two related parameters, the aridization of vegetation and the aridization of soil. Such indicators of soil degradation as water and wind erosion, salinization, alkalinization, waterlogging under irrigation, destruction of structure, depletion of humus and nutrients– although they accompany desertification in various situations in different combinations– are not specific to it. Thus they cannot be used for its diagnosis or assessment. The decrease of biological productivity, if it is not connected with soil aridization but is a result of some temporarily acting causes (droughts, for example), cannot be considered diagnostic either.

The Diagnosis of Desertification

Like any dynamic natural process, desertification may be established and assessed only by a comparative analysis, that is, by comparison of two different states. Two substantially different methods may be used: (1) comparison of the state of the same territory at different times; (2) comparison of the state of two different territories at the same time.

With the first method, the presence of desertification may be established and its degree and rate determined, if the time interval is sufficiently long.

With the second method, the usual



SCHEMATIC MAP OF DESERTS IN CENTRAL ASIA

1-northern boundary deserts; deserts: 2-sand; 3-clay; 4-gypseous; 5-loess; 6-takyr; 7-solonchak; 8-intermittent and dry channels; 9-main canals; 10-mountain regions; 11-seas and lakes

principle of comparative geographical analysis based on the hypothesis of a correspondence or similarity between the geographical sequence of phenomena and their genetical sequence is used. In this case only the fact of desertification may be established and the degree of its manifestation in some relative units may be determined. The rate of the process cannot be determined by this method.

It is important to note that the approach developed on the basis of our initial definition and these two methods does not require an absolute knowledge of the initial state of a territory or of its 'non-desertified' state. Any two states in time or in space can be compared and evaluated in relative units by taking the ultimate state, desert, as a reference base. Such an approach has a substantial advantage because, as a rule, the data for the characteristics of the initial climatic state of a territory, particularly for the distant past, are absent or insufficient and unreliable.

One more methodologically important question is connected with the differences between natural ecosystems and agro-ecosystems. Because all natural processes, including desertification, have different qualitative and quantitative manifestations in the natural state of the landscape and the cultivated lands, the assessment of desertification should be made separately for natural ecosystems, including natural pastures, and artifically made agro-ecosystems.

Irrigated lands should be excluded from the assessment as they are not subject to desertification (unless threatened by shifting sands coming from outside) even if there is soil degradation (such as erosion, salinization, alkalinization, etc.).

The generally accepted classes of intensity (slight, moderate, severe, very severe) are apparently adequate to reflect the degrees of the desertification process existing in nature. However, the quantitative criteria for these categories cannot be the same in all the natural zones of the world. Specific quantitative criteria have to be determined for each category in each natural zone.

The assessment of the degree of aridization of vegetation in natural ecosystems, including natural pastures, may be made by the quantitative determination of (1) ratio of "climax" and invading species in plant cover composition, (2) ratio of xerophilous and mesophilous species in plant cover composition, (3) density of the plant cover, (4) biological productivity. Determination of these parameters requires special botanical investigation, methods of which are well established, including ground surveys and remote sensing techniques.

Based on detailed surveys of bioproductivity and other parameters of vegetation condition, appropriate scales of aridization or desertification can be developed for different physiographic conditions and natural zones. An example of the concrete use of the proposed approach can be seen in Table 1. The scales of state (degree,

intensity) of desertification are based on the characteristics of vegetation for different natural zones. Similar scales should be composed for each type of vegetation and plant association within each natural zone and subzone. Then the scales of desertification will be sufficiently accurate for the quantitative assessment in any particular circumstances and on a sufficiently large scale for practical purposes.

Similarly, for assessment purposes, the degree of soil aridization, as defined above, could be quantified in terms of the hydrophysical properties and the water regime of the soil both of which depend on the overall soil condition.

From the viewpoint of soil hydrology, soil aridization leading to desertification can occur in two different ways:

(i) the available moisture reserve could decline irreversibly following reduced influx or increased discharge of water, though soil properties and hydrological parameters remain the same; or
(ii) the hydrological parameters of the soil can change irreversibly as a result of its degradation, compaction, reduced depth following erosion, or decline of moisture retaining capacity, while water influx remains unchanged. Both processes will eventually result in a reduced reserve of available moisture.

The water regime of a soil taken in certain hydrological terms may be used as a criterion of the degree of soil aridization. As an example of possible classes of aridic water regimes, the following generalized scheme for the conditions of deserts and semi-deserts of the USSR may be presented:

- Xeric water regime– soil on an average is drier than at wilting point all months of a year;
- Sub-xeric water regime– soil on an average is drier than field capacity all months of a year and drier than at wilting point for 6 months or more but not the whole year;
- Sub-hygric water regime– soil on an average is drier than field capacity for more than 5 months in a year and drier than at wilting point for 1 to 5 months.

The proposed parameters of the available water supply, deficit of soil water and soil water regime, taken singly or together, may serve as reliable measurable criteria of the degree of soil aridization for the comparison of soils in both time and space.

However, it is necessary to note that their practical utilization for the assessment of the degree of desertification will require special scientific research on water regimes of soils under desertification, using a uniform programme and methodology for the development of certain grades and their quantitative parameters.

The Monitoring of Desertification

Monitoring of the desertification process requires continuous or periodic regular observations and measurements through ground surveys or the use of remote sensing techniques. To monitor desertification it would appear worthwhile to establish within the framework of the Plan of Action to Combat Desertification a wide network of observation stations based on existing research centres, experimental stations, test fields, and nature reserves, as appropriate. These monitoring stations should assume responsibility for conducting combined research on bioproductivity and soil water regimes on a regular basis.

The difficulties are more methodological than organizational. First: how, where and when should observations and measurements be made? There should be a certain diversity in this respect, related to the diversity of economic, social and technological situations in various regions and natural zones affected by desertification. Periodicity of observations and fixing of points of observation depend on the seasonal climatic factors, the character of land use, the technology of agriculture or animal husbandry, the ratio between used and unused lands, the compositon of the soil cover and the seasonal cycles of vegetation. These characteristics must be determined by appropriate research institutions selected for the purpose.

Helio (sun-driven) water pump in the Central Karakums lifting water from a well

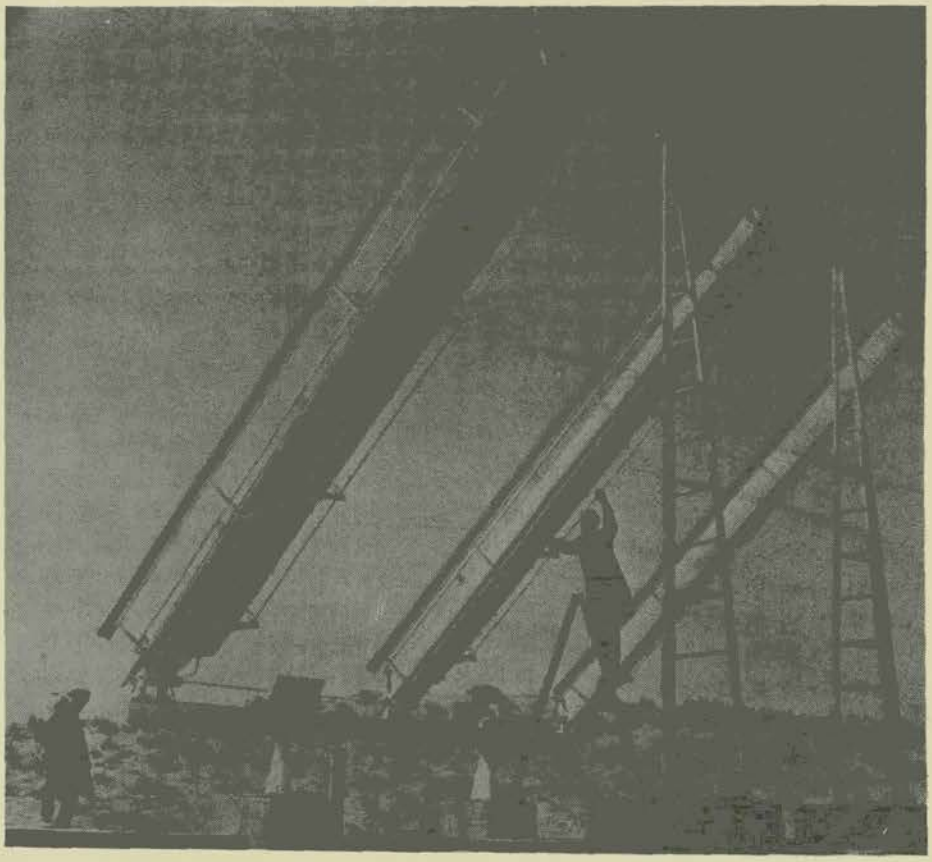


Table 1. Degree of of aridization of vegetation in natural ecosystems, including pastures, depending on the degree of desertification: 1—phytomass stock, tonnes/ha; 2—biological productivity, tonnes/ha/year; 3—plant cover, percentage

Degree of desertification[a]	Sub-boreal and sub-tropical deserts			Sub-boreal halophytic deserts[b] and semi-deserts			Dry steppes and sub-tropical semi-deserts			Forest steppes			Sub-tropical xerophytic forests and shrubs and Calligonum growths		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
None	—	—	—	—	—	—	—	—		12,5-25	4-6	50-75	25-50	6-8	50-75
Slight	—	—	—	—	—	—	5-12,5	2,5-4	25-50	5-12,5	2,5-4	25-50	12,5-25	4-6	25-50
Moderate	—	—	—	2,5-5	1-2,5	10-25	2,5-5	1-2,5	10-25	2,5-5	1-2,5	10-25	5-12,5	2,5-4	10-25
Strong	1-2,5	1	10	1-2,5	1	10	1-2,5	1	10	1-2,5	1	10	2,5-5	1-2,5	10
Very strong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

a. As defined in this paper, this term is taken for the definition of desertification.
b. In the general geographical meaning of this term.

Table 2. Desertification risk in different natural zones of the USSR, depending on land use

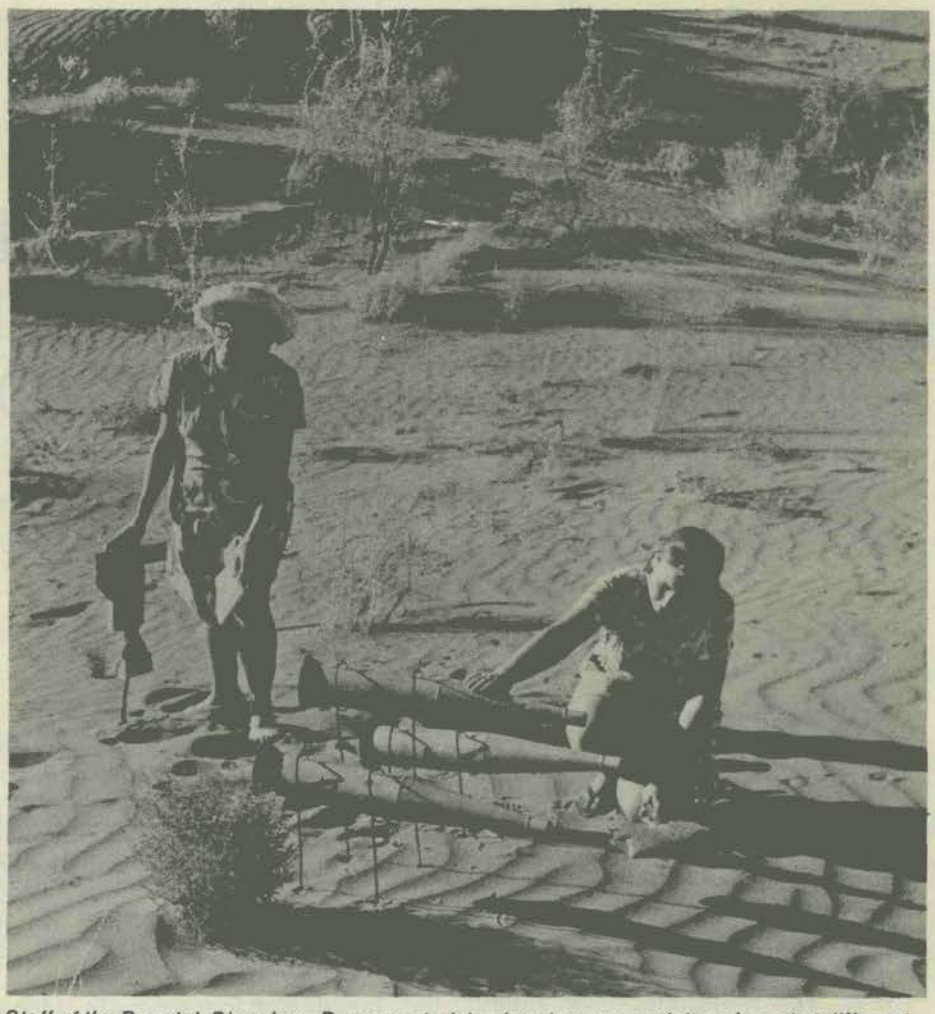
Natural zone[a]	Soil texture	Degree of risk under			
		Irrigated agriculture	Rainfed agriculture	Pastoral animal husbandry	Constructions and communications[b]
Sub-boreal and sub-tropical deserts	Light	c.	—	Very severe	Very severe
	Heavy	Very severe	—	Very severe	Very severe
Sub-boreal halophytic deserts and semi-deserts	Light	—	—	Very severe	Very severe
	Heavy	Very severe	—	Severe	Severe
Sub-tropical semi-desert	Light	—	—	Very severe	Very severe
	Heavy	Very severe	—	Severe	Severe
Sub-boreal and sub-tropical dry steppes	Light	—	—	Very severe	Very severe
	Heavy	Severe	—	Severe	Severe
Sub-boreal and sub-tropical steppes	Light	—	Severe	Severe	Severe
	Heavy	Slight	Very slight	Moderate	Slight
Sub-tropical xerophytic forests and shrubs and Calligonum growths	Light	—	—	Very severe	Moderate
	Heavy	Moderate	—	Severe	Slight

a. Excludes alluvial and oasis territories within the zone.
b. The risk of desertification of the surrounding lands is understood and not for the territories under construction or communication per se, as for the latter the concept of risk is meaningless.
c. Use of these lands for irrigated or rainfed agriculture is unlikely.

An important aspect of desertification assessment and monitoring is that of identifying the factors which ease or contribute to desertification in each particular case. In the case of desertification by natural processes, these factors may be climatic or geologic (tectonic) such as aridization of climate, uplifting of land, lowering of the water table, or geochemical accumulation of salts in closed-drainage landscapes.

In man-induced desertification processes, the factors may include deforestation, overgrazing, wrong seasonal use of rangelands, cultivation of marginal soils, use of environmentally unwise farming practices, over-exploitation of ground-water resources, changing hydrology of a particular area, mismanagement of water resources, transformation of geochemical processes, construction of communication lines, etc.

Often, desertification is the result of a number of causes, or is provoked by one cause and intensified by others. Concrete analysis of an environmental situation and of the factors involved will make it possible to find rational means of desertification prevention or control and ways of restoring the biological potential of the area. Both desertification prevention and control often require a combination of social, economic and technologically co-ordinated activities, constituting an overall plan of social and economic development for a particular territory.



Staff of the Repetek Biosphere Reserve studying break-away particles of sand at different elevations, using cylindrical sand-traps

Desertification Risk Assessment

The problem of desertification prevention is particularly significant as it is much simpler and cheaper than combating the process once it begins. An initial parameter of desertification prevention is desertification risk evaluation, including the extent of risk and the allowable limits of environmental pressure, which, if exceeded, will inevitably cause desertification. This area needs further scientific investigation. While some of the problems of desertification risk assessment are already understood, there are many others which require further in-depth study.

The concept of desertification risk may be defined as "the degree of potential development of desertification processes when the allowable limits of variation around ecological equilibrium are exceeded in the course of human activity and development". Natural desertification processes are excluded from the concept of risk.

Different types of human activity in a particular area may involve different degrees of desertification risk. For instance, in irrigated farming in subboreal steppes, and in subtropical grass savanna on loamy and clayey soils, desertification risk will be slight; in rain-fed agriculture, very slight; in livestock raising, moderate; and, in development of human settlements, and in construction of enterprises and communication lines the risk will be slight. Within the same natural zone, the levels of desertification risk will vary depending on the type of soil. Sands and loamy sands, for example, are more vulnerable than loams and clays (Table 2).

The following categories of desertification risk were used when preparing the table:

very slight—while desertification under the given type of land use is not ruled out, its probability is negligible;
slight—desertification is likely but not to a significant degree;
moderate—desertification is likely to a significant degree;
severe—desertification is unavoidable, and its degree and extent will be substantial;
very severe—desertification is unavoidable, and the degree of manifestation will be catastrophic.

Consideration of the particular degree of desertification risk is very important in working out preventive measures and devising techniques of environmental management that minimize the existing risk. It must be stressed that the suggested approach to desertification assessment and control, like other existing approaches, calls for more research and a concerted effort of research centres to resolve this very important problem.

MANAGEMENT ISSUES IN CONTROLLING NEGATIVE IMPACTS OF IRRIGATION IN THE LATIN AMERICAN ARID REGION

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Introduction

In Latin America, as in most parts of the world, primary responsibility for "desertification" (environmental degradation in arid and semi-arid regions) has been attributed to exploitation of resources resulting from economic development. Among the most commonly cited factors contributing to the degradation process is irrigated agriculture (Mabbutt *et al.*, 1981). Yet while the development and expansion of irrigated agriculture have been proceeding at a rapid pace in Latin America during the past two decades, little research has been devoted so far to its negative impacts.

Investments in irrigation infrastructure by national governments and international lending agencies have been motivated by a variety of pressures to solve or mitigate immediate economic problems. Predominant among these are the need to increase crop yields, to provide more rural employment and to raise rural incomes. Political pressures, particularly for land reform, while less often so explicit, are also addressed by irrigation schemes which open hitherto uncultivated or underutilized terrain for settlement by the landless. Yet serious doubts have been raised concerning the success of irrigation projects in alleviating such economic and political problems (see, for example, Hall, 1978). At the same time, these developments create further problems which often go unremarked, or at least unchecked.

While irrigated agriculture may be an important factor contributing to the desertification problems of Latin American drylands, few would argue that irrigation should be abandoned. Not only does irrigated agriculture have great potential for improving production and rural lifestyles, it has been practised in many areas of Latin America for millenia, with considerable stability and to the benefit of local farmers. Indigenous irrigation systems are documented from great antiquity in Peru and Mexico; in some cases, pre-Columbian canals are still in use. This does not mean that all the earlier systems were more sound than the modern ones, nor that they all successfully avoided environmental degradation or other negative impacts. Rather, it underlines the point that irrigation is an integral part of long-established agricultural practice in many arid and semi-arid areas of Latin America.

What, then, has led to the desertification processes experienced in contemporary irrigation schemes? Central to these processes is the problem of management of both resources and technology. To be sure, managerial problems arise in irrigated agriculture everywhere. It will be argued here, however, that thanks to its unique colonial and modern history, Latin America has distinctive problems of its own, which need to be understood before comparisons can be made with other world regions.

Problems Caused or Exacerbated by Irrigation

The development of irrigated agriculture necessarily entails environmental impacts both intended and unintended.

The types of negative impacts of irrigation on local environments which most concern us here are direct consequences of poorly regulated water use. A striking example is that of Venezuela's Lake Valencia region. According to Böckh (1968), "during the past two and a half centuries, the lake surface has dropped 21 meters, and its size has been reduced from 640 to 370 square kilometers"; its soluble salts rose from 785 parts per million in 1920 to 12,070 ppm in 1966. These changes were primarily the result of human use of the lake's tributaries for irrigated agriculture. At the same time, wasteful use of water has converted some of the farmland to swamps, and efforts to extend farmland have resulted in deforestation of the lake's headwaters.

Thus, typically the mismanagement of water use has multiple effects: lowering of the water table in some areas, waterlogging elsewhere; wind and water erosion; and most commonly, soil salinization. In addition, irrigation may have the effect of increasing insect populations harmful to crops, and parasites dangerous to humans, not to mention pollution of

water sources from chemical pesticides and fertilizers, though these effects lie beyond the scope of this paper. Many of the above-mentioned effects might be avoided by a shift to appropriate capital-intensive irrigation technology such as sprinklers or drip systems, but land tenure arrangements discourage such investments (Kates *et al.*, 1976).

Some of the negative impacts brought about by irrigation are indirect in cause; these are primarily related to demographic changes induced by settlement through irrigation. Often, irrigation projects result in higher concentrations of human populations, with consequent pressures on local resources other than land and water, such as forest (for firewood) and pasture. Alternatively, irrigation projects can result in population displacement, with loss of land and livelihood for already impoverished farmers and workers as in the case of Brazil's drought-prone north-east where the population was removed from the sites of dams and irrigation works without being provided adequate alternatives (Hall, 1978). Again, while technical approaches which avoid land-levelling, for example, might mitigate the need for such displacements, there are socio-economic and political barriers preventing their use (Lees, 1978a).

Finally, considerable environmental damage, particularly soil salinization and waterlogging, is the result of technical failure of the irrigation devices themselves. Installations are often faulty and badly constructed and channels for monitoring and correcting technical failures are extremely poor. Faulty and inadequate drainage facilities are among the most common and significant problems in modern irrigation systems throughout Latin America.

Background to Contemporary Irrigation Management in Latin America

The modern development of irrigated agriculture in Latin America contrasts in many important respects with that of the major irrigated zones of other third world regions, particularly East Asia and Africa. The contrasts involve matters which go beyond differences in crops, resources, environment and agricultural processes. Most specifically, they concern control and management of water use. In part, contrasts can be traced to the recent colonial histories of these different areas.

Unlike the British in India and the Sudan, the Japanese in Taiwan, or the Dutch in Java, the Spanish and Portuguese colonial governments in Latin America showed comparatively little interest in investing in either infrastructure or management of irrigation works. Local municipalities and private landowners were left largely to their own devices. Indigenous pre-colonial systems of irrigation continued in many areas with little change, though they often declined where they had been dependent for maintenance on earlier state control, as in the coastal desert valleys of Peru (Moseley, 1978).

As a consequence, the national governments of Latin America did not inherit a developed legacy of colonial irrigation management practices. In one sense, Latin America's irrigation history provided a potential for beginning with a comparatively "clean slate". However, it also meant that there was no trained cadre of irrigation management personnel for the independent states to take over, and little experience to build upon. While there has been a vast expansion in the extent of irrigated land and in the construction of hydraulic works, there has not been a concomitant development of a skilled agro-managerial bureaucracy to direct the use of the new technology.

Indigenous or "traditional" local systems of irrigation management are found in diverse regions and are extremely variable in form. One system which predominates in the indigenous communities of the Mesoamerican and Andean highlands appears to be of pre-hispanic derivation (Lees, 1973; Mitchell, 1977). Here irrigation works are often confined to a single community, whose members cultivate tiny plots of land with primarily subsistence crops. Water allocation is assigned to a locally elected or appoint-

Surface salt caused by bad drainage and waterlogging brought on by the irrigation system. Photo: D. Mason, FAO

ed official who is accountable to the community; maintenance of the works is the responsibility of all community members. Systems of this type have tended to be highly stable, probably because of their relative economic isolation, and the relatively small amounts of water they require (Downing, 1974; Mitchell, 1977).

This type of regulation applies only to community-held canal irrigation; it does not apply to exploitation of ground water. Farmers in a number of areas, particularly as they shift to new cash crops requiring higher or more frequent water application, have resorted to sinking wells. Unregulated irrigation from private wells has affected the hydrologic balance in ways that have yet to be controlled by local or higher level authorities (West, 1981).

In contrast with these indigenous systems are other municipally controlled systems of colonial and post-colonial derivation which are dominated by local land-owning elites. (See Hunt and Hunt, 1974, for a Mexican example.) Land tenure arrangements promoting share-cropping contribute to irrational and wasteful water management in these systems. This has been the case in Argentina's Mendoza oasis, where salinization, waterlogging and erosion have been experienced (Kates *et al.*, 1976).

Both types of systems become subject to external intervention by state governments during the process of technological modernization and development. When this occurs, state officials are installed and new local organizations (water-user associations, for example) are created. Previous sytems of control are, for better or worse, by-passed. The new managers are accountable not to the local community or municipality but to a state or parastatal bureaucracy. What are the consequences?

Modern Irrigation Management Problems

State government, rather than municipal irrigation control systems in Latin America, are usually introduced in three situations: with modern, state-funded technical improvements in existing "traditional" irrigation systems; with the introduction of irrigation to existing dry-farmed areas; and with colonization schemes where there was little or no previous settlement or agriculture. Impacts on local environments and human populations tend to be somewhat different in these three varying circumstances.

With technical and organizational modernization of existing irrigation systems, although there may be some practical accommodation to traditional subsistence and cultural practices, there tends to be a gradual undermining of local autonomy or self-sufficiency. Highly diverse "traditional" systems of resource exploitation (diverse crops and plant varieties, diverse water sources and techniques of cultivation) adapted to localized environmental variability tend to be replaced by more uniform systems of exploitation (dependence on a single source of water, cultivation of fewer crops using fewer techniques). Farmers become dependent upon outsiders for agricultural needs such as fertilizers, pesticides, seeds and marketing systems. Repairs, maintenance and general management of technically modern irrigation systems tend to fall outside of local cultivators' competence in terms of expertise, financial ability, and even legal domain. What happens locally becomes increasingly dependent upon external (non-local) events. Consequently, local adaptability tends to be lost, and local farmers are subject to decisions made elsewhere concerning their cultivation practices. If assistance to them from outside sources is not timely, effective, or appropriate, the potential for economic loss, waste of resources, and environmental damage is considerably heightened.

Unfortunately, there is very little scientific knowledge about indigenous or "traditional" resource management in arid and semi-arid irrigated regions in Latin America (coastal Peru is a partial exception; see, for example, West, 1981). Ethnologists and human ecologists have long argued for the necessity of taking into account locally adaptive techniques of cultivation in modernization schemes (Lees, 1980). But funding for research on this issue has been scarce, and trained technical experts have not been encouraged to engage in this sort of research (though this is not unique to Latin America). Most agronomic research is focused on expert-oriented commercial agriculture, rather than on the endangered marginal lands and their economically marginal inhabitants (Schneider, 1982). Thus, when development projects are implemented in traditionally irrigated areas, they often occur in the context of technical ignorance about both local ecology and indigenous subsistence practices. This tends to increase the likelihood of unanticipated impacts and to magnify their negative consequences.

Where modern irrigation is introduced in regions previously dry-farmed, as in new settlement schemes, lack of previous experience by both farmers and technical and managerial personnel becomes a problem. More often than not, communication between farmers and technical experts concerning on-farm water management is very poor (Lees, 1978b), so that existing knowledge is not applied.

Agricultural extension, which is critical for the success of newly introduced irrigation, suffers from weaknesses prevalent throughout much of the third world (Schneider, 1982). Institutional research is rarely linked closely with highly local problems. Trained personnel are scarce. Agents are assigned to territories far too large, with too many farmers, to oversee with reasonable effectiveness. Too large a proportion of extension service personnel time is devoted to paperwork. Finally, the types of recommendations emerging from resource management research are generally beyond the means of many indigenous farmers to apply; they are too costly and too risky for small-scale, poor farmers. Consequently, much available knowledge tends to be seen by small farmers as irrelevant or impossible to put to use. Wasteful or damaging cultivation and irrigation practices continue in part because improvements are either inaccessible or unattractive to local farmers.

In the more marginal highland zones, the problem of communication with farmers is often exacerbated by social barriers between them and technical experts. Sometimes, the experts do not speak the native language of the local population. Often, their own class and cultural expectations limit their ability to understand the actions of local cultivators and lead them to give too little credence to what they are told, and even to what they see. For example, it is easily observable that in some parts of the high Andes, most day-to-day

cultivation and herding activities are carried out by women. Nevertheless, local field agents persist in conveying information about resource management to men (because men are considered to be "heads of household"), rather than communicating directly with the persons most involved in the activities in question.

Information about what is happening in the field tends to be poorly conveyed by regional officials to central authorities (Lees, 1978b). Again, this problem is not limited to Latin America (see Wade, 1981, for an Indian example). This situation clearly inhibits the development of systematic means for responding to local technical failure and damage. Without improvement in monitoring and information flow, waste and damage are destined to continue in modern irrigation projects.

Arid zone in the western ranges of the Andes (Areguipa Province, Peru). Photo: P. Almasy, UNESCO

Technical Considerations

Virtually all the environmental problems mentioned earlier in this paper– salinization, waterlogging and so forth– are connected with difficulties in controlling conventional gravity-flow canal irrigation. While canal irrigation is among the most ancient forms of irrigated agriculture, it is far from simple, particularly in farm-level management. Indeed, it may be the most difficult form of irrigation to control. Alternative forms were available and used in antiquity in Latin America, such as "pot irrigation" from shallow wells (Kirkby, 1973) and sunken field agriculture (Moseley, 1978). Contemporary alternatives, particularly sprinkler and drip irrigation, are available but in very limited use. These contemporary alternatives offer considerable advantages over canal irrigation in terms of management, water conservation, and avoidance of damage due to over-application of water including reduction of weeds and pests, drainage problems, and erosion.

Among the most costly factors involved in the installation of modern canal irrigation facilities is the process of land leveling, which is often deemed necessary for proper distribution of the flowing water. Direct costs include such items as machinery, labour, and loss of surface soils. Indirect costs are loss of time and population displacement incurred for the purpose of land preparation. The costs to the Brazilian government of its canal irrigation schemes in the north-east are tremendous, but the costs to the local populations of this region, displaced for settlement by others, are incalculable (Hall, 1978). If alternative forms of irrigation technology had been applied in this case, the costs might not have been nearly so great.

The managerial problem of canal irrigation must be weighed against other barriers to the adoption of "non-conventional" technologies such as sprinkler and drip irrigation. The latter technologies are often termed "capital intensive". It is assumed that the farmer must bear the cost of their purchase and installation, in contrast to canal and reservoir infrastructure, the cost of which is normally underwritten by the state. While canals and reservoirs may also be "capital intensive", the question becomes, who raises the capital? A related question is, who will provide the technology, since it is rarely locally available? Is sprinkler or drip irrigation technically too complex for illiterate and uneducated farmers to use properly? These are questions that have been raised not only in Latin America but elsewhere in the world where similar water management problems occur. Scholars and policy-makers with an interest in the future of desertification control have a considerable stake in the answers.

If alternatives to conventional canal irrigation technology do not appear to be the preferred choice in the near future, then improved management of existing systems will need closer scrutiny. Current research on management is usually directed toward problems of optimal water application for specific crops, equity in allocation, and the problems of water scarcity in general. Little attention has been paid to management as a means of avoiding or reducing environmental damage. Fruitful areas of investigation would be "early warning systems" for detecting drainage and salinity problems and new types of field organization for quicker responses to problems when they are detected.

Conclusions

Much attention has been given to the management of modern irrigation in Asia and parts of Africa, but there is no parallel literature or body of research for Latin America. Clearly there are serious questions to be addressed concerning not only the effective use of land and water resources for meeting national priorities, but also the amelioration of the negative impacts of current local and regional irrigation practices. While soil degradation processes are found elsewhere, the causes of mismanagement, like their possible solutions, must be examined in the context of Latin America's own historical background.

Further research is urgently needed. Some areas suggested for consideration are:

1. What is the relationship between land tenure and on-farm irrigation? Are there clear differences between the farms cultivated by land owners, share-croppers, renters, and communal or co-operative farm members? Between large- and small-scale farmers? How could each be improved to manage water resources better?
2. What is the impact of non-regulated water exploitation, for example in various ground-water extraction systems, compared with regulated exploitation? Does the use of wells significantly alter effectiveness of regulation? Can ground-water exploitation be more effectively regulated?
3. Is the most effective technology being used? What are the alternatives to land levelling and canal infrastructure? What "non-conventional" technology is available and what are the obstacles to its use?
4. What is the environmental and economic cost of the lack of effective monitoring of environmental impact and slow response time in irrigated agriculture? How can monitoring and response time be improved, given personnel limitations?
5. What useful indigenous or traditional water management practices can be incorporated into modernized irrigation systems? What are the existing local procedures for dealing with water shortages and other hazardous conditions? Can they be protected and retained, or should they be altered?

These are issues which have been studied in some parts of the world, but need much further attention in Latin America. Regardless of the many observations that irrigation can have severely deleterious consequences for natural environments and the people who inhabit them, irrigated agriculture will continue to expand in the arid lands in the future. Research into improved management schemes should, therefore, receive the highest priority.

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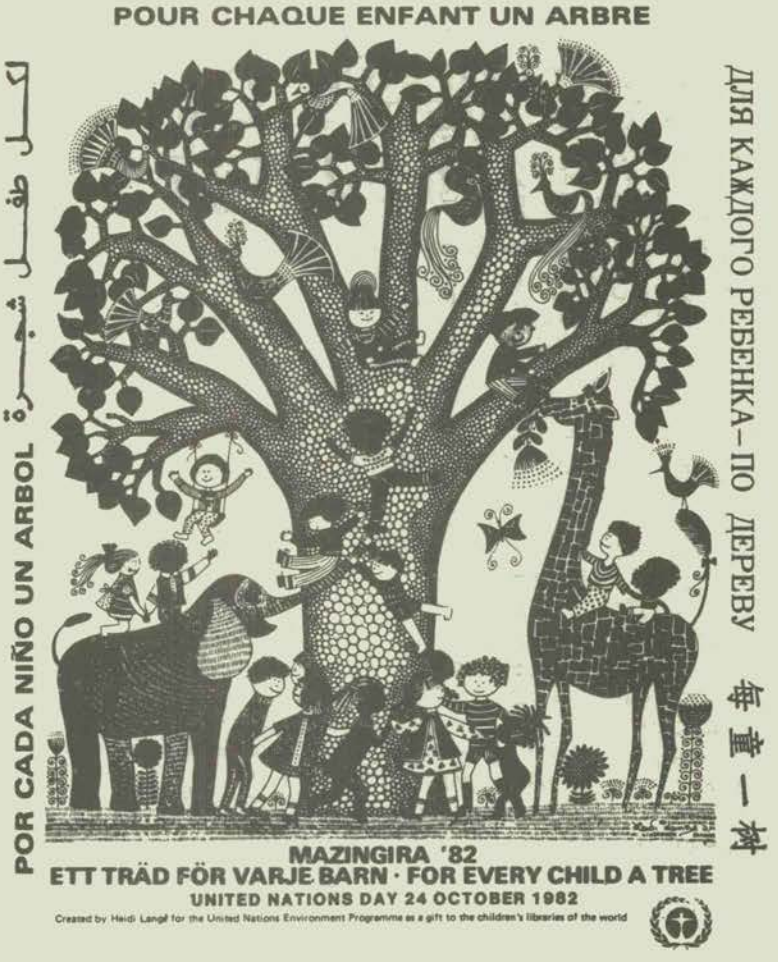
"FOR EVERY CHILD A TREE" UPDATE ON INTERNATIONAL ACTIVITIES

INTERNATIONAL RESULTS CROWN UNEP'S "FOR EVERY CHILD A TREE" PROMOTION

1. Since desertification is the end product of many ecological problems, an international information campaign to publicize the urgent need to preserve the world's dwindling forests was launched by UNEP as part of its tenth anniversary activities. The campaign, based on the objectives of UNEP's Conservation, Monitoring, Environmental Management and Desertification programmes, was designed to catalyse individual commitment, group action and national policy planning.
2. To ensure popular appeal, the Executive Director asked some of the world's most admired illustrators of children's books to create posters demonstrating the value of trees. Artists from Botswana, China, Denmark, Japan, Kenya, Mexico, Papua New Guinea, Switzerland and the USA contributed designs.
3. Eight national environmment secretariats and two NGO foundations paid for the printing of 5,000 posters each. A total of 50,000 were distributed in sets of six.
4. As a contribution to the environmental education of the young, UNESCO had dispatched posters from Paris by June 1982 to: Europe 19,800, USA 3,600, Canada 1,800, Francophone Europe and Africa 1,200, Latin America 600, Australia 2,000, UNESCO's Special Third World distribution 1,200, and within the UN system, JUNICS 360 and UNICs 330.
5. In addition, Australia, Austria, Canada, China, Denmark, France, Japan, Mexico, Papua New Guinea, Switzerland and the UK arranged for special distribution through school or library systems. The balance of the posters were mailed in response to individual library or NGO requests. Canada, Japan and Kenya requested permission to reprinted selected posters in larger quantities.

The American film star of "Roots" TV fame, Cicely Tyson, put her roots down in Kenya to inaugurate the UNEP project "For Every Child a Tree", which encouraged global tree planting during 1982 to commemorate the historic Stockholm Conference on the Human Environment, 5 June 1972. Photo: Mani Sandagar

6. NGO involvement was secured through a 12-page illustrated folio, "For Every Child a Tree", explaining the dangers of deforestation. It urged parents during 1982 to plant a birthday tree for every child. The folio was originally printed in English 10,000, French 5,000, Spanish 5,000, Arabic 3,000, Swahili 3,000 and Russian 3,000. Japanese and German editions were produced later by Japan and the Federal Republic of Germany. The folio urged children in the developed world to ask that their seedling be planted in the third world and provided a clip-out coupon for mailing a donation to the Environment Liaison Centre in Nairobi to distribute to NGOs active in green belt movements in Asia, Africa and Latin America.
7. The third component in the campaign, a book titled "Trees as a Guide to Ecology", was written as a teachers' guide in order to provide both a scientific basis and illustrative material through which to educate the young about the importance of trees. Spanish, French and English editions (42 pages) are presently being printed.
8. This campaign did not require any special funds. The major expenses such as poster printing were covered by the generosity of the artists' own governments and two NGO donors. Production design of two posters was provided by the Government of Norway. The Regional Office for Africa helped to procure the Botswana tapestry. The design of the tree folio was a gift from a Canadian art studio.



National activities to date include:

AUSTRALIA: A massive tree-planting campaign of three million trees was under way in 1982 towards the greening of Australia for the Bicentennial 1988.

CANADA: Ontario's famous "Toronto National Exhibition" featured a "For Every Child a Tree" booth which sold attractive mugs, T-shirts and buttons as a fund-raising NGO activity and provided a potential of 6 million visitors with information on forests, tree planting and acid rain. The Premier of Ontario, Bill Davis, pledged 183 million seedlings to be planted in Ontario. Video-taped messages were broadcast on a number of Canadian television stations based on six public series announcements prepared by the Canadian Foundation for World Development.

Toronto: The Survival Institute is reprinting UNEP's official tree poster designed by Jorg Müller of Switzerland as support for a desertification educational campaign.

Ottawa: The Board of Education has incorporated the planting of 10,200 trees in 54 elementary and 24 secondary school programmes.

CHINA: The fourth session of the fifth National People's Congress of China adopted a resolution to launch a nation-wide tree-planting drive, which was during the United Nations Environment Programme's tenth anniversary year (1982), in which every able-bodied Chinese citizen is to plant three to five trees every year. About 600 million people in China will join the tree-planting drive, adding 2,500 to 3,000 million trees throughout China every year.

CZECHOSLOVAKIA: An extensive youth tree-planting scheme has been developed with an external aid project ear-marked for Ethiopia.

DENMARK: The Dramatic "Bjorn Wiinblad" poster presented by Denmark to 5,000 children's libraries world-wide and reprinted specifically for the Danish schools received critical acclaim. It has now become a collector's item. In July, a film team from Denmark's National TV visited projects in many third world countries to create special 5-minute daily television shows for December's "Advent Calendar" designed to collect funds for the fight against tree and soil loss in developing countries.

The Danish children's tree planting project was incorporated into Kenya's green belt movement in September 1982. A gift of US$320,000 was presented to the Kenyan children by Ambassador H.E. Hans Jespersen. Accepting it, the President of the National Council of Women of Kenya, Prof. Wangari Maathai, promised, "Trees will be planted in schools, highways, market places and on private land."

GAMBIA: The National Library of the Gambia magazine has produced a special "Tree Planting" edition containing stories and poems about trees and their place in the environment. The special edition commemorates UNEP's tenth anniversary (1972-1982) and the "For Every Child a Tree" project.

HAITI: Double Harvest, a locally based group in Haiti, sponsored by Dutch NGOs, has developed tree nurseries to nurture suitable trees well suited to poor, dry soils, and highly resistant to pests and disease for this denuded tropical region. The Haitian Ministry of Agriculture is reportedly initiating a parallel campaign to plant 50 million fruit trees.

JAPAN: Each child born in 1972 was given a seedling on 5 June 1982. Two million trees were to be planted in Japan. The National Federation of UNESCO Associations was to open a campaign in November to raise funds for assistance to afforestation efforts in developing countries.

Japan at the session of a special character "launched a fund for a green world". Commenting on this initiative by Japan, Dr. Tolba said, "In order to prevent global desertification by the year 2000, it is estimated that 1.8 million dollars will be needed annually, which is only 0.3 per cent of the world's annual military spending, now running at 500 billion. We have the knowledge and technology. It is a question of funding."

KENYA: During the May/June 1982 planting season, more than 30,000 seedlings were planted. President Moi took the initiative in challenging Kenyans to fight soil erosion and desertification on an individual as well as a collective basis. In November, President Moi challenged the Ministry of Environment and Natural Resources to increase the production of tree seedlings to 200 million a year.

In January 1982, the famous American actress Cicely Tyson put her own roots down in Kenya by planting several seedlings in Kajiado at a Maasai school to inaugurate the "For Every Child a Tree" project of the United Nations Environment Programme.

LEBANON: A ceremony honouring old trees was held in November 1982. New trees were to be planted by primary school children.

MAURITIUS: June was a national tree planting month— 10,000 fruit trees were distributed throughout hundreds of villages of Mauritius.

NETHERLANDS: A tree planting day was held on 31 March 1982 with trees provided for villages in India and Indonesia. The green belt concept is an active NGO and aid policy of the Netherlands.

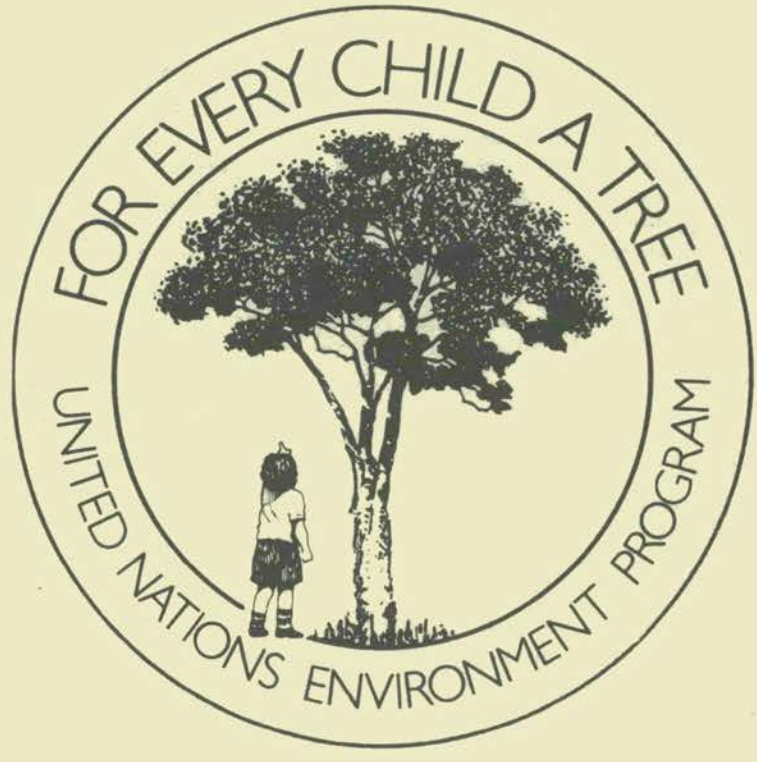
PAKISTAN: President Ziaul-Haq in his message launching Spring Tree Planting Weeks said: "What is disturbing, is that we have ignored the importance of trees in the past three decades".

THE UNITED KINGDOM: Tom King, Minister of State for the Environment, inaugurated Britain's 6-month "For Every Child a Tree" campaign with a World Environment Day tree planting ceremony on Parliament Hill, London. The Tree Council adopted the slogan "For Every Child a Tree" as the answer to what it calls "Britain's Geriatric Tree Problem". The Council has mounted a campaign to involve young people in caring for and replacing Britain's aging and depleted tree population, particularly during the country's National Tree Week, 20-28 November 1982, when it supplied thousands of tree seedlings for planting by youth organizations. A resource list of books posters and visual aid for teachers and children's librarians has been prepared and distributed. A poster and poetry competition with prizes is now under way, open to all young people in the United Kingdom.

USA: The Public Library Mobile Services of the city of Los Angeles distributed a thousand *elderica* pine seedlings, 18 inches tall, to children who registered for their summer programme adapting UNEP's tree theme to "adopt a baby tree". The programme was conducted at 30 summer bookmobile stops, in housing projects, recreation centres, shopping centres, etc. These stops, served by five bookmobiles which operated out of two headquarters locations, carried materials in five languages and had a bilingual staff. The children and parents reached by the programme were primarily black, white, Chinese, Japanese, Korean and Hispanic. Response was so overwhelming that the mobiles ran out of trees.

The seedlings were provided by the Tree People, a non-profit corporation which is attempting to get one million trees planted in Los Angeles before the 1984 Olympics. In return they obtained from each recipient a signed "confirmation card" stating that the seedling was planted.

These are just a few examples how UNEP's the "For Every Child a Tree" project has catalysed programme exchanges, both North-South and South-South, to revitalize tree planting.



GOBI DESERT: PRESERVING A UNIQUE AREA

A REPORT FROM THE
UNEP VISIT TO THE
GREAT GOBI NATIONAL PARK

In August 1982, a UNEP information mission visited the joint UNEP/ Mongolia Government project, the Great Gobi National Park, in order to see and record what has been done for preserving that territory and to relate that experience to the public. The words "Gobi Desert" usually evoke an image of enormous barren expanses of sterile land scorched by the relentless sun; the land where nothing ever grows and no living being can safely exist. While this picture is only partly realistic, scientists do agree that the ecological system of the Gobi Desert which stretches from south-eastern Mongolia to northern China is one that borders between life and death. Moreover, they warn that the balance is so delicate that a careless step or action could easily topple this balance with death finally taking the upper hand. This would mean further desertification in the region.

However, because of the Great Gobi National Park the process of desertification in Mongolia's part of the Gobi has been effectively stopped. The area is being preserved in its original state with indigenous vegetation and animal species characteristic of that part of the world.

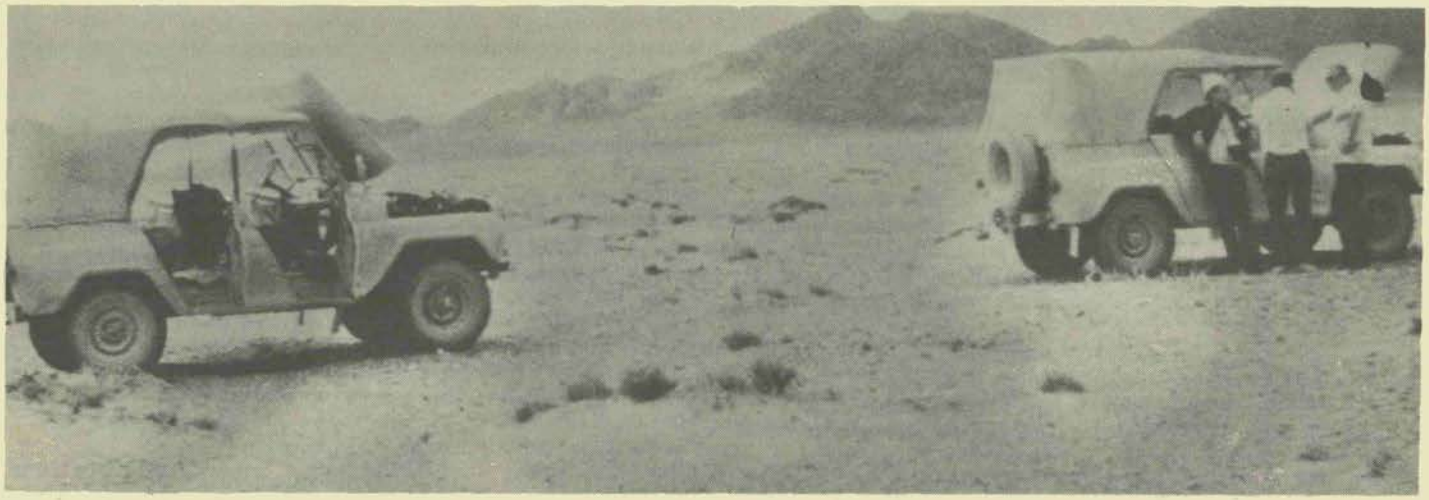
According to scientists, the Gobi Desert represents a unique territory found nowhere else in the world. It comprises large areas of extremely arid stony desert and patches of regular sand desert with and without sand dunes. Hills and mountains are common in this territory. The Gobi Desert is characterized however by uncommon flora and fauna. For instance, wild camel of which there about 700 left and the Gobi bear of which there are only about 30 exist only in the Mongolian part of the Gobi Desert. The part of the Gobi Desert situated behind the Altai mountain range is of great importance to modern science as it contains extremely rich and valuable genetic resources. It comprises all representative ecological systems characteristic of the whole region. The need to preserve such a unique territory was obvious. It was becoming clear as well, that this need was also urgent as the territory showed signs of severe strain. There was danger that the process of desertification would proceed at a quicker pace.

Even though Mongolia occupies a vast territory (around 1.5 million sq km), it was being developed very quickly and the ever-growing needs of the developing Mongolian economy would have soon begun to make claims on the Gobi Desert area. Mongolian nomadic farmers constantly drove their cattle through parts of the Gobi which were covered with vegetation, thus causing overgrazing and soil erosion. In order to put a stop to further deterioration of the Gobi Desert territory, the Mongolian Parliament issued in 1979 a decree which established a national park in that area covering about 50 thousand square kilometres.

Subsequent measures taken by the government were quite extensive and far-reaching. On more than three quarters of the Park's territory, the entire part lying beyond the Altai mountain range, any economic and farming activity including prospecting minerals and grazing cattle was completely prohibited. A joint UNEP/Mongolian Government project was launched with the following primary aims set before it:

a) to carry out complete geographical and other surveys of the territory;
b) to set up a number of monitoring, anti-desertification, educational and training programmes in the Park;
c) to come up with a master plan for further development of the Great Gobi National Park.

Once the project was inaugurated it developed quickly. The Park's boundaries were established and rangers recruited for the project were entrusted with the task of protecting the Park's territory from any activity leading to further deterioration of the area. A number of experienced Soviet



Since the desert can retain car trucks for many years, travellers must go by prescribed routes to preserve the delicate natural balance. Photo: Alain le Garsmeur

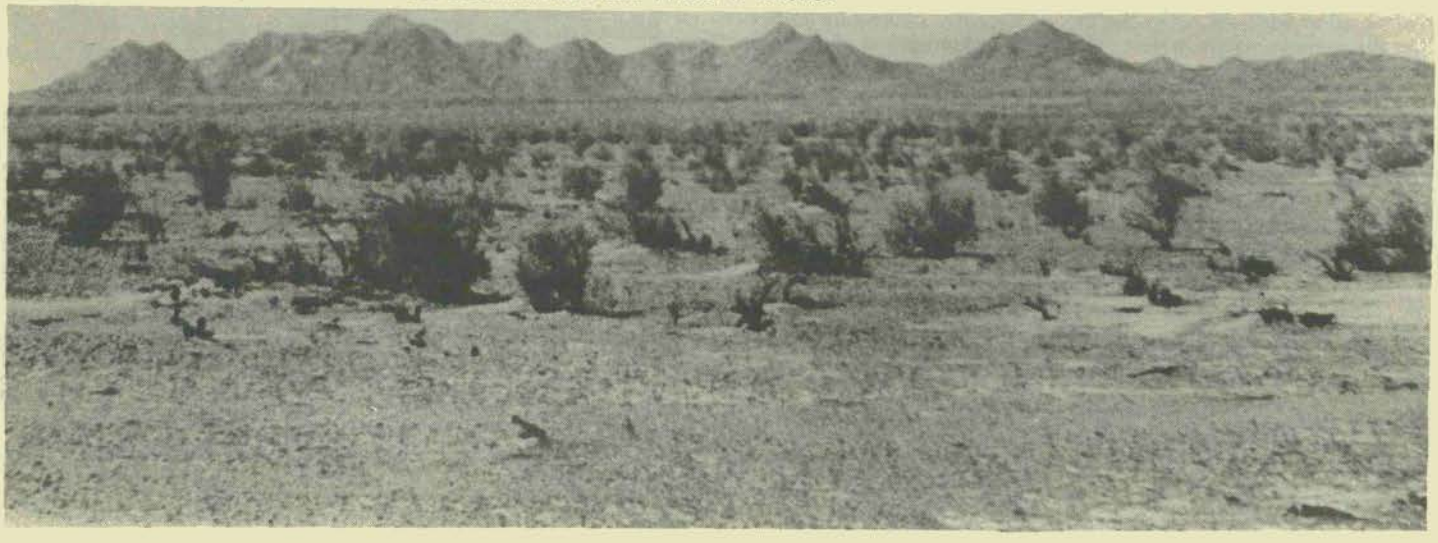
specialists in different fields of environmental science were contracted by UNEP to work on the Park's many programmes. Necessary equipment was purchased. The Park's infrastructure was established. All these measures have resulted in a near halt to the process of deterioration of the Park's territory.

The main element in the project's combat of desertification is saxaul *(Haloxylon amodendron)* which grows quite densely in most of the Gobi territory. Its roots stretch down to 40 metres in search of water, thus, providing an excellent fixator of soil. In addition saxaul offers nourishment for the Gobi's wild animals and it grows naturally requiring no special efforts by man to sow or water it. In former times, nomadic farmers used to pick saxaul in large amounts as it provides an excellent charcoal for fuel. They also grazed large numbers of cattle. Thus saxaul growth in the desert was being effectively curtailed. Without the plant, soils were left defenseless against winds and infrequent but extremely strong rainstorms. Consequently, the soils were deteriorating rapidly. When such activity is completely prohibited, saxaul grows quite freely fulfilling its important natural functions.

As was mentioned earlier, the Gobi Desert ecological system hangs in a delicate balance and any trips into the area, especially in an automobile, can upset this balance by aiding the processes of soil erosion. The Gobi Desert is able to retain traces of animals or car tracks for from 5 to 40 years, according to scientists. Any unauthorized trips into the Park are strictly prohibited. Even the Park's administration has to move within the Park by special car routes shown on the maps and cannot deviate from these routes except in cases of utmost necessity.

It can fairly be stated that the process of desertification within the Great Gobi National Park, Mongolia, has been stopped because of the joint efforts of the Mongolian Government and the United Nations Environment Programme, with the assistance of the USSR. Combating desertification is part of a much broader range of measures aimed at exploring a unqiue territory on the planet and preserving it for future generations.

Haloxylon amodendron *stands in the Great Gobi National Park. Photo: V. Voronov*



NEWS FROM UNEP

Governing Council Session of a Special Character 10-18 May 1982

The Governing Council of the United Nations Environment Programme held a session of a special character 10-18 May 1982 to commemorate the tenth anniversary of the United Nations Conference on the Human Environment (Stockholm, Sweden, 1972). The occasion marked ten years of UNEP's existence. It was designed to review the major achievements in the implementaton of the Action Plan for the Human Environment and examine future perspectives, action and international co-operation in the field of environment and major environmental trends to be addressed by UNEP over the next ten years.

The session of a special character hosted representatives from 106 nations, 12 United Nations bodies and Secretariat Units, 8 United Nations specialized agencies and 10 other intergovernmental organizations; 47 international and other non-governmental organizations were represented by observers.

The President of the Republic of Kenya, H.E. Daniel arap Moi, delivered the opening address. He spoke of the achievements of the Environment Programme and pointed out some areas of concern for the future. He noted that among other achievements, "particular studies or initiatives have been applied to the complex problems of human settlements, and the serious challenge of what is called desertification". He said there was a direct relationship between widespread poverty and environmental degradation. "In situations of acute widespread poverty, vast communities are compelled to live in a manner which destroys valuable soils, water resources, and vegetative cover— all of which are of crucial importance in the maintenance of life itself." He called upon all nations to generate the political will to address these problems effectively and to give more support to UNEP that it might better fulfil its global environmental role.

In his introductory statement, the Executive Director said that the task of the session was to give new impetus to the environment movement for the next decade. Desertification, he said, was an example of new areas of concern which had been revealed over the last decade. The general debate which followed showed that many delegations shared this view.

Environmental problems related to desertification and desertification control received particular attention from delegates. The report of the session states that the continued degradation of land and water resources resulting from very extensive deforestation, denudation of land resources, soil erosion, flooding, waterlogging and salinization, premature siltation of reservoirs and over-exploitation of ground water constituted the single most serious threat to the global environment and represented a grave danger to the well-being and indeed the survival of many developing countries.

Delegations pointed out that the growing seriousness of widespread problems, including among others, desertification, would require a "massive mobilization of resources on a global scale in the 1980s if irreversable damage to the resource base of the planet was to be avoided". Desertification and deforestation, the loss of crop lands and soil degradation were among the key areas cited by several delegations for special attention in view of the limitations on the resources available to UNEP.

In the resolution of the Governing Council at its session of a special character the expansion of world-wide efforts to combat desertification was listed as a major achievement (1, 3b (ii). Desertification Control was further listed as an important priority for future action (III 2e). Among all the environmental trends and priorities for action listed, UNEP should concentrate on, among others, the promotion of land and water management including control of desertification and deforestation (VI. 3).

United Nations Environment Programme Governing Council, Tenth Session, 20-31 May 1982

The United Nations Governing Council held its tenth session 20-31 May 1982. Represented were 55 member states of the Governing Council, 36 non-member states, 13 United Nations bodies and Secretariat Units, 7 United Nations specialized agencies, 12 intergovernmental organizations and 28 non-governmental organizations.

Under discussion of programme matters delegates heard a report from the director of United Nations Sudano-Sahelian Office (UNSO) on the conceptual framework for the implementation of the Plan of Action to Combat Desertification (PACD) in the Sudano-Sahelian zone, as well as on activities conducted in 1981. Several delegations expressed their appreciation of UNSO's work noting that lack of adequate human and financial resources continued to be the main constraint in the implementation of desertification control activities in developing countries. In further discussions there was wide acknowledgement of the seriousness of desertification as an environmental problem, and general support for UNEP's strategies and proposed areas of concentration.

The Governing Council adopted two decisions directly related to desertification control.

Decision 10/14 Section VII, *Implementation of the Plan of Action to Combat Desertification* notes the action taken by governments, UNEP and other members of the United Nations System for the implementation of PACD and urges them along with other intergovernmental bodies, non-governmental and all other organizations concerned to augment their efforts to prevent and combat desertification in order to accelerate progress in implementation of the plan.

Decision 10/18, *Implementation of the Plan of Action to Combat Desertification in the Sudano-Sahelian Region,* while welcoming the efforts made and results achieved by the United Nations Sudano-Sahelian office, and urging the office to continue these efforts, expresses its concern for both the persistence and aggravation of the desertification process in the Sudano-Sahelian region and the slowness with which PACD is being implemented. The Executive Director of UNEP is authorized to continue to contribute to UNSO and is requested to strengthen support of its programme. He is further urged to provide additional resources to facilitate a process of exchange of information and expertise among countries of the Sudano-Sahelian region and between them and the other countries of the African region which have similar problems.

Sixth Meeting of the Interagency Working Group on Desertification, 10-11 March 1982

The Sixth Meeting of the Interagency Working Group on Desertification was held on 10-11 March 1982 at FAO Headquarters in Rome. The meeting was attended by representatives of FAO, UNEP, UNDP, UNESCO, WFP, UNSO, ECA and ECWA. The following issues of co-operation among the agencies of the United Nations system were discussed at the meeting:

- follow-up on the implementation of General Assembly resolution 35/73, para 10 calling upon UNEP, in its co-ordinating and catalytic role, to institute in co-operation with organs, organizations and bodies of the UN system, specific programmes of research and training for the control of desertification at the national, regional and international levels;
- the preparation of a series of teaching and management manuals on specific topics of anti-desertification technology and management envisaged by the Plan of Action to Combat Desertification (PACD);
- follow-up on the implementation of UNEP Governing Council decision GC 9/22A, para 4 endorsing the intention of the Executive Director to submit a comprehensive report on the implementation of PACD, to the Governing Council, to enable it to make in 1984 a first general assessment of progress made in the implementation of PACD as was recommended by the United Nations Conference on Desertification (UNCOD);
- the assistance required by the Desertification Branch of UNEP from other UN agencies and bodies in implementing the above measures.

A workplan on the implementation of General Assembly resolution 35/73, para 10 prepared by the Desertification Branch was agreed upon by the member agencies. The workplan, among other things, included the preparation of studies and draft programmes of training and research and the convening of a workshop for their consideration and to explore modalities for the implementation and co-ordination of a world-wide programme of training and research.

With regard to the preparation of a series of teaching and management manuals, it was agreed that UN bodies and agencies provide UNEP with lists of their publications relevant to the recommended topics in PACD, which would serve as a base for identification of gaps and for recommending priorities and target audiences for new publications. It was also agreed that the list of manuals to be prepared on various subject areas should include a manual on desertification problems and methods of combating desertification with an emphasis on the integrated approach to it. The manual would address decision-makers in countries prone to desertification.

A summary of a workplan for the General Assessment of Progress in the Implementation of PACD made during the first seven years (1978-1984) after UNCOD was submitted and discussed at the meeting. The summary included a description of the proposed structure of the Executive Director's report to the Governing Council and an annotated listing of the various activities and documents proposed for the assessment of the current status of desertification.

The preparation of a world desertification map, as recommended by PACD, was discussed and it was agreed that a final position on this matter would be decided upon at the Experts Meeting in October 1982 under the UNEP/FAO Desertification Assessment and Mapping Project. For a regional desertification map, it was generally agreed that the Sudano-Sahelian region would be the most appropriate region for assessment of the current status and trend of desertification at the regional level. ECWA suggested that the ECWA region should be considered as an alternative or additional region to the Sudano-Sahelian region for the regional assessment. ECA proposed a case study on the Kalahari Desert.

Other points in the proposed workplan were generally supported including a review of measures taken under PACD since 1977, up-dating of some of the Background Reviews prepared for UNCOD and evaluation of the Study on Financing the Plan of Action carried out by a group of high-level experts in international financing.

Apart from the discussion on the above-mentioned items, the meeting considered a project proposal presented by ECA entitled "Regional Seminar/Workshop on Combating Desertification in Africa". The main objectives of the project were to assess the state of the implementation of PACD at the national level in the 25 African countries affected, with particular emphasis on the Kalahari Desert area; to develop from the country reports to the workshop the strategies that would enhance the national capabilities to combat desertification through the exchange of information and experiences gained elsewhere; and to ensure the participation of the affected local populations in anti-desertification programmes. Support of the project proposal was expressed by UNEP, FAO, UNESCO and WMO.

Interagency Working Group on Desertification Seventh Meeting, Geneva 13 September 1982

The Seventh Meeting of the Interagency Working Group on Desertification (IAWGD) was held on 13 September 1982 at the Palais des Nations in Geneva. The meeting was attended by representatives of the following agencies and organs of the United Nations systems: FAO, UNEP, UNDP, UNIDO, ILO, UNESCO, UNFPA, UNSO, WHO, ECA and ECWA.

Following the opening remarks, the meeting discussed follow-up measures for the implementation of General Assembly resolution 35/73, para 10 which calls upon UNEP to institute in co-operation with the entire UN system specific programmes of research and training at the national, regional and international levels. A note summarizing the previous action and making suggestions regarding the proposed workshop on the institution of specific research and training activities to be held in Paris 2-4 November 1982 was reviewed at the meeting. The Paris workshop will consider two studies prepared by UNEP– an inventory of arid-lands research and training institutions and a survey on research and training activities of the United Nations agencies, including a draft programme. The workshop will also explore modalities on the implementation and co-ordination of world-wide programmes of research and training on desertification control. It was emphasized that the workshop should consider the issue of strengthening existing research and training programmes as well.

With regard to the implementation of UNEP Governing Council Decision 9/22 para 4, which calls for a General Assessment of Progress in Implementation of the Plan of Action to Combat Desertification (PACD) in 1984, the various actions taken by the Secretariat, including the distribution of the Desertification Questionnaire were noted (see News). The meeting was informed of the distribution of the work among the United Nations agencies and the parties responsible for the preparation of the various documents. Agencies reported that the various activities for which they were responsible according to the workplan were on schedule.

The meeting reviewed the actions taken for the implementation of recommendations made at earlier meetings of IAWGD. The discussion centred around the preparation of teaching and management manuals envisaged in PACD. Several UN agencies had provided UNEP with lists of their publications relevant to the various subject areas. It was agreed that each agency comment on the nine specific topics for teaching and management manuals given in PACD and send them to UNEP.

The meeting then considered preparations of an annotated directory of international, regional and national organizations and institutions dealing with the problems of desertification and the development of arid lands as requested in the Plan of Action. Member agencies were requested to express their views on the potential audience, content and the utility of such a directory as well as on the feasibility of its preparation. It was agreed that UNESCO prepare a working paper on this issue, for consideration by the forthcoming Workshop on Research and Training.

Government Nominated Experts' Meeting on Desertification in the Americas and the Caribbean, Cocoyoc, Mexico
8-12 February 1982

The Government Nominated Experts' Meeting on Desertification in the Americas and the Caribbean was convened in Cocoyoc, Mexico on 8-12 February 1982. All the governments of the region were invited to send experts to participate in order to promote the strengthening of national, subregional and regional efforts aimed at the prevention and control of desertification. The meeting was organized by the Mexican Government in co-operation with UNEP in response to the proposal presented by the head of the Mexican delegation at the ninth session (May 1981) of the Governing Council of UNEP. The general objective of the meeting was to analyse the problems that affect the countries of the Americas and the Caribbean and to formulate recommendations for action for presentation to the Intergovernmental Regional Meeting on the Environment in Latin America and the Caribbean which would be held in Mexico City 8-12 March 1982.

In the meeting, 41 experts participated from 18 countries (Argentina, Bolivia, Brazil, Canada, Colombia, Cuba, Chile, Dominican Republic, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Peru, United States of America, Uruguay, Venezuela) and 31 observers from different national and international organizations. They made presentations describing the current problems and activities related to controlling and combating desertification in their respective countries. The important trends that could be identified in the region on the basis of the information presented in the national reports are as follows:

- Improper agricultural practices and irrational rangeland and forest exploitation have accelerated the desertification processes with the appearance of phenomena such as wind and water erosion, sedimentation, and soil salinization and alkalinization.
- The main types of governmental actions referred to were agricultural development programmes, afforestation programmes, and watershed management plans.
- Among the main problems obstructing the implementation of these actions were inappropriate land ownership systems and the lack of qualified personnel, infrastructure, environmental development studies, interinstitutional co-ordination mechanisms and national plans of action to combat desertification.
- Emphasis was placed on the methodologies used for the physical, economic and social evaluation of desertification. Some successful methods mentioned for the purpose were remote sensing, environmental impact assessment studies for development projects, inventories of natural resources, national censuses and environmental planning and management studies.
- The lack of co-operation between neighbouring countries was emphasized and the need to make a systematic analysis of regional progress in the implementation of the Plan of Action to Combat Desertification was pointed out.

The meeting heard a detailed account from the Assistant Executive Director of UNEP of the progress made in the implementation of the Plan of Action to Combat Desertification since the Nairobi Conference in 1977. He referred to the Special Account, the study on additional measures for financing PACD, the activities of the Consultative Group for Desertification Control and the Interagency Working Group on Desertification, and stressed the fact that the progress made was far from meeting the expectations at the time when such activities were formulated. During the discussion it was mentioned that the United Nations Conference on Desertification in 1977 and the Action Plan together constitute significant progress in the efforts of mankind to use arid and semi-arid land resources for the support of social and economic development.

The meeting then divided into four groups to discuss proposed recommendations under the following four headings:

- Assessment and mapping of desertification;
- Prevention and control of ecosystem degradation and desertification, with special reference to technological aspects;
- Integrated regional development;
- National policies and plans.

Under the four respective headings it was recommended:

(i) that there be a special session of experts from the Americas and the Caribbean on remote sensing of desertification and natural resources degradation;
(ii) that research on advanced technology be promoted to allow its incorporation in development plans;
(iii) that dynamic and integrated inventories of biotic, abiotic and human resources be developed so that an accurate assessment of the potential in each area may be carried out and that efforts to find and improve efficient methods for the use of the biomass could be promoted and;
(iv) that in each country an already existing governmental organization should be

given the co-ordinating role in prevention and control of desertification, that a national interinstitutional co-ordinating commission be established and that all countries that have not yet done so start formulating national plans to prevent and control the deterioration of ecosystems and desertification.

The meeting further made several general recommendations calling for, among other things, an improvement in the exchange of information on desertification issues, an increase in comprehensive environmental education and training programmes, the promotion of research programmes and pilot studies, the establishment of protected areas for the study of the functioning of different ecosystems, increased regional and subregional co-operation, the increase of support from international financial organizations, and the application of appropriate assessment techniques in the countries of the Americas and the Caribbean.

A special Desertification Symposium was held on 15 February at which six papers were delivered covering desertification problems. These were:

a) "Desertification in North Africa", A.M. Balba;
b) "Desertification in West Africa", S.U. Adu;
c) "Desertification in India. Past and Future of the Thar Desert", H. S. Mann;
d) "Assessing, Monitoring and Combating Desertification", B. G. Rosanov;
e) "World Soils Policy and Its Application in Latin America", Suárez de Castro;
f) "World Soils Policy", E.G. Hallsworth.

UNEP participation in the meeting was well received. Special acknowledgement was extended to UNEP's Executive Director at the concluding session of the Congress.

Earthscan Field Trip to Niger and Press Briefing Seminar on Desertification in Ouagadougou, Upper Volta
11-19 June 1982

Twenty-five journalists from 16 countries of Africa and Europe participated in an Earthscan field trip to Niger and a press briefing seminar on desertification in Ouagadougou, Upper Volta, 11-19 June 1982. The countries from which journalists came were : Congo, Finland, France (2), Gambia, Federal Republic of Germany, Ghana, Mali, Morocco, Netherlands, Niger (4), Senegal (2), Switzerland (2), Tanzania, USSR, United Kingdom and Upper Volta (4). The field trip and seminar helped to demonstrate to journalists the environmental problem of desertification and gave examples of what activities have been undertaken in the region for its control.

The field trip/seminar was organized by Earthscan in collaboration with the Permanent Interstate Committee for Drought Control (CILSS), the United Nations Sudano-Sahelian office and the Club du Sahel, with financial assistance from the Swedish International Development Authority. The Seminar, which was held 17-18 June 1982, was also attended by the Minister for Tourism and the Environment, Upper Volta; the Ambassadors of Canada, France, German Federal Republic, Netherlands, and the United States; and observers from UNDP, WHO, FAO, CEAO, BIRD, USAID, OXFAM, UNIC, UNESCO, FAC, CIDA (Canadian Aid Agency), ICRISAT and FED.

The field trip included meetings with Nigerian ministers and sub-prefects throughout the country. Several projects related to desertification control were visited by participants including, among others, the World Bank-funded Irrigated Eucalyptus Plantation Forestry Project at Namarde Goundgou, the USAID-funded Forestry, Land Use Planning and Range Management

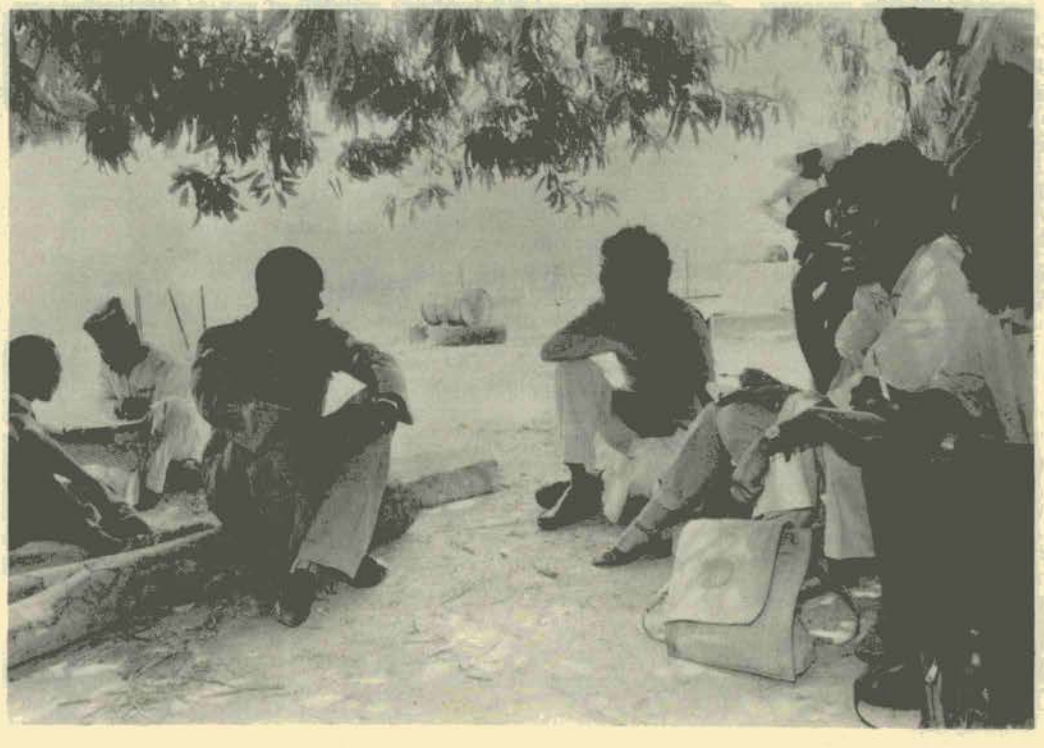
Twelfth International Congress of Soil Science
New Delhi, India
8-16 February 1982

The twelfth International Congress of Soil Science was held from 8 to 16 February in New Delhi, India. The Congress was opened by the President of India. More than 2,000 delegates attended the Congress including about 800 delegates from abroad. UNEP was represented by the Assistant Executive Director.

The transactions of the Congress have been published in six volumes:

1. Managing Soil Resources;
2. Non-Symbiotic Nitrogen Fixation and Organic Matter in the Tropics;
3. Vertisoils and Rice Soils of the Tropics;
4. Desertification and Soils Policy;
5. Whither Soil Research;
6. Abstracts (In English, French and German)

Dr. Ari Toubo Ibrahim, Minister of Rural Development in Niger, briefs journalists on the Earthscan Sahel field visit to the World Bank-funded Irrigated Eucalyptus Plantation Forestry Project at Namarde Goungou, near Niamey. Photo: Mark Edwards/Earthscan



projects, the CARE windbreak and cereal production project The field trip provided the opportunity for journalists to see first hand the activiites for desertification control in the region.

The official opening of the Press Briefing Seminar included statements from the Minister for Tourism and the Environment, Upper Volta, the Executive Secretary of CILSS and the Director, Regional Bureau of UNSO. The seminar further consisted of the presentation of four papers dealing with desertification and desertification control. Georges Bourgoignie of the Club du Sahel presented a detailed and informative account of the novel working strategies and co-operative institutional arrangements between the Club du Sahel and CILSS for the increase of food production while maintaining an ecological balance in the Sahelian region. Special emphasis was made on the continuing need for increased international financial aid to the countries of the Sahel despite the many successful efforts made to date. Larry Dash of USAID presented a concise model of the requirements of physical development of the region if the Sahel is to be food independent by the year 2000. Dr. Ibrahima Albassadjé Toure, co-ordinator of the post-graduate course in Integrated Pastoral Management in the Sahel, Dakar, presented a paper which examined some of the major problems of stock-farming in the Sahel based on observations made in the area and on the views of herders as well as managers and technicians in the pastoral sector. J. D. Keita, Regional Forestry Official for Africa, Accra, gave in his paper a general overview of the causes and consequences of the various manifestations of desertification and a discussion of afforestation as a means to combat desertification.

The field trip/seminar contributed to one of the main tasks entrusted to CILSS and the Club du Sahel, namely, to co-ordinate all Sahelian drought control activities and to sensitize the international community to this effect. It further contributed to the goals of Earthscan as a global news and information service on environmental issues.

Inter-Regional Jojoba Seminar, Khartoum, Sudan 21-28 February 1982

The first interregional seminar on the development of jojoba *(Simondsia chinensis)* as a renewable resource for the African and Arab countries was held in Khartoum, Sudan, 21-28 February, 1982. The seminar was sponsored by the government of the Sudan and UNDP. Technical support for the seminar was provided by Prof. D.M. Yermanos of the University of California, Riverside, and by Dr. M. Khairi of the Ministry of Agriculture, Khartoum, Sudan.

The response to the invitations sent by the government of the Sudan was excellent. Representatives from 30 countries came for the seminar and the number of participants throughout the seminar ranged between 50 and 100 persons. Attendance of all sessions and the field tour were excellent. The great number of questions asked and the lively discussions that followed indicated a high level of interest in the subject.

The information presented was at a high level and all aspects of jojoba cultivation were presented by the speakers including such subjects as the botany, genetics, chemistry, applications and marketing of jojoba; farming aspects of jojoba in a highly mechanized enterprise; the operation of a jojoba production project, with emphasis on small-scale, labour-intensive farming; the progress of the UNDP-UCR-sponsored jojoba project in the Sudan during the past four years; and the adaptation of jojoba in the Sudan and its vegetative propagation techniques. Several other non-scheduled speakers contributed their experiences.

Two field trips were conducted: one in El Rowakeeb and one in Erkovit. The 3-year old jojoba plot in the first site was growing satisfactorily. There was an abundance of male and female flowers. These, however, were still in sterile stage and no ovary swelling was observed to indicate that seed would be produced this coming summer.

In Erkovit, where several acres of three and a half year old plants were available, the appearance of the plants was extremely encouraging. Plant growth was comparable to that observed in the US and Mexico. Plants were profusely branching, with a great deal of new, vigorous growth and bright green colour. Several plants had seed at various stages of development, and some of them had an impressive load of seed for their age. No significant damage from pests or disease was observed. The general consensus was that the appearance of this plot left no doubt that jojoba can grow and perform satisfactorily in that region of the Sudan.

No information was provided on the use of jojoba for desertification control. This was because the problem does not exist in the area where jojoba is currently being studied. It appears that information on this subject will have to be developed in desertification-prone regions of Africa.

An exhibit of jojoba seed, oil, meal and a great number of jojoba products was presented. Literature on Jojoba including a booklet published in Arabic was made available to the participants.

Two basic conclusions from the seminar are that jojoba will grow successfully in appropriately selected locations in Africa and that a genuine, strong interest in jojoba is present in several of the countries represented in the seminar.

A few recommendations arose out of this seminar:

1. Pilot-size plantations of jojoba, similar to those established in the Sudan, should be established in countries interested in evaluating the potential of this plant under local conditions. Recommended size of plantations is 40-100 hectares.
2. Large commercial plantations should be discouraged until additional information and experience with jojoba in Africa becomes available.
3. Efforts should be made to maintain the interest in jojoba created by this seminar. It is proposed that the University of California become the liaison centre for keeping communication channels open with countries interested in jojoba. In the beginning this might be restricted to sending literature and information on developments with jojoba. Later it could include training sessions for jojoba researchers and growers, provision of planting materials and technical support for emerging jojoba projects.

An International Public Hearing, "The Human Environment: Action or Disaster", London 15-16 June 1982

An International Public Hearing on the State of the Human Environment in 1982 was held in Country Hall in London on 15-16 June 1982. Nearly 100 environmental experts were assembled by the United Nations Environment Programme to discuss in front of the press, TV cameras and radio, the state of the global environment, including problems of desertification, and to recommend what action should be taken in the next ten years.

The Hearing took the form of a debate on changes in the quality of the environment during the decade 1972-1982 and on the effectiveness of measures that have been adopted to maintain and enhance environmental quality. A wide range of topics was debated and a wide range of opinions expressed. In addition to the two keynote speakers, Dr. Russell Peterson, President of the National Audobon Society, USA, and the Rt. Hon. Michael Heseltine, Secretary of State for the Environment, United Kingdom, two sets of four speakers were selected to make brief addresses which would focus the proceedings in each of two sessions. The first day's debate centred on the issues of acid rain and problems of the atmosphere while the second day was devoted exclusively to problems of the terrestrial environment drawing particular attention to the extent and causes of soil loss, soil degradation and the process of desertification. A panel of five "judges" weighing the debate was presided over by Poland's Manfred Lachs, a member and former President of the International Court of Justice at the Hague.

Professor Mohammed Kassas of the University of Cairo and President of the International Union for Conservation of Nature and Natural Resources (IUCN) was one of the four speakers addressing the second session and led the discussion with respect to desertification. He pointed out that the land bordering the deserts comprised the life support systems of up to 700 million people world-wide. Combating desertification and other environmental problems, according to Professor Kassas, "is not a technological issue, they do not need a technological fix, because technological means are known, scientific knowledge is available to solve all these problems. The hindrance comes through lack of practical will, the wrong socio-political systems, the wrong socio-cultural attitudes."

The other three speakers included Mme. Jacqueline Ki-Zerbo, who spoke of her experiences in the combat of desertification with the Interstate Committee for Drought Control in the Sahel (CICLS). The Hon. Philip F. Leakey, Assistant Minister for Environment and Natural Resources, Kenya, and H. E. Emil Salim, Minister of State for Development Supervision and the Environment, Indonesia. Each referred to relevant national experiences and to the practical difficulties involved in checking environmental deterioration and in instituting positive measures to improve the terrestrial environment.

The event was organized by UNEP with help from the British Broadcasting Company (BBC). It was sponsored by the Japan Broadcasting Corporation, the United Nations University, the Japanese newspaper "Asahi Shimbun", the Swedish Committee for the Stockholm Conference and the World Wildlife Fund (UK). Additional financial support was provided by the World Wildlife Fund (Netherlands) and the 3 M Corporation of the United States.

The London Hearing will be a subject of a major BBC "Horizon" film entitled "State of the Planet". The production will be shown in November 1982 and will thereafter be made available for world-wide viewing. UNEP is producing a 30,000-word book on the Hearing.

Preparations for the Fourth Meeting of the Consultative Group for Desertification Control

The fourth session of the Consultative Group for Desertification Control (DESCON-4) is scheduled to be held 15-19 February 1983. DESCON was established in accordance with General Assembly resolution 32/172 of 19 December 1977, authorizing the Executive Director of UNEP to convene a Consultative Group to assist in mobilizing resources for the activities undertaken within the framework of implementing the Plan of Action to Combat Desertification.

A total of 18 high priority anti-desertification project proposals will be submitted to DESCON-4 for consideration. Out of these 18 project proposals, 11 are new and 7 are resubmissions from previous sessions; 13 projects come from Africa with 10 from the Sudano-Sahelian region, 2 from Asia and 3 from Latin America.

The Consultative Group has directed during its second session in 1980 that future projects should be based on new ideas which would consider desertification as a component within an integrated approach to socio-economic development and must also address the priority areas identified in the Administrative Committee on Co-ordination's Report to the UNEP Governing Council at its ninth session.

Eight project proposals prepared by the concerned governments with the assistance of the United Nations Environment Programme, and ten project proposals by the concerned governments with the help of United Nations Sudano-Sahelian Office were forwarded in September to all members and co-sponsors of the group. They were asked for their views and comments as well as expressions of interest in the financing of the whole or specific components of any of the projects which require external assistance for their implementation.

Additional and more detailed information on project proposals will be made available to governments and donor organizations upon request through UNEP and UNSO during the months of October and November 1982. The Desertification Branch is also preparing relevant information and working papers for the meeting for distribution to DESCON members and co-sponsors in December 1982.

General Assessment of Progress in the Implementation of the Plan of Action to Combat Desertification: Desertification Questionnaire and Other Preparations for 1984

The Plan of Action to Combat Desertification (PACD) calls for a first General Assessment of Progress in implementation of the Plan after the first seven years. The Executive Director

of UNEP in a report to the Governing Council at its ninth session expressed his intention "to prepare a comprehensive report on the implementation of PACD for submission to the Governing Council at its thirteenth session." The UNEP Governing Council in Decision 9/22A (para 4) endorsed the intention of the Executive Director and urged him to submit the report, if possible, before the target date of 1985.

To implement this decision the Desertification Branch prepared a workplan including anticipated contributions from the UN system and suggested convening an Advisory Panel to assist in the preparation for the 1984 Assessment. The workplan, subsequently elaborated by a consultant, was endorsed by the IAWGD. An Advisory Panel was formed and held its first meeting in Nairobi on 21-23 June 1982. The panel, in consultation with a consultant and members of the Desertification Branch, reviewed and decided on the workplan, the proposed contents of the Executive Director's report and the supportive studies and background documents. This documentation is depicted in a summary chart.

The Executive Director's report which will be the central document for presentation to the Governing Council as well as the two main supportive documents, the "Global Assessment of the Status of Desertification" and "Evaluation of Progress in the Implementation of Plan of Action to Combat Desertification" will draw some basic and important data and information through a questionnaire prepared in the Desertification Branch with the help of a consultant and finalized by the Advisory Panel.

A preliminary questionnaire designed to identify the main governmental and other institutions responsible for desertification control activities in each country was sent to national focal points in June 1982.

The main questionnaire has been sent by the Executive Director in September 1982 to the govenments of countries affected by desertification and to governments concerned with desertification problems. It falls in three parts: Background Information on the Drylands, Information on the State and Trend of Desertification and Progress in the Implementation of PACD. It seeks information at a standardized factual level, including information on areas potentially threatened and actually desertified, current trends, the main active desertification processes, socio-economic consequences and a wide range of related subject areas with particular attention to changes in these areas since 1977. It was recongized that for many countries, specific and quantitative data for many of the items may not be unavailable and therefore encouragement was given for the provision of more general qualitative information in such cases.

To ensure adequate responses to the questionnaire and to the compilation of data needed for the assessment, the Desertification Branch intends to send several consultants to visit countries and agencies in an endeavour to improve the quality and increase the quantity of information in response to the questionnaire.

The preparations for the 1984 General Assessment of Progress in the Implementation of PACD are proceeding according to the workplan. Most importantly, collaborative actions by the concerned UN agencies and bodies as well as regional organizations have been confirmed during the IAWGD meeting in September 1982.

Preparations for a Regional Seminar/Workshop on Combating Desertification in Africa Khartoum, Sudan 23-28 October 1982

ECA/UNSO/UNEP and ETMA are sponsoring a Regional Seminar/Workshop of Government Experts on Combating Desertification and Drought in the African region to be held in Khartoum, Sudan, 23-28 October 1982. All the countries in Africa prone to desertification are invited to participate. Participating countries will come from North African, the Sudano-Sahel, East Africa and Kalahari regions.

The main objectives of the seminar are to review progress in the implementation of the Plan of Action in the region and to foster regional and interagency co-operation. The seminar should be also of assistance in evaluating techniques which have been employed by member states in combating desertification, and in determining the effectiveness of these measures.

Using the country reports to be submitted at the seminar the participants will assess desertification control measures at the national level and the difficulties encountered by member states in implementing them. They will recommend strategies for overcoming the problems. Discussions will focus on the design of suitable environmental education programmes for affected local populations in order to improve their pastoral and agricultural practices as well as forest exploitation methods as a means of alleviating desertification hazards.

Special reports and papers to be prepared for discussion during the seminar include a special report by UNEP/UNESCO/ECA on the assessment of drought and desertification among the Kalahari region countries; a joint UNDP/UNSO paper on problems and progress on combating desertification among the Sudano-Sahelian countries; a UNEP report on desertification control activities in Africa; and an FAO paper on ecological management of arid and semi-arid rangelands in Africa.

During the workshop field trips will be arranged for participants to visit desertification control projects on reafforestation, underground water resources development, ecological management of rangelands, sand dune stablization, and utilization of solar, geothermal and wind energy to ease fuelwood demand.

Preparations for the Workshop on Research and Training, Paris 2-4 November 1982

The Plan of Action to Combat Desertification (PACD), accords high priority to training and research aimed at the development and dissemination of scientific and technical knowledge on the problems arising from desertification, on the ways and means for their control, and, where feasible, on the methods of ameliorating already desertified lands.

At its thirty-fifth session, with resolution 35/73 (para 10) on the implementation of PACD, the General Assembly called upon UNEP "in its co-ordinating and catalytic role, to institute, in co-operation with organs, organizations and bodies of the United Nations system, specific programmes of research and training at the national, regional and international levels and to invite private foundations and other grant-making institutions to co-operate financially and technically in the implementation of those programmes."

The Interagency Working Group on Desertification (IAWGD) at its sixth meeting in March 1982, considered and approved a workplan for

the implementation of G.A. resolution 35/73 (para 10) calling for, among other things, the convening of a workshop to explore modalities for implementation and co-ordination of world-wide programmes of research and training in desertification control including contributions of agencies, foundations and institutions.

In preparation for the workshop and in accordance with the workplan, two studies have been prepared by the Desertification Branch of UNEP with the help of consultants for consideration by participants of the workshop. These are entitled "Inventory of Arid Lands Research Institutions and their Sources of Financial Support" and "Review of Current Research and Training Activities for Desertification Control and Proposals for Future Programmes". The Desertification Branch has further prepared a Working Paper which reviews the recommendations of PACD and of the High Level Group of consultants with regard to programmes on research and training, surveys the latter of the two above studies, and presents the comments and views of UN agencies on both studies. The workshop will be held at UNESCO headquarters in Paris 2-4 November 1982. Representatives of the 16 UN agency and body members of IAWGD, 4 other UN bodies, 24 research and training institutions and associations of scientific organizations, 6 foundations and funding organizations, and 9 other consultants and organizations, have been invited to attend.

It is expected that participants to the workshop will identify important gaps in current research and training activities for desertification control and the ways and means of instituting programmes to fill those gaps. On the basis of the recommendations of the workshop a report will be prepared and presented to the UNEP Governing Council and the UN General Assembly.

Study on Additional Means of Financing the Plan of Action to Combat Desertification

The General Assembly resolution 36/191 of 17 December 1981 on the Study on Additional Means of Financing PACD requested the Secretary-General to obtain the views of governments on the feasibility studies and concrete recommendations for the implementation of the additional measures of financing deemed practicable by the Secretary-General and the modalities for obtaining financial resources described in the Sercretary-General's report (A/36/141). The resolution also requested the Secretary-General in co-operation with the Executive Director of UNEP, to obtain the views of governments on establishing and providing financial support for an independent corporation for financing desertification control projects. It also requested the Secretary-General to report on implementation of the resolution to the General Assembly at its thirty-seventh session. By 13 August 1982 only 11 governments had replied to the Secretary-General's *notes verbale* seeking their views on the points referred to.

Because of the limited number of replies from member states, it was not possible to prepare a comprehensive report incorporating the views of governments.

Taking account of this situation, a report prepared by the Secretariat in response to paragraph 5 of resolution 36/191 addressing these issues, suggests that the General Assembly may wish to further urge the governments to communicate their views on the above issues.

NEWS FROM UN AGENCIES

UNSO

Thus far in 1982, the United Nations Sudano-Sahelian Office has continued to assist the governments of the Sudano-Sahelian and adjacent regions, on behalf of UNEP, in implementing the Plan of Action to Combat Desertification, with emphasis on two broad fronts: a) resource mobilization for and the preparation and implementation of individual desertification control projects; and b) the formulation of national strategies for combating desertification.

The national strategies, in addition to co-ordinated sets of projects, include policies and measures to ensure that development activities, particularly in the rural areas, are environmentally sound and do not lead to increased desertification. Since the beginning of the year, UNSO assistance has commenced in Djibouti and the Gambia for the preparation of comprehensive national anti-desertification strategies. Similar assistance is being formulated for Benin, Niger, Senegal and Upper Volta and is expected to commence shortly. On a regional basis, UNSO supported and participated in a meeting at Banjul in October which reviewed, updated and reinforced the joint CILSS/UNSO regional plan for desertification control.

In the combat of deforestation, UNSO is increasingly adopting a multidisciplinary approach, on the grounds that in order to get people to carry out desertification control activities, alternative approaches which make sense to them and improve their living standards must be presented which bear in mind the constraints of the ecosystems in which they live. UNSO is assisting implementation of integrated projects in Djibouti, Mali and Upper Volta. They link pasture management, water harvesting, agricultural activites and environmental protection. Similarly, afforestation programmes to provide the countries with fuel and construction wood on an ecologically sound basis are now increasingly linked with projects involving improved, fuel-efficient stoves. Projects for the development and building of such stoves, using local materials and labour for the most part, have been initiated in the Gambia, Mali, Mauritania, Niger, Senegal and Upper Volta.

In connection with the fourth meeting of the Consultative Group for Desertificaion Control (DESCON-4), UNSO has assisted governments of the Sudano-Sahelian region in preparing ten desertification control projects, including two

regional projects: a regional programme for sand dune fixation and arresting dune formation with national components in Mauritania, Somalia and the Sudan, and a regional training programme for integrated development in pastoral regions, covering the member states of the Permanent Interstate Committee for Drought Control in the Sahel (CILSS); and eight national projects in Cape Verde, Chad, the Gambia, Mali, Mauritania, Niger, Senegal and Upper Volta. Thus, the mobilization of resources with the aid of UNSO and through the means of DESCON-4 should, if successful, benefit 12 countries of the Sudano-Sahelian region.

In addition, UNSO has been continuing its regular resource mobilization activities and has been obtaining the support of new donors as well as increased assistance from donors of longer standing. This assistance has been mobilized either through earmarked contributions to the United Nations Trust Fund for Sudano-Sahelian Activities or to the recipient countries and projects directly. Major areas of support have come from Scandinavian and Western European governments and more recently, from the Middle East and Magreb areas. In this connection, an agreement with the Arab Gulf Programme for United Nations Development Organizations (AGFUND) to assist five projects in Benin, Djibouti, the Gambia, Mauritania and Upper Volta has been obtained.

UNSO is assisting the governments of the Sudano-Sahelian region in compiling detailed and often difficult to obtain data for the Desertification Questionnaire prepared and circulated by UNEP to all countries affected by desertification for the first General Assessment of Progress in the Implementation of the Plan of Action to Combat Desertification. UNSO has undertaken responsibility for a special detailed regional assessment of the Sudano-Sahelian countries under its mandate.

WMO

WMO has continued to take various actions towards the implementation of the WMO Plan of Action to Combat Desertification. Some studies were completed by its Technical Commission and Working Groups and their reports are either ready for publication or for submission to the Technical Commissons for review and appropriate action. Other studies are still in progress.

The following reports of working groups are under publication as WMO technical notes:

(i) Meteorological factors associated with certain aspects of soil degradation and erosion.
(ii) Hydrological aspects of drought.

The following other reports are being prepared for submission to the eighth session of the Commission for Agricultural Meteorology to be held in February-March 1983:

(i) Drought probability maps.
(ii) Meteorological aspects of land management in arid and semi-arid areas with particular reference to desertification.
(iii) Impact of climatic variability on agriculture and of agricultural activities on climate.
(iv) Land-use and agricultural management systems under severe climatic conditions.

A Symposium on Meteorological Aspects of Tropical Droughts was held in December 1981. It was the first symposium on the subject. The main thrust of the presentations was towards an examination of recent advances in those branches of atmospheric science of relevance to ascertaining the physical processes resulting in drought. Some papers that were presented suggested that the outlook for predictability of longer-term scale phenomena such as droughts is encouraging and that the albedo feedback mechanism is important in semi-arid regions.

Emphasis was also given to the need for drought management through water harvesting for irrigation and for soil/water studies for use in agricultural drought evaluation. Relationships between monsoonal flow and drought were also discussed. The abstracts of the papers presented at this symposium have been published by WMO in the series of its programme of Research in Tropical Meteorology reports.

Research into the meteorology of semi-arid zones in the tropics is in progress. This research addresses the need for meteorological data in drought-prone areas and aims at discovering to what extent the large areas of subsidence in these regions are self-sustaining as a result of radiative feedback processes involving the atmosphere and the earth's surface. Pilot studies are in progress in Australia and India. Another area of research is the monitoring of the moisture budget over limited areas, including semi-arid areas, in the tropics with particular reference to agricultural needs. For this purpose, pilot studies are in progress in the Sahel and in India.

WMO has continued to participate in the activities of the Inter-Agency Working Group on Desertification and has attended both the sixth and seventh sessions in Rome and Geneva respectively. It has also participated in an expert group meeting which drew up the World Soils Policy to combat degradation of land/soil resources. WMO will present a paper entitled "Meteorological and Hydrological Aspects of Desertification" at the forthcoming ECA/UNSO/UNEP/ETMA Regional Workshop on Combating Desertification in Africa.

NEWS FROM GOVERNMENTS

NEPAL

Nepal participated in the United Nations Conference on Desertification held in Nairobi in 1977 and in line with the Plan of Action to Combat Desertification has given high priority to programmes in erosion control, soil conservation, watershed management and afforestation.

During the last three decades population pressure on limited agricultural land and the increasing need for forest products such as firewood, fodder and timber have led to nation-wide deforestation. If the present rate of encroachment on forests continues, it is estimated that remaining accessible forests could completely disappear in the next 15 years in the hills and in 25 years in the *terai*. Deforestation has caused serious ecological imbalance leading to widespread soil erosion. The problem is particularly acute in the hills. Agriculture has encroached on land unsuitable for cultivation and the removal of vegetation cover has contributed to erosion, increased flooding and the drying up of springs.

Against this background the Sixth Development Plan (1980-1985) aims to:

- rationalize the utilization of forest resources to make a maximum contribution to the national economy and to protect the environment; and to
- restore ecological balance and environmental stability through soil conservation, flood control and better land use.

In order to meet these objectives it is envisaged:

- to continue the community forestry development programmes in the hill regions, which enlist the participation of rural people to protect and manage existing forests and to plant new trees; and
- to undertake soil conservation measures particularly through integrated rural development and watershed management projects.

The allocation in the Five Year Plan to the forestry sector is $71.4 million. Among bilateral donors, Australia, Canada, the Federal Republic of Germany, Switzerland, the United States of America and the United Kingdom have major programmes in these areas. The USA started a major resource conservation and utilization programme, which, *inter alia*, assists reforestation in the Gorkha, Mustang and Myagdi districts. The Asian Development Bank is assisting in the Sagarnath forestry development project as is the World Bank through an IDA credit in the community forestry development project, for which UNDP through FAO is providing technical assistance.

In the past UNDP and FAO have provided technical assistance to several aspects of forestry including erosion control and watershed management and this is continuing under the Third Country Plan Programmes. The following projects are of particular interest:

—*Watershed Management and Land Use Development Project* was started in 1977 and completed in December 1980. The purpose of the project was to strengthen the Department of Soil and Water Conservation, particularly its planning and implementation capacity, and to carry out demonstration activities in the Phewa Tal watershed. A second phase, *Watershed Management and Conservation Education*, started in January 1981. A smaller project to protect the important *Shivapur Watershed* is planned to start in mid 1982.

In order to replant and conserve depleted forests, particularly in the hills, *The Community Forestry Development Project* was started under preparatory assistance in 1979. The main phase became operational in July 1980. The project covers the first five years of a proposed 20-year programme and seeks to enlist the participation of local people in establishing nurseries and planting and managing community forests in 340 villages. During the initial five years of operations it is planned to plant 52,000 hectares.

Afforestation and soil conservation are also important components of the Integrated Rural Development Programme (IRDP). The primary aim of the programme is to maintain a balance between population and environment by preserving and developing natural resources through soil conservation and agricultural and forestry development. Within the framework of this programme UNDP is providing technical assistance for *Integrated Rural Development in Rasuwa and Muwakot* which started in 1977 and *Integrated Rural Development in Mahakali Hills*, which became operational in 1980.

SENEGAL

In the south-western corner of Senegal, work is being done to stabilize the sand dunes along the Great Coast, which stretches for nearly 200 kilometres between Cape Verde and St. Louis, the capital of Senegal before independence. In 1973 the Government of Senegal requested assistance from the United Nations Development Programme to initiate a project for stabilizing the dunes. The zone selected was that of Lompoul, halfway between Dakar and St. Louis. The seven-year project got under way in 1975.

The project has established tree nurseries. Mostly eucalyptus and acacia were used as they grow well in sandy terrain and their leaves enrich the soil and provide fodder. Before trees are planted in the shifting dunes, synthetic fibres are laid over the dunes between short wooden stakes. They are laid in a criss-cross fashion across the sand to stop it from shifting so that the young trees can take root.

The main purpose of the sand fixation project is to prevent the sand from encroaching on what are called "niayes" or depressions between sand dunes that have a very high water table where the local population cultivate market garden products such as cabbages, potatoes, carrots and onions. The heavy demand for firewood and fodder by the surrounding villages had destroyed the plant cover. The result was that the sand was burying the niayes, which were being abandoned by the migrating population.

Plantations that were started as recently as 1981 already have reached a height of more than two metres, their roots seeking out the humidity and rich soil lying below the sand dunes. Lands planted in 1976 now contribute to 12 miles of eucalyputus stands along the coast. They act as a windbreak and have saved some of the most endangered niayes. The success of the

GOVERNMENTS

Lompoul project proves that it is possible and feasible to save fertile lands from the encroachment of desert.

INDIA

The problems of deforestation were highlighted at the UNEP Regional Workshop on Environmental Management in the Pulp and Paper Industry held in New Delhi. In the opening statement delivered on 17 February 1982 by Mr. C. P. N. Singh, India's Minister of State for Environment and Ocean Development, it was stated that the Indian paper industry's increased need of pulpwood was causing extensive deforestation by the consumption of nearly one third of the country's forest produce. Deforestation, he said, is threatening the ecological balance and the life-support systems upon which the population of countries like India depend for survival.

Delegates were informed that the Indian Government had taken up tree-planting programmes on a priority basis and its efforts were being supplemented on a voluntary basis by social and protective forestry movements. The paper industry in India was called upon to participate in the movement for expanding forested areas in order to ensure adequate raw materials for their ever-increasing requirements.

Other measures which are taken by some developed countries should be implemented such as the recycling of paper. This would help meet the paper industry's requirements for wood pulp and decrease pressure on forest resources. Efforts should also be made to use indigenous raw materials like agro-wastes, rice straw, sabai grass, bagasse and water hyacinth. As long as the paper industry continued to eat into forest produce without a corresponding increase in forest stock, deforestation would continue to be a major problem facing the people of India.

UNION OF SOVIET SOCIALIST REPUBLICS

The Institute of Desert affiliated with the Academy of Sciences of Turkmenia, a Soviet constituent republic in Central Asia, has drawn up detailed maps of rangelands in the Kara-Kum Desert which are now being extensively used by herdsmen. The maps, compiled with the help of meteorologists, also show the rangelands' productivity for the current year. They indicate places where the pastures can be expected to be rich with vegetation and where they will probably be poorer than usual. Such maps, complete with productivity forecasts, make it possible to set up a system of control over desert rangelands. Proper and effective control over the rangelands' productivity and their rational utilization will not only help prevent them from being buried under the encroaching sand dunes but also increase sheep population in the region.

BOOK REVIEWS

DESERTIFICATION IN THE UNITED STATES: STATUS AND ISSUES, April 1982

J. Eleonora Sabadell, Edward M. Risley, Harold T. Jorgenson, Becky S. Thornton for Bureau of Land Management, Department of the Interior, USA. 122 pp plus 154 pp appendices

Desertification in the United States: Status and Issues provides a holistic overview of the trends in land quality changes brought about principally by human intervention in the United States dry domain. Following the United Nations Conference on Desertification in 1977, during which conferees agreed to the need for National Plans of Action to Combat Desertification, the United States determined that several constructive purposes could be served by the preparation of an overview document dealing with desertification in the US. The result is the above report, "a one-time survey and assessment of important on-going physical and social events which are affecting the quality of land resources in the extensive water-deficient areas of the western states".

The report deals comprehensively with all aspects of desertification in the 19 central and western states, drawing upon a large and detailed resource base from a variety of authoritative sources. A great many governmental, professional, trade and academic organizations and institutions as well as elements of the private sector contributed to the report. All the material used in the report existed prior to its drafting but was not aggregated into one volume for purposes of desertification assessment.

After dealing with the natural background and historical perspective of desertification, the report presents data on desertification processes and manifestations. This information comes under three headings : Biological Resources; Soils; and Water. A great many maps, charts and diagrams here and throughout the report help present the information. Further sections deal with the Dynamics of Desertification; Inventorying, Monitoring and Trend Determination; Conservation Programmes and Practices; and Research Needs and Available Capabilities.

Despite the wealth of information, one of the principal findings of the report is that "it has not been possible to precisely measure, map or categorize relative degrees of desertification in the regions of the United States". The report goes on to state, however, that the tools for accomplishing an overall inventory and subsequent periodic monitoring of desertification do exist and are identified.

The report also points out that as a more developed country with a governmentally subsidized research system, the United States has a much greater capacity for studying problems as they arise than do less developed countries which lack established research and monitoring capabilities or an accumulated data base for the purpose of identifying trends. The report recognizes other differences with regard to desertification problems between developed and less developed countries. While the US arid lands have increased in population, they do not have the history of overpopulation which in other countries has led to increased pressure on natural resources. The problem of land denudation for firewood, for example, is not a factor in the western United States. Cultural differences also make regulatory control of livestock population much easier in the States than in some other countries where such action is precluded by cultural status attachment or religious beliefs.

Nevertheless, the report adds that in a world of growing interdependence, it becomes increasingly important to provide sound land management to achieve better and sustained productivity on a world-wide basis. Co-operative activities are therefore of great importance to the United States, especially as "the global supply and demand for food, forage and timber may determine the acreage of the U.S. lands under agriculture".

As stated in the report, there are three compelling reasons for carrying out national assessments of the status of desertification. These are : "(1) Greater scientific understanding; (2) Increased public awareness; and (3) The ability and will to take responsible action". *Desertification In the United States: Status and Issues* serves as a valuable example of what can be achieved towards a comprehensive assessment of the state and rate of desertification and takes a major step towards generating the public awareness and political will to take action on its findings.

COMBATING DESERTIFICATION IN CHINA

James Walls

A report on a seminar sponsored by the Academy of Sciences of the People's Republic of China and the United Nations Environment Programme; UNEP, Nairobi, 1982, 70 pp. illus.

The United Nations Environment Programme, in co-operation with the Academy of Sciences of the People's Republic of China, sponsored two sets of training courses, one in 1978, and the other in 1981. In accordance with the UNEP/China project agreement the lectures delivered and the field studies conducted during the first training course in 1978 have been published to enable skilled technicians from developing countries who had not attended the course to benefit from China's experiences in combating desertification.

The fruits of this exchange are now available in one volume entitled *Combating Desertification in China* for the use of the rest of the world's growing number of specialists and technicians who are dealing with the pressing issues of desertification control. The volume includes a summary view of China's experience in controlling shifting sand plus the texts of five lectures delivered to the training course participants on various subjects including monitoring of desertification; utilization of surface-water resources; stabilization of sand dunes; creation of shelter belts; and the utilization and improvement of pasture. In addition the volume describes the seminar itself and includes the participants' reports on the seminar which point out what they felt were particular strengths or weaknesses in the programme.

Combating Desertification in China provides an important example of international co-operation. The experience of the People's Republic of China in combating desertification, gained over 20 years, had contributed to a number of significant results. Chinese scientists felt they had something to show and 18 scientists from 8 countries in the developing world felt they could benefit from that experience. The seminar was held over a 30-day period and was conducted in three stages– the theoretical or technical lectures including the five presented in the book; the field trip which took participants more than 6,200 km to view Chinese projects in action; and a review of the seminar which allowed participants to reflect on their experience and share with each other their conclusions. Because of the participants' own experience in combating desertificaiton in their countries, meaningful and productive discussions developed between themselves and with the seminar organizers with each gaining from the experience of the others.

In addition to being a testament to the benefits inherent in international co-operation among less developed countries, this volume is also a detailed account of techniques and methods of proven value for the control of desertificaton. For this reason the book should be of interest to those concerned with the technical aspects of desertification control. Each technique is described in detail and related to a particular problem encountered by the Chinese. For example, the techniques of shelter belt construction under different wind and sand movement conditions with reference to a variety of needs are described, and a selection of species for stabilizing sand dunes in semi-arid regions is provided. Complete with photographs the book comes close to being a manual on the control of desertification.

The reader benefits finally from a candid presentation of summaries of the participants' evaluations of the course. These, while pointing out some faults of an organizational nature, all testify to the enriching experience had by all. The value of the experience, they said, was derived from placing in close contact to one another and with the Chinese a group of skilled and experienced people in the field of desertification control. In a friendly and relaxed atmosphere these scientists were for a full month engaged in serious discussions on a most challenging environmental problem. The book *Combating Desertification in China* provides both an example of the benefits to international co-operation and a detailed account of specific measures for the control of desertification.

PHOTOGRAPHS FOR DESERTIFICATION CONTROL COVERS

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

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

Technical Requirements

Photographs must be colour transparencies of subjects related directly to desertification: deserts, process of desertification, lands, animals, human beings, structures affected by desertification, control of desertification, reclamation of desertified lands, etc. Submissions must be of high quality to be enlarged to accommodate a 30 x 42 cm (12 x 171/2 in) format.

Captions

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

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DESERTIFICATION CONTROL

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

Desertification Control

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

Audience

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

Language

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

Manuscript preparation

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

Metric system

All measurements should be in the metric system.

Tables

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

Illustrations

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

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

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

Footnotes and references

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

Other requirements

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

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

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