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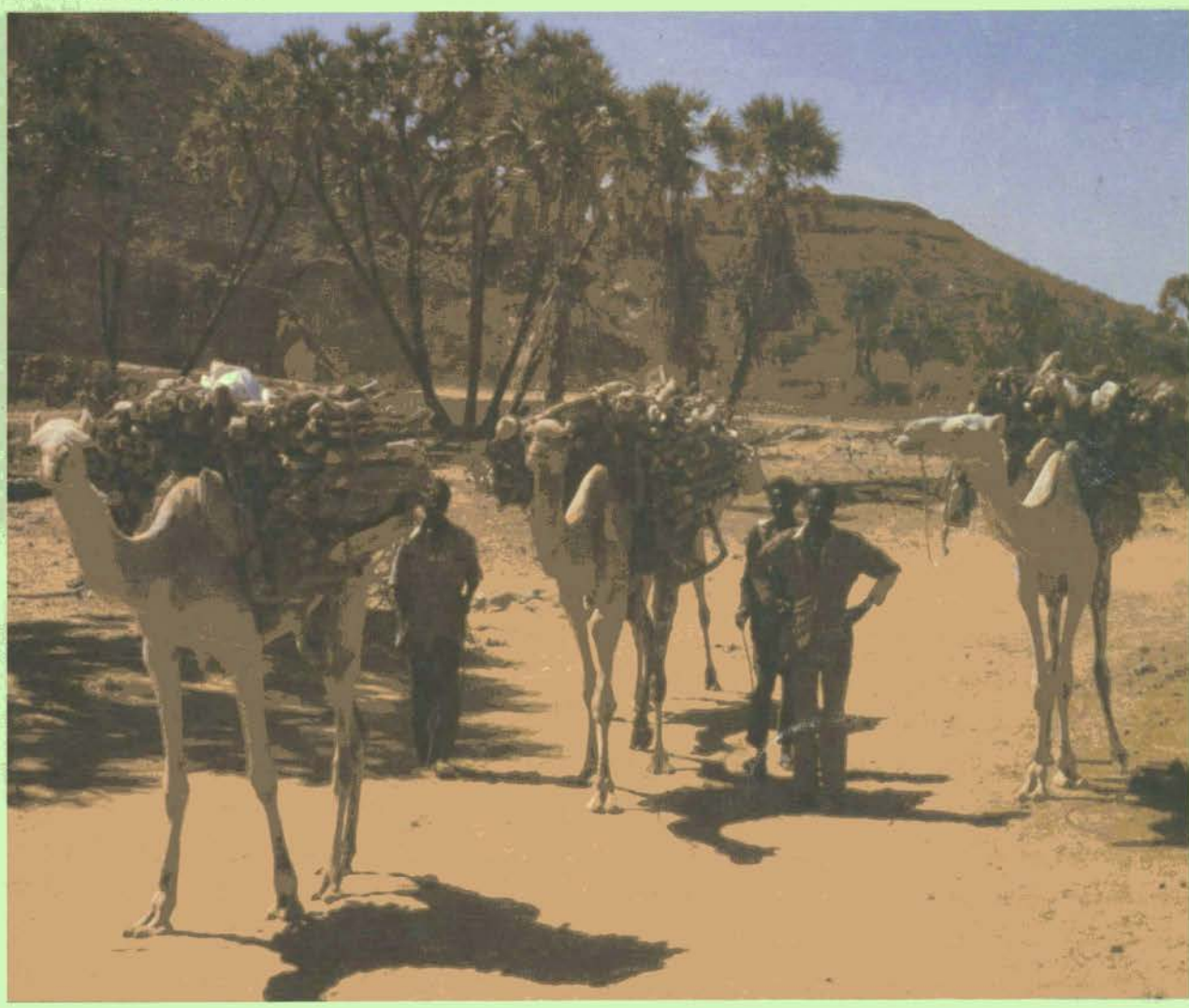

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Photo: Joran Fries. Sweden

In the Sudano-Sahel region, crop failures often occur in dry years so farmers store surplus crops from good years. The small hut-like structures are granaries.

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Cover: Harvesting fuelwood for the cities causes devastation of forests. Photo: Joran Fries. Sweden.

The United Nations Conference on Desertification (UNCOD) was held in Nairobi from 29 August to 9 September 1977. This was the first worldwide effort initiated to consider the global problem and responsibilities posed by the spreading menace of desertification. Ninety-five States, 50 United Nations offices and bodies, 8 intergovernmental organisations and 65 non-governmental organisations participated. The United Nations Conference on Desertification prepared and adopted a worldwide Plan of Action to Combat Desertification (PACD) with 28 specific recommendations. The PACD was approved by the United Nations General Assembly at its 27th session on 19 December 1977.

Recommendation 23 of the PACD 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 coordinating the implementation of the PACD to the United Nations Environment Programme (UNEP) with its Governing Council (GC) and Administrative Committee on Coordination (ACC).

Immediately after approval of the PACD, the Desertification Unit was established within UNEP to assist the Executive Director and ACC in carrying out their tasks to implement it.

In 1985 the Desertification Control Programme Activity Centre (DC/PAC) was created on the basis of the Desertification Unit by UNEP's Executive Director with approval from the Governing Council. In 1995 DC/PAC broadened its base of activities to become the Dryland Ecosystems and Desertification Control PAC (DEDC/PAC). DEDC/PAC is a semi-autonomous office with increased flexibility to respond to the demands of following up and implementing the PACD.

One of the main functions required by the PACD from the Desertification Unit is to prepare, compile, edit and publish at six-monthly intervals a bulletin to disseminate information on, and knowledge of, desertification problems and to present news on the programmes, activities and achievements in the implementation of the PACD around the world. Articles published in *Desertification Control Bulletin* do not imply expression of any opinion on the part of UNEP concerning the legal status of any country, territory, city or area, or its authorities, or concerning the delimitation of its frontiers or boundaries.

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Cover photographs

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

Technical requirements

Photographs must be colour transparencies of subjects related directly to desertification, land, animals, human beings, structures affected by desertification, control of desertification, reclamation of desertified lands, etc. Submissions must be of high quality to be enlarged to accommodate a square 18 cm x 18 cm (8 in x 8 in).

Captions

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

Copyright

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Articles

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

Audiencez

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 and Spanish. All manuscripts for publication must be in English.

Manuscript preparation

Manuscripts should be clearly typewritten with double spacing and wide margins, on one side of the page only. The title of the manuscript, with the author's name and address, should be given in the upper half of the first page and the number of words in the main text should appear in the upper right corner. Subsequent pages should have only the author's name in the upper right hand corner. Users of word-processors are welcome to submit their articles on diskette in MS-DOS format, indicating the programme used.

Metric system

All measurements should be in the metric system.

Tables

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

Illustrations and photographs

Line drawings 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 cm x 24 cm (8 in x 10 in) on glossy paper are essential. Dia-positive slides of high quality may be accepted; however, their quality when printed black and white in the bulletin cannot be guaranteed.

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

Footnotes and references

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

Other requirements

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

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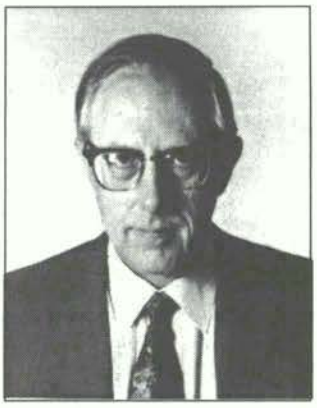


The Convention is in Force

The Convention to Combat Desertification came into force on 26 December 1996.

This international treaty was requested by the United Nations Conference on Environment and Development at Rio de Janeiro in 1992, and is one of the major international achievements of the post-Rio period. Unfortunately, there is still inadequate awareness of this achievement and of the need for increased action in the field to support and implement it.

The Convention is a major tribute to the government delegations who worked tirelessly during the two years of negotiations under the able and distinguished chairmanship of Ambassador Bo Kjellen. It is also a tribute to the dedication and determination of Ambassador Arba Hama Diallo, Executive Secretary of the Intergovernmental Negotiating Committee (INCD) and his distinguished and capable staff. All who participated, including many from UNEP, can and do take pride in this accomplishment.

This is all very well, but so what? and now what? One may ask. After all, it is 20 years since the United Nations Conference on Desertification in Nairobi prepared the United Nations Plan of Action to Combat Desertification. This led to the preparation of over thirty national action plans, and a series of variably successful projects but there was never sufficient political or financial support for implementation of the Plan per se. If the record of the 15 years before Rio is less than impressive, why should this new convention make any difference? What progress has been made and what can be expected now?

In fact there has been much progress:

- There is now an agreed definition of what desertification really is. So it is now possible to assemble a reliable and consistent database.
- There is increasing political recognition of desertification as an issue which has to be addressed.
- There is a growing concern about food security, the loss of arable land and about the increasing populations of the world, especially in the dryland countries.
- There is an increased concern about poverty issues and about the needs of women.
- There is a new political climate of openness in most countries;
- There is a move towards much greater recognition of the rights and needs of the rural poor and of their importance in the social, political and economic structure of the state.
- There is new recognition that the problem of desertification is not only one of physical deterioration of the soil and vegetation but is also fundamentally a social problem; that is to say, the loss of livelihood being faced by one billion people in the rural dryland areas who are economically dependent on agriculture (and the degrading soil) for their survival.
- There is recognition that desertification is not only a problem in Africa but one that affects all continents.
- Now there is a convention in force which lays out new measures to be undertaken by governments of affected countries and by those in a position to help.
- There are regional annexes to this convention which specifically address the needs of Latin America, Africa, Asia and the Northern Mediterranean.
- There is also a General Assembly resolution which was passed in 1994 calling for Urgent Action for Africa.
- There is greatly increased involvement of international, national and local non-governmental organizations (NGOs).
- There is widespread recognition that community participation is essential for success in environmental sustainable development of the drylands.
- There is increasing awareness of successes in controlling land degradation. UNEP has evaluated and reported on 10 such cases in the last two years and there is an increasing case load of sustainable practice.
- There is an increasing flow of private investment to the developing countries.

However, there is less public money available from the richer countries for development, and there is as great an urgency as ever to find effective ways of utilizing the money that is available for support to sustainable development.

Recognizing the importance of adequate funding, the convention will establish a new global mechanism to help identify sources of funds and promote the mobilization and channelling of funds, but the exact nature of this mechanism still has to be determined by the Conference of the Parties.

In September 1996 Chad became the fiftieth country to ratify the Convention, triggering a statutory 90 day period after which the Convention came into force. There is a further statutory period of a year within which the first Conference of the Parties (COP)

has to be held. This will be held in Rome, 29 September to 10 October 1997. Those governments that have ratified the Convention will participate as Parties and it is hoped that many more will have ratified by that time.

But there is still work to be done in preparation for that meeting. The agenda of the 10th meeting of the INCD (January 1997 in New York) will address many of the key issues such as the nature of the global mechanism and what organization will host it. Other issues that have to be decided by the COP include the decision on the location of the Permanent Secretariat (Bonn, Montreal and Murcia have made offers); and the scope and size of the Permanent Secretariat.

Is all this making any difference in the field? Is desertification being reduced by people having meetings in New York and Geneva? Not directly, no. But there is much more recognition of the problem now than five years ago. There is much more activity in the field, especially by NGOs and many more appropriate actions are being supported by donors than in the past.

What good does a convention do for ordinary people? One advantage is that they can ask their governments "Well now you have ratified this convention, what are you actually doing about implementing it?". Another is that it has focussed international attention on the issue in such a way that all participants now recognize the importance of the rural landholders' involvement in the process of improvement.

What has to be done now to make progress? The Convention calls for the preparation of national action programmes (NAP) in all affected countries based on a truly participative and "bottom-up" approach. Many of these are now well under way with varying degrees of participation and support.

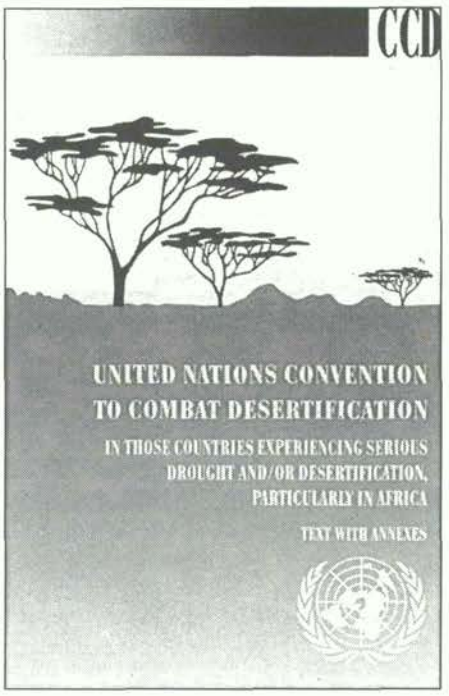
While past assessments of desertification have focused on the global picture and the physical parameters, future work will be much more integrated and focus more on indicators of progress at field level; on people issues.

A significant initiative in the Convention is to get consultative groups established at the national level where different government ministries, the interested donors and NGOs could gather and agree to support the NAP and also agree on who would do what and what approaches would be taken across the board. Early attempts at launching these have been made but as yet without notable success. The establishment of these cooperative arrangements is one of the keys to the successful implementation of the Convention.

It is to be hoped that by the first COP in October the national mechanisms will be in place so as to support real action in implementing this Convention on the ground, literally at the grassroots level.

W. Franklin. G. Cardy, *Executive Coordinator,*
Natural Resources and Director, Land
UNEP

Summary of the ninth session of the INC for the Convention to Combat Desertification[1]



3-13 September 1996

The Intergovernmental Negotiating Committee for the Convention to Combat Desertification (INCD) met for its ninth session at United Nations Headquarters in New York, from 3 to 13 September 1996. The INCD is currently functioning during the interim period between the conclusion of the Convention and its entry into force, and is preparing for the first Conference of the Parties (COP-1).

During the session, delegates reviewed the status of ratification, the situation as regards extrabudgetary funds, and the implementation of the resolution on Urgent Action for Africa, as well as interim measures in other regions. The working groups continued to prepare for COP-1, which is expected to be held in September or October 1997. In the working groups, delegates addressed outstanding issues relating to arrangements regarding the Global Mechanism, the designation of a Permanent Secretariat, scientific and technical cooperation, rules of procedure, financial rules, and communication of information. The general impression given by delegates was that good progress was made, especially concerning scientific and technological cooperation, even though several of the most important, primarily financial, issues remain unresolved.

A Brief History of the INCD

Desertification affects about one-sixth of the world's population, 70 per cent of all drylands and one-quarter of the total land area in the world. The most obvious impacts of desertification are: poverty; the degradation of 3.3 billion hectares of the total area of rangeland; a decline in soil fertility and soil structure; and the degradation of irrigated cropland.

The Convention to Combat Desertification (CCD) was formally adopted on 17 June 1994, and opened for signature at a ceremony in Paris on 14 and 15 October 1994. The Convention takes an innovative approach in recognizing: the physical, biological and socio-economic aspects of desertification; the importance of redirecting technology transfer so that it is demand driven; and the involvement of local populations in the development of national action programmes. The core is the national and subregional/ regional action programmes, to be developed by national governments in cooperation with donors, local populations and non-governmental organizations (NGOs). To date, the Convention has 115 signatories and has been ratified by 47 countries. It will enter into force 90 days after receipt of the 50th ratification.

[1] This report was compiled from the special issue of Earth *Negotiations Bulletin* published by the International Institute for Sustainable Development (IISD), with the support of UNEP. This report is printed without prejudice and in the understanding that any views expressed herein are not necessarily those of UNEP.

Negotiation of the Convention

During its 47th session in 1992, the United Nations General Assembly, as requested by the United Nations Conference on Environment and Development (UNCED), adopted resolution 47/188 calling for the establishment of the INCD. At the organizational session of the INCD in January 1993, delegates elected Bo Kjellén (Sweden) Chair of the Committee. The first session was held in Nairobi, Kenya, from 24 May to 3 June 1993. The first week focused on sharing technical information and assessments, and the second week dealt with the structure, elements and objectives of the Convention.

The second session of the INCD met in Geneva from 13 to 24 September 1993. The Committee considered the compilation text of the CCD and agreed on the future programme of work, including the elaboration of regional instruments for Africa, Asia and Latin America. The third session of the INCD was held at United Nations Headquarters in New York from 17 to 28 January 1994. The two working groups focused on the draft negotiating text of the Convention. The INCD also discussed the regional instrument for Africa.

At the fourth session, which took place in Geneva from 21 to 31 March 1994, negotiations of the draft Convention continued and delegates also formally considered the Regional Implementation Annex for Africa. The Asian and Latin American regional groups produced their own draft regional implementation annexes. When the fifth session of the INCD met in Paris from 6 to 17 June 1994, delegates worked through the remaining bracketed text in the Convention and finalized four regional implementation annexes for Africa, Asia, Latin America and the Caribbean, and the Northern Mediterranean. The Convention was adopted on 17 June 1994, along with resolutions recommending urgent action for Africa and interim arrangements for the period between adoption of the CCD and its entry into force. The Convention was opened for signature at a ceremony in Paris from 14 to 15 October 1994.

Post-agreement negotiations

The sixth session of the INCD was held in New York from 9 to 18 January 1995. The Committee reached agreement on its work programme for the interim period and the mandates of the two working groups and plenary.

Delegates at the seventh session, which took place in Nairobi from 7 to 17 August 1995, reviewed the status of ratification and implementation of the Resolution on Urgent Action for Africa and Interim Measures. The Committee discussed and provided input on the structure and elements that should be considered in preparation for COP-1.

The eighth session, held from 5 to 15 February 1996 in Geneva, reviewed the status of ratification and the implementation of the Resolution on Urgent Action for Africa and Interim Measures. The Committee also discussed and began negotiations on some of the Secretariat's texts on the preparations for COP-1. Delegates requested the Secretariat to prepare a new text for negotiation at INCD-9, based on their discussions on the Committee on Science and Technology, communication and information, draft rules of procedure for the COP, draft financial rules, the Global Mechanism and arrangements to house the permanent Secretariat and, for INCD, programme and budget. Some delegations revisited the question raised at INCD-7 on whether there was a need for two-week sessions of the Committee in the future.

A brief analysis of INCD-9

When INCD Chair Bo Kjellén noted at the closing Plenary that this session had accomplished more than he expected, he expressed what many delegates were feeling slow but steady progress was made at INCD-9. Newcomers said that although the issues were difficult they sensed a real willingness from all parties to find consensus, unlike many other processes of this kind.

Negotiations dealing with rules of procedure, scientific and technological cooperation, financial rules and procedures for communication of information and review of implementation were largely completed. The main issues that remain to be resolved at INCD-10 are the function of the Global Mechanism and its host institution, as well as the physical and administrative host of the permanent Secretariat. The programme and budget of the permanent Secretariat, which was not on the agenda at INCD-9, will be discussed at INCD-10.

Although Working Group I was bogged down by disagreement on the Global Mechanism, Working Group II sailed smoothly through most of its agenda, allowing even a brief look ahead at what to include in the work programme of the Committee on Science and Technology. Nevertheless, some delegates complained that time could have been used more efficiently, especially since meetings were often delayed by up to 45 minutes. This was largely as a result of consultations in regional groups. Some suggested that time should be allocated before INCD-10 for regional groups to prepare their positions, to be followed by a shorter INCD session. The proponents of a shorter INCD-10 argued that longer sessions only serve to allow delegates to postpone making difficult decisions.

Implementation measures underway: Many delegates expressed satisfaction with the reports on the implementation measures being undertaken in all regions. Presentations from affected African countries reflected that their preparations had now moved from awareness raising to addressing legal and policy provisions to create an enabling environment for the participation of affected populations. Some noted that the achievements of the action programmes so far demonstrate that the Convention is worthwhile. Delegates felt that in spite of the fact that the time allocated to this debate was shorter than in the past, the reports were still of a high quality. Many also attributed this to good organization and cooperation from delegates. A speakers list was prepared and publicized well in advance, delegates adhered to the five-minute time limit per speaker and many circulated supplementary information.

Steady progress on Ratification: Instruments of ratification trickled in steadily during INCD-9, bringing the total to 47. With only three ratifications to go to reach the required 50, the Convention is expected to come into force in early 1997. Despite this positive development, some developing countries expressed concern that the Convention was not considered important enough by Northern countries, such as the United States, the United Kingdom, France and Japan, who have not yet ratified it. Some stated that although the South has already ratified conventions that are of interest to the North, the North seems to have lost interest in ratifying and funding CCD implementation. Others argued that the problem is not the lack of political will, but the bureaucracy involved in ratification processes in some of these countries.

Designation of the Permanent Secretariat: While the bidding on the physical location of the permanent Secretariat has begun, some delegations regretted that no offer came from Africa. The main contenders seem to be Montreal, where the cost of living is lower and co-location with the Biodiversity Secretariat could be advantageous, and Bonn, where the Climate Change Secretariat is located and whose country offered the largest financial package. Observers noted that both are trying to establish themselves as international cities. The third contender, Murcia, in Spain, has the attraction of being located close to desertified areas, but many delegates privately quipped, "how does one get there?"

Considering the United Nations' current financial constraints, the political pressure the organization is being subjected to, and the haunting past of the 1977 United Nations Conference on Desertification and its Programme of Action to Combat Desertification, which were marked by a lack of political will to mobilize financial resources to combat desertification, the final decision may well be in favour of the best economic offer. Yet, some caution that even such an attractive offer may be superseded by the usual politicking. Many hoped that the action taken at INCD-9 to establish a contact group consisting of the Bureau members, Working Group Chairs, representatives of regional groups and the bidding countries, would safeguard against such politicking and provide a transparent method in making this choice.

Although both the World Meteorological Organization and the United Nations Development Programme have signaled an interest in providing support to the Permanent Secretariat, the strongest contenders seem to be UNEP and the United Nations itself. Some delegates suggested that placing the Secretariat directly under the United Nations and its Secretary-General would give the Secretariat a higher status, while under UNDP or UNEP it would be closer to the field. The latter seemed preferable to some in the light of the Convention's participatory approach. Others suggested that the UNEP administration would be desirable in order to emphasize that the Convention addresses environment and not solely development issues. Some believed that oversight by the Secretary-General would be more detached and give the CCD Secretariat more autonomy, an aspect that some desired while others expressed reservations about the consequences. Notwithstanding other arguments, it seemed clear that all groups are treading cautiously and closely watching the performance of the Secretariats of the Biodiversity and Climate Change Conventions, in particular with respect to transparency, acceptance of the predominant role of the COP, and administrative and decision-making procedures. The anticipated reforms in UNEP will also have implications for the INCD's decision.

The OECD group of countries seemed surprised that the G-77 and China expected a decision on the administration of the permanent Secretariat at this session. They argued that it was not decided this early in other negotiations and that they needed time to consult their home departments to solve technical issues, as well as to receive more details regarding the bids. Members of the G-77 and China were disappointed that a decision could not be taken. Some believed that the OECD group of countries was stalling and not giving priority to these negotiations.

Some delegates have suggested that some people are linking the choice of location and host institution. At present, UNEP provides administrative support to the Secretariat of the Convention on Biological Diversity, which is located in Montreal. The United Nations Secretary-General provides administrative support to the Secretariat of the Convention on Climate Change, which is located in Bonn. The bidding cities and institutions noted that their offers are not linked together, and that the institutional presence of UNEP and the United Nations are not limited to a single location.

Déja vu all over again: Negotiations on the Global Mechanism's (GM) function of mobilizing resources was, for many, a repeat of the experience in Paris in June 1994. The late night meetings by informal groups, frequent adjournment of meetings, and a contact group were all used by Working Group I and were familiar to those who had followed the same issue at INCD-5 in Paris.

Nevertheless, delegates were content with progress made on the GM. Positions appeared to be clearer now than they were at INCD-8 and regional groups were more direct about what they wanted. Some fear that the GM will be only a costly and ineffective administrative body. One delegate joked that it should be restricted to an address on the World Wide Web. Others said the GM is the heart and soul of the Convention. They complained that even though there is now consensus that desertification is a global problem and African countries are ready to implement the CCD, the lack of decision on the GM signifies that there is still reluctance to support the Convention.

Several delegates remarked that the lack of consensus on the still outstanding issue is due to a confusion between the role to be played by the institution that hosts the GM and the role of the GM, which itself is not an institution. Several delegates noted that the GM cannot take the lead in mobilizing financial resources, which the Convention states clearly is the role of the Parties. The GM can only act where there is a need and play a lobbying and facilitating role. Many delegates expressed fear that without multilateral arrangements, some countries and

important sectors will be left out and conditionalities that come with aid may creep into the Convention. Furthermore, no mechanisms are in place to tap into the widely hailed private resources.

Delegates offered various reasons to explain the source of frustration they felt during these negotiations. Some delegates expressed concern that delegates who were not involved in the negotiation of the GM in Paris now want to renegotiate the Convention. Others suggested that the discussion was started too late in the session to realize much progress on such a difficult issue. Another factor was the poor preparation among delegates, mainly due to the frequent, unplanned changes in the agenda of Working Group I. Others suggested that more progress might have been achieved if, instead of informally exchanging text, a small drafting group comprising all interest and regional groups had been established. One delegate commented that the GM would forever haunt the Convention.

Sciance versus politics: Substantive debates over the balance between scientific input and political decision making, which have plagued other United Nations negotiations, have also emerged in INCD deliberations. Working Group II addressed the issue in texts on the creation of the Committee on Science and Technology and rules of procedure. Observers who have followed the INCD process since its beginning were surprised at the ease with which the contentious issues in the texts related to scientific and technological cooperation were now resolved. However, the desire that the COP should remain sovereign was an underlying force in many of the decisions.

During discussion of the rules of procedure, for example, the G-77 and China argued that subsidiary bodies, such as the Committee on Science and Technology, should not be allowed to vote except for elections of the Bureau because, if subsidiary bodies are authorized to vote, the COP may be unable to call into question their decisions. The Convention on Biological Diversity's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), which met in Montreal during the first week of INCD-9, also attempted to recognize the need for balance between political and scientific input, with the Chair suggesting from the outset that the SBSTTA not become a "mini-COP," as the previous year's deliberations had been labeled. Negotiations on the CCD will provide one forum in which this tension between politics and science will continue to be played out on the international stage.

NGOs gain ground: Negotiating sessions are always the most frustrating periods for NGOs because they find it difficult to lobby for their positions. But several delegates and NGOs alike said that the NGOs, in spite of having made few direct inputs from the floor, had realized many gains, primarily due to better preparations prior to and during the session. NGOs submitted their texts early for the regional groups to consider, which enabled some of their inputs to be taken on board. In several cases, when they followed through with one-on-one lobbying, their texts were adopted. Delegates also noted that NGOs made good use of their daily publication, *ECO*.

The road to the COP: The momentum gained from incoming ratifications and the steady progress at INCD-9 led many to believe that the preparations for the first Conference of the Parties (COP-1) may be concluded at INCD-10 in January 1997, making an eleventh session unnecessary. Despite the United Nations General Assembly arrangements for an 11th session (probably in August 1997), the INCD Chair only anticipates the need for consultations between INCD-10 and COP-1 (planned for September or October 1997). A number of delegates expressed concern that the four-month period between INCD-9 and 10 may be insufficient for delegates and the Secretariat to complete the requested work, necessitating further consultations. In view of these two points, a number of delegates suggested postponing INCD-10 until August 1997. Some noted that unresolved issues thereafter can be decided at COP-1. While some have constantly compared the INCD and Climate Change Convention processes and have argued that not holding an 11th session relegates the Convention to an inferior position, others have noted that one reason an INCD-11 may not be needed is that the CCD has benefited from the groundwork laid by the previous conventions.

In spite of the short formal sessions of Working Group I during both the eighth and ninth INCD sessions, the remarkable progress made by the Group at INCD-9 may be a pointer towards the importance of consultations between the regional groups before negotiating. Granted the short interval to INCD-10, and the relative difficulty of the issues that remain to be resolved, the proposal to have adequate time for regional consultations at the beginning of the next session seems vital. The suggestion of some that delegates return to the "spirit" of the Paris negotiations may also provide the needed impetus to complete the INCD's work at its final session before COP-1.

The next session of INCD is scheduled to take place from 6 to 16 January 1997 at United Nations Headquarters in New York.

Land Degradation and Sustainable Development in Papua New Guinea

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Introduction

Lying barely south of the Equator, to the north of Australia, Papua New Guinea (PNG) is an archipelagic nation of some 600 islands scattered over 2 million km2 of the South Pacific Ocean. Its mainland (New Guinea) in the west is a sub-continental island shared with Irian Jaya, which is a part of Indonesia. This mainland comprises 85 per cent of the country. Together with the provincial islands, the total land area is 463,000 km2. The country's 1990 population was 3.8 million growing at the rate of 2.3 per cent per annum. In 1995, the population was estimated at 4.3 million.

Papua New Guinea has enviably rich and diversified natural resources. The country has been described as "a mountain of gold floating in a sea of oil". Besides gold and petroleum, the country has vast reserves of copper, silver, nickel, gas and timber. Until recently, PNG's economy was dependent on copper, coffee, cocoa and copra. Since the mid-1980s, copper has been overtaken by gold, petroleum and timber as the leading export items. However, agriculture is still the mainstay of the economy with about 80 per cent of the population at least partially dependent on subsistence farming. Cash crops such as coffee, cocoa, coconuts, rubber, oil palm and tea are grown on small holdings and plantations.

Although much of PNG's natural environment is still comparatively pristine, the sustainability of the environment is under threat (Schoel, 1994). One of the forces behind this emerging "environmental crisis" appears to be the socio-economic transformation produced by development. The imperatives of modernization, economic growth, resource utilization, international trade, increasing consumption and population growth are putting more and more pressure on land and other natural resources in PNG. The challenge facing the country is how to achieve the required social and economic development while ensuring at the same time that natural resources are managed sustainably and the environment is protected. This paper highlights some of the major threats to sustainable development and the need for sound management to provide a firm foundation for sustainable development.

The Reality of Resource Development in Papua New Guinea

Minerals and petroleum (Fig. 1) are at present the largest export income-earners in PNG and their importance is likely to grow in the future. In 1993, oil, gold and copper accounted for 72.4 per cent of total exports and this contribution is projected to rise with the opening of the new gold mine at Lihir.

Mining and associated infrastructure development are having an increasingly deleterious impact on the environment in PNG. The greatest impact of mines stems from their current practice of using river and ocean dumping as the main means of disposing of mine wastes (Table 1). During the last 15 years, some 400 millions tons of tailings have been dumped into the Empress Augusta Bay from the Bougainville copper mine (Asian Development Bank 1992). The tailings are estimated to have formed a 7 km2 delta and have affected 100 km^2 of sea floor. The Jaba River which carries the tailings is biologically dead and fish populations are reduced in its tributaries (Photo 1a and b).

The potential chemical and biological impact of the gigantic Ok Tedi gold and copper mine on the Fly River ecosystem has been extensively studied (Jackson 1982 et *al* 1995, Rosenbaun and Krockenberger, 1993, Eagle, 1994). Dissolved manganese copper, particulate copper, and suspended sediment levels remain significantly higher than the background levels 190 km below the junction of the Ok Tedi and Fly Rivers. Some 600 km downstream, the Strickland River adds waste to the Fly River system from a new gold mine at Porgera. The waste flows another 385 km to the Gulf of Papua.

All gold and copper mining operations in PNG are on an open cast basis. It is less the total area of forest cleared that warrants concern than the absolute devastation

Figure 1: Major mine sites of Papua New Guinea

caused by these sites. Most gold operations involve high pressure water blasting of the mountainside and then dredging of the rivers below. The resultant visible scars produce strong responses from the people. The miners have stripped the whole mountain-side down to bare earth and deliberately eroded them in order to wash the gold they hope is there into the river-bed where they can sluice for it.

The closure of the Bougainville copper mine in 1989 was basically the direct result of landowner's concern over environmental damage. After more than ten years of operation, the Ok Tedi gold mine has been the subject of a massive environmental damage claim in the Victorian Supreme Court in Melbourne, Australia. The landowners at Ok Tedi and Fly River have claimed some four billion Australian dollars from the Australian mining giant, BHP, a major owner of the mine and Ok Tedi Mining Ltd (OTML), the company involved in the mining operations, for alleged environmental damage.

The Ok Tedi mining lease was granted in 1981, but mine development was marred by the 1984 collapse of a partially constructed tailing dam, which cost the partners (BHP and OTML) 70 million Australian dollars and left them - including the cash strapped PNG Government - with little choice but to abandon the project and dispose of the tailings into the Ok Tedi river. Since 1984 when gold mining started in Ok Tedi, more than 30 million tons of ore have been removed by open-cut methods, and the gold extracted using ferricynides. The tailings disposal has caused extensive physical and chemical pollution of the Ok Tedi and Fly rivers. The project has been described an environmental disaster. Most recently, it has been announced that a settlement, costing Ok Tedi Mining Ltd more than 500 million Australian dollars (including the payment of 7.5 million Australian dollars in legal expenses to the landowners) had been reached (Post Courier, PNG, June 12, pp.1 and 3).

What is surprising, however, is that despite the conflict arising from the Bougainville Copper Mine and the court action over environmental damage caused by the Ok Tedi Mine, the Government of PNG has recently given its approval to ocean dumping by the new Lihir Gold Mine in PNG.

The environmental impacts of oil extraction are so far minimal. However, it may perhaps be too early to speculate on the long-term effects. In PNG in general, there appears to be a great impetus to exploit natural resources without regard to longer-term damage.

Environmental and social impacts of logging (Photo 2a and b) in PNG have been well-documented in the Barnett Inquiry Report (Barnett, 1989), in which no company was found to have complied with the environmental standards required of them by the Department of Environment and Conservation (and the relevant Environmental Planning Act 1978).

The Report found that the forests were being mined for short-term gains rather than being managed on a sustained basis.

Papua New Guinea is one of the 17 most important countries in the world listed by FAO that still have base areas of their landmass forested (FAO, 1992). PNG's forest estate covers 36 million hectares (approximately 78 of the country's total land area of 46.5 million hectares). There are well over 10,000 species of flora, including as many as 1,500 tree species of which some 240

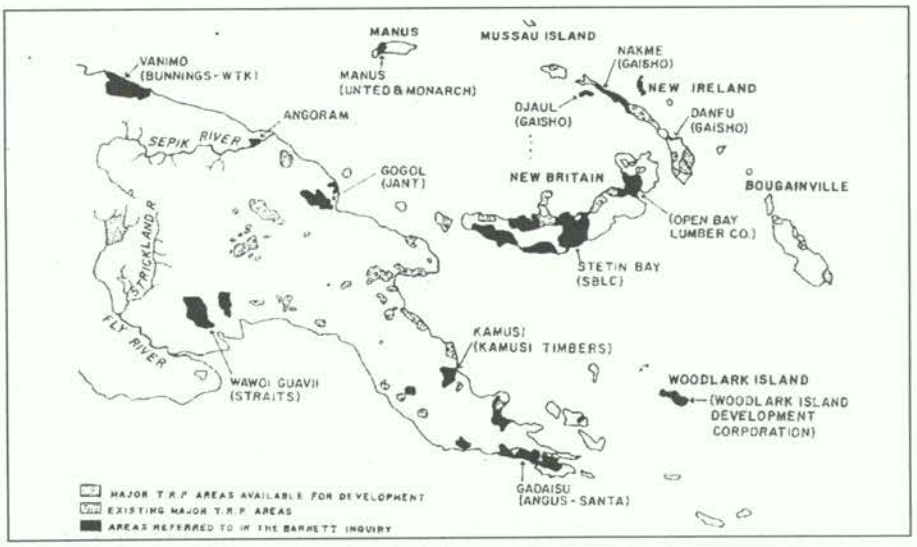

Figure 2: Timber Right Purchase Areas and Local Forest Areas
Source: Department of Forests, 1988

Mine	Tailings produced (tons per day)	Mine life (in years)	Disposal method
Bougainville*	135,000	30	Into river
Ok Tedi	80,000	30	Into river. (More than 10,000 t/day of fine waste rock also enters river)
Misima	15,000	10	Deep ocean via submarine pipeline. (10,000 t/day also dumped directly into ocean)
Hidden Valley	10,000	10	Storage in tailing dam
Porgera	9,000	18	Into river
Mt. Kare	300	3	Into river
Wau	1,400	9	Into river
Mt. Victor	400	2	Storage in sealed limestone sink hole
Lakekamu	0	15	Virtually all rock wastes contained within dredging area

*Ceased operations in 1989 due to civil war, partly over environmental damage
Source: Hughes and Sullivan (1989)

Table 1: Disposal of tailings from mines in Papua New Guinea

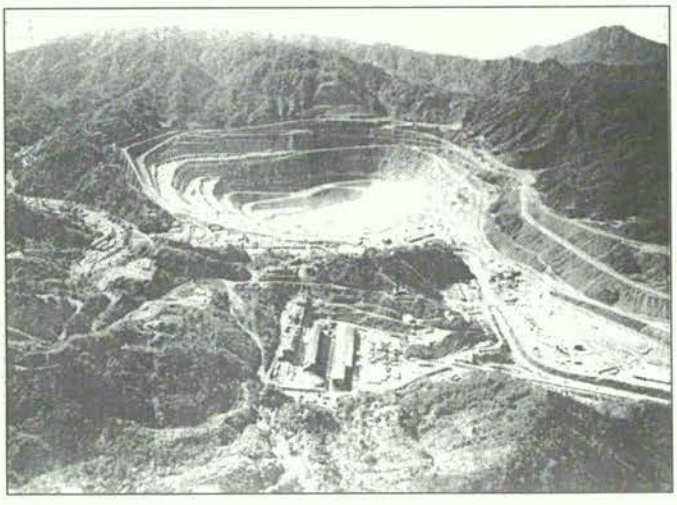

Photo 1a:Overall view of the Bougainville copper mine (Panguna mine). Ceased operations in 1989 due to civil war, partly over environmental damage

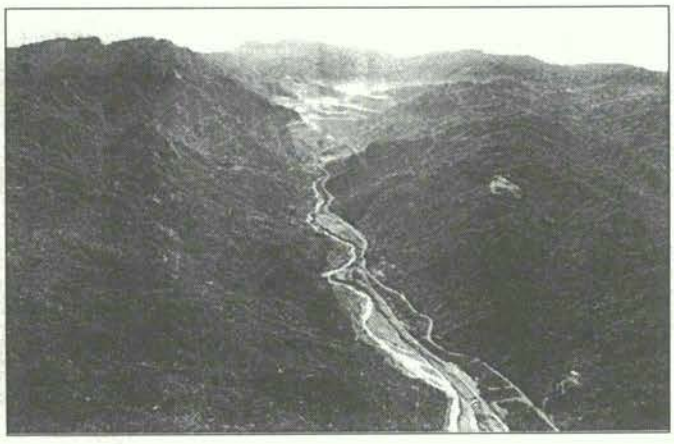

Photo 1b: The Jaba River with mine in the background. Because ofthe tailings dumped into the river, the Jaba is biologically dead

species are currently harvested for export.

The World Bank (1990) estimates that the operable (commercial) forest area is 15 million hectares and the inoperable area 20 million hectares. It further estimates that the annual deforestation rate between 1981 - 1985 averaged 2,200 hectares per annum while logging operations covered 70,000 hectares per annum during the same period. Table 2 gives the annual rates of forest disturbance or destruction.

Logging in PNG is an operation that involves removal of all currently saleable timber, leaving a relic stand consisting of unsalable timber species, defectives and small trees. Such stands do not tend to regenerate adequately for further cutting within an acceptable period of time and are usually converted to agricultural land by customary landowners (Sargent and Burgess, 1988). The majority of loggers do not maintain the required metre buffers along rivers; often long slopes that are greater than 30 degrees damage river and creek banks and block and pollute rivers and creeks with debris (Nadarajah, 1994). Extensive damage is also caused by the wide snig tracks along which logs are dragged out.

Environmental clauses in the logging permits are usually the bare minimum believed to ensure a second harvest of forest and are quite inadequate for maintaining the biological integrity of the forests (Marshall 1990). The Barnett Inquiry Report found that any area of the forest that is rich in commercial species is effectively clear felled with little heed paid to the importance of maintaining even those values that are so important to the landowners - in particular stocks of animals and birds for hunting, and trees used by the local people for canoe building. The Report emphasized that environmental clauses were breached extensively, which goes to show that logging activities in PNG are inadequately monitored in terms of their logging practices.

Source: Papua New Guinea National Report, Unisearch 1992, p.44

Bribery and corruption compound the problem of sustainable logging in PNG (Photo 3a and b). The Report shows

Photo 2a: WTK Reality Logging Yard. Sawmen "dioping off" decayed parts of logs for export.

Photo 2b: Logs for the export market. The MV JONG KONG berths at Vamino to load logs

graphically the role played by graft in the logging business. Barnett found that the problem was particularly severe in New Ireland, where "bribery, corruption and the buying of support have become so widespread that they have become a major social sickness". Most of the logging companies used transfer pricing as a mechanism for secretly transferring profits off-shore. It is apparent that governments and landowners in PNG are forsaking economic rents to which they are entitled to logging contractors. The Report found that logging companies are not interested in conservation, their aim is to make as much money as quickly as possible and they will go to any lengths to achieve this. "The industry is corrupt and corrupting" (Marshall, 1990).

Forestry operations, particularly excessive logging are a threat to the subsistence of rural residents through deforestation which causes soil erosion and contaminates water supplies as well as through a loss of biodiversity and non-timber forest resources. Other environmental impacts include loss of nutrients, disturbance of nutrient recycling process, changes in soil physical properties, drainage disturbance, reduction in the rate of regeneration process and significant changes in soil temperature. The research in the Gogol TRPA (Timber Right Purchase Areas) clearly demonstrates some of these effects. (Saulei's 1991)

The current forest revenue and concession regime does not seem to protect either the ecosystem or the short-term financial interests of the landowners. What happens to the land after the loggers finish with it, appears to be nobody's concern (Nadarajah 1995). The current trend of establishing oil palm plantations on the deforested land is entirely unplanned and ad hoc. The use of agricultural chemicals in oil palm plantations is common. However, no studies have yet estimated the impacts of such agricultural activities on the environment.

At present, little information exists on the impact of firewood collection on deforestation in PNG. Most villagers and fuelwood collectors supplying towns or villages generally do not travel long distances to collect their woodfuel.

Activity	Type	Rate (ha per year)
Logging		
Clear felling	Deforestation	6,000
Selective	Mainly disturbance	70,000
Agriculture		
Subsistence*	Mainly disturbance	200,000
Commercial	Deforestation	10,000
Other activities		
Mining	Mainly deforestation	1,000
Firewood	Mainly disturbance	2,000
Infrastructure	Deforestation	2,000
Resettlement	Mainly deforestation	5,000
Total		296,000

*Some of this clearance may be of secondary forest or grasslands.

Source: *Papua New Guinea National Report*, Unisearch 1992, p.44

Table 2: Estimated annual rates of forest disturbance or destruction 1990

Charcoal making is less known and consequently not common in PNG. It is therefore possible that fuelwood collection in general has had a negligible impact on forest sustainability in PNG. The exceptions, of course, could be the high density areas such as the Highlands where anthropogenic disturbances have led to conversion of forests into grasslands. Firewood is a significant fuel in urban centres but surveys in Port Moresby have found that there is a decline in use intensity (Hedger and Levett (1991).

It would appear at present that environmental degradation is not caused on any large scale by pressure of population in PNG since the total population (4.3 million) its growth rate (2.3) and density (8 persons per km2) are comparatively low by African and Asian standards and also since the level of urbanisation (15) is relatively low. Nevertheless, there is distinct evidence that where population densities are relatively high as in the highlands (which comprises only 13.5 per cent of the total land but 36 per cent of the population), the practice of subsistence agriculture causes environmental degradation.

Traditional agriculture in PNG is based on the rotational bush fallow variant of the shifting cultivation system, which is highly productive and sustainable, provided that population pressure does not lead to the shortening of fallow cycles. However, the intensification of commercial agriculture coupled with increasing population pressure in some parts of PNG (e.g. the Highlands) threaten the environment as well as long-term sustainability of PNG's agricultural production systems.

Evidence seems to point to the fact that localised population pressure appears to be one of the factors leading to the gradual extension of slash and burn agriculture into forested areas, creating the greatest risk of environmental degradation with the destruction of trees and seed sources. There is little doubt that shifting cultivation has been and still is one of the chief causes of deforestation in PNG. The Department of Forest (1991) has estimated that some six million hectares are in use at any one time in the gardening fallow cycle in PNG. Most of the 200,000 hectares or so of forested land brought into subsistence cultivation each year is through the conversion of secondary forest on a rotational system, but it is reasonable to assume that as much as 10 per cent of this, i.e. 20,000 hectares, is primary forest (UNISEARCH 1992).

The land which is most at risk is that which is cleared and subsequently utilised continuously or where the period of fallow is inadequate for the recovery of its previous condition. Shortening of fallow cycles and frequent burn-offs have led to the conversion of primeval forests to secondary forests and ultimately to bush and grasslands in the upland areas. According to the Department of Forests (1991), shifting agriculture is principally responsible for the present day occurrence of anthropogenic grasslands over an area of 3.5 to 4.0 million ha in PNG.

In the coastal areas, destruction of mangrove areas is a matter of concern while other factors affecting sustainability of resources in the coastal areas include "pesticide (DDT) and dynamite fishing" and commercial fishing for high value sedentary species. There is however, little reliable data on which one can make an assessment of the extent of damage caused to coastal resources. Tourism is underdeveloped in PNG and consequently has not had much impact on coastal beaches and corals.

Informal, unplanned peri-urban development and squatter settlements are some of the most visible and pressing urban and environmental issues in the coastal areas of PNG. In Lae, peri-urban development has occurred on steep, unstable slopes and erosion, landslides and flooding have become a serious problem. Around Port Moresby, peri-urban development and garbage disposal are acute problems.

As yet, there is no comprehensive database on PNG's environment. However, in terms of land use, some remarkable progress has been made recently with the establishment of the Papua New Guinea Information System (PNGRIS). To date, with financial and technical assistance from Aus Aid and CSIRO, PNGRIS has compiled a fairly comprehensive set of land use data including an update of the 1990 Population Census in various software programmes. This information is available for use by planners and relevant government departments. So far, however, the

available information from PNGRIS does not cover the whole country and there is presently no nationwide monitoring and data collection on key environmental variables, although a land management project led by Bryant Allen of the Australian National University is currently involved in mapping and assessing the extent of environmental stress in all the varied agricultural systems of PNG.

PNG's National Sustainable Development Strategy (NSDS)

In recent years in PNG attention has been focusing on the impacts of economic development and the issue of creating an environmentally sustainable economy and society. The PNG Government in cooperation with non-governmental organizations has embarked on a programme of concurrent and interconnected activities for planning for sustainable development.

Following the Government's endorsement in April 1994 of a proposal for the development of a national sustainable development strategy for PNG, a National Steering Committee was appointed to coordinate the formulation of the NSDS through a nationwide participatory process. Subsequently, the Government requested UNDP to assist the NSDS Steering Committee formulate and implement a national sustainable development strategy. As a first step in providing this assistance, UNDP funded the Joint Inter-Agency Mission to provide an integrated package of policy advice to the PNG Government on sustainable development.

The joint inter-agency group comprised seven international consultants and three national consultants. The group organized several working groups in various parts of PNG dealing with issues such as policy planning, enabling the Government, managing Papua New Guinea's assets and people's participation. The main areas on which the mission focused, included legislation and institutions, management of non-renewable resources such as petroleum and mining, sustainable management of renewable resources such as land and marine resources, business development and people's participation.

Using the vision of sustainable human development contained in the "Five Goals of PNG's National Constitution"[1] as the framework for its work, the Mission analysed the major environment and development issues facing PNG under three broad headings: enabling government, managing PNG's resources, and accelerating effective popular participation and human development. The agenda for action mapped out for the NSDS followed a similar framework.

Strategies recommended to provide a supportive legal and institutional policy framework for good governance include:

- A workable and properly enforced legal system;
- Establishment of effective administrative procedures and supportive institutional (government) structures;
- Accountability and transparency in government; and
- A national framework for a "bottom-up" approach to planning.

A set of three strategies and mechanisms were recommended for sustainable management of PNG's renewable and non-renewable natural resources. These strategies look first at investing the benefits (financial as well as non-tangible ones such as skills development) from the use of mining and petroleum and then propose strategies for creating employment in the formal urban and rural sectors and finally in the informal rural sector which is the mainstay of PNG society.

Specific action programmes identified include:

- The need to clearly ensure that revenue obtained from non-renewable resources are well-managed for the benefit of present and future generations;
- An employment-led growth strategy to provide meaningful employment for job seekers;
- Development of fisheries sector on a commercial basis being firmly embedded in sound sustainable management principles;
- A sustainable agricultural development strategy to maintain the agriculture sector's productive base, improving the competitiveness of the commercial sector and broadening the productive base through diversification;
- A shift in priority from urban to rural development to provide sustainable livelihoods for the vast majority of PNG's people who live in the rural areas.

These initiatives would be linked to activities aimed at the empowerment of people in villages and communities through better education, training and awareness raising activities. Effective participation is dependent on people having the knowledge and skills to take part in decision-making, on access to the relevant information, and on mechanisms that allow their involvement.

The Inter-Agency Report (also called Yumi Wankain) was published by UNDP in October 1994. Since the publication of the Report, there has been a change of government in PNG and the implementation of the NSDS has been stalemated because of the bureaucratic problems of finding a suitable location for its secretariat within the governmental administrative structure. As a result, nothing much has been done about the NSDS and planning for sustainable development in PNG has gone no further than drawing up paper plans.

Discussion and Conclusion

The planning process of NSDS in PNG has been facilitated by international agencies. It is time for a real initiative and commitment from PNG itself to address the issues of sustainable development by translating the NSDS into an action plan and embarking on the implementation process. While implementation at national level has been slow, the country's natural resources are dwindling and the social and environmental impacts of resource development is causing stress.

If sustainable development is to achieve its potential under the NSDS, it must be integrated into the planning and the measurement systems of individual and corporate activities in agriculture, forestry, fishing, mining, industry, commerce and other sectors of the

[1] The five goals are: (1) integral human development ; (2): quality and participation; (3): national sovereignty and self-reliance; (4): conservation of natural resources for the collective benefit of all and for future generations; (5): Papua New Guinea ways of social, political and economic organization

economy as well as modes of livelihood in society. For that to happen, the NSDS Commission or Secretariat and the National Planning Office should translate Yumi Wankain into an operational action plan in terms familiar to business, government leaders, landowners, local communities and individual members of the public, at national, provincial and local (district and village) levels.

The price of effective sustainable development is eternal vigilance and surveillance. Sustainable development principles enunciated in the NSDS and those of Agenda 21 should become part and parcel of the new laws and regulation policies of the country and should be rigorously enforced. Too often, in PNG, there has been laxity in the enforcement of regulations and legislation relating to the Environmental Planning Act and the Environmental Contaminants Act since their passage in 1978. In the forestry sector in particular, lack of effective enforcement of regulations and legislation has led to flagrant abuses of laws and regulations by loggers. Such logging malpractices need to be kept under constant surveillance and severe penalties imposed to ensure compliance. Measures should be introduced to boost capacity for monitoring to ensure existing and new legislation are enforced by the relevant agencies and institutions. The development of the country's resources will continue in a haphazard and destructive manner unless the problems facing legislation and enforcement are addressed.

The ultimate success of environmental management in PNG depends to a large extent on people participation and initiatives. PNG has experienced many rural development programmes with varying degrees of success. Some of the reasons for the failure of rural development projects appear to be the "top-down manner" in which such projects are implemented and the lack of the necessary involvement of people in the planning process (Hayes and Mowbray 1994). Efforts to improve the environment in PNG require awareness, acceptance and responsibilities by citizens and local communities and by enterprises and institutions at every level, all sharing in the common effort in ensuring environmental sustainability.

Important lessons can be learnt from Manus regarding the community-based "bottom up" approach, emphasizing village initiatives in resource and environmental management. The policy approach adopted in this province encourages communities to identify their own basic minimum needs and to take responsibility for managing, developing and conserving ways of approaching the issue of environmental management. The time has come to begin to think seriously and to find more innovative ways of managing the environment and solving the "environmental crisis".

In finding new and more effective ways of resolving and or mitigating the land degradation problem caused by prevailing agricultural practices, the initiative should first focus on the need for better economic assessment of land degradation, rehabilitation and prevention and their role in decision-making. It should pursue the problem within the context of overall development planning.

In an era in which structural adjustment programme (SAPs) have been imposed on PNG by the World Bank and the IMF, the prospects of higher levels of damage to the environment could be great. In my view, sustainable development requires greater use of economic instruments such as the "polluter pays" and "user pays" principles to complement regulation and control measures. These could both increase revenue and improve environmental protection. Because poverty contributes to environmental damage, as the poor are often forced to act unsustainably in order to live, SAP policies should include an employment-led growth strategy to provide meaningful employment for job seekers. They should also include access to credit and lower interest rates for small enterprises to expand, diversify, and increase their employment and productive capacities. Other measures such as secure property rights are also required. Poverty tends to increase during the early stages of SAPs, and this could have an adverse effect on sustainable development. However, I must admit that the policies I am advocating are not easy to adopt during SAPs.

In addition to SAPs, increasing unemployment, law and order problems are currently significant impediments to sustainable development and political stability in PNG. These would seem to emphasize all the more the need for the adoption of an employment-led growth strategy which opens up new opportunities without trading off environmental goals against growth. Such opportunities would seem to exist in the area of tourism and also in the informal sector of PNG economy. Eco-and landowner-tourism ventures would seem to provide a leeway, while in the informal sector, attention is needed in the provision of appropriate training and support to make the sector an efficient part of the domestic economy.

Education and public awareness programmes are the vehicles for conveying correct environmental messages on pollution control and resource misuse and for changing false environmental perceptions and ensuring that the community or society behaves responsibly and in an environmentally sensitive manner. There is an urgent need to reform the education sector by making it more responsive to employment needs and sustainability of resources in the country. Education at the middle and lower levels should inculcate workforce skills and environmental awareness. Adult education especially in the rural areas should aim at empowerment of people by providing knowledge and skills to take part in decision-making. It should stress training and environmental awareness, with particular focus on mechanisms which will allow for effective participatory involvement and management of the environment and resources in a modern development context.

In conclusion, the harsh truth is that PNG today is confronted with an emerging environmental crisis. The combined effects of modernization, economic development, population growth, international trade and consumption are pushing both the state and individuals within PNG to meet their needs by causing environmental damage with its attendant wider social impact. Degradation from ineffective control of deforestation, mining and agricultural activities and land use pressures are leading to the loss of essential reserves of seeds and nutrients, the genetic storehouse that has been the

heritage of PNG for ages. It is time a real commitment is made by Papua New Guineans themselves to arrest this ominous catastrophe that looms like Damocle's sword and which can turn the otherwise pristine PNG environment into a desert for posterity.

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Making Aridlands Productive: Conservation and Utilization of Thar Desert Biodiversity for Sustainable Development in India

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Abstract

The Thar Desert aridlands which occupy a 2.34 million sq. km area in the western part of India lay unproductive until recently. Great efforts are being made to make the area productive through ecological restoration and biodiversity conservation programmes. The Thar Desert is unique in the sense that its land is highly "generic" and supports rich biodiversity. Researchers have shown that the Thar desert possesses some disappearing species of plants which can be successfully and sustainably utilized for production of food, fodder, fuel and several industrial raw materials.

The advent of the 649 km long Indira Gandhi Canal bringing sweet Himalayan waters to the Thar desert has greatly helped in bringing back some form of productivity to the desert as well as helped to check its monstrous expansion.

Introduction

The Thar desert in India covers about 2.34 million sq. km of hot, aridland. Eighty five per cent of the great Indian arid zone lies in India and the rest in Pakistan. Nine one per cent of the aridland i.e. 2.08 sq. km. area falls in Rajasthan, about 61 per cent of the geographical area of the State. The Rajasthan aridlands include the entire districts of Sriganganagar, Bikaner, Jaisalmer, Barmer, Jodhpur and Churu. The other districts such as Nagaur (96 per cent), Jalore (88 per cent), Jhunjhunu (69 per cent), Sikar (65 per cent), Pali (48 per cent) and Ajmer (9 per cent) lie partly in the arid zone of the State.

The word "desert" gives the impression of a vast, tree-less, undulating, expanse of sand. The great Indian desert "Thar" does not conform to this popular notion. The desert is not an endless stretch of sand dunes, bereft of life or vegetation. During certain periods it blooms with a colourful range of trees and grasses and abounds in an amazing variety of bird and animal life.

The Thar desert receives between 100 to 500 mm of rainfall a year, 90 per cent of which is received between July to September with a very high coefficient of variation in quantity and duration. The number of rainy days varies from 10 to 18. Low relative humidity and high wind velocity result in high evapotranspiration.

India made strenuous efforts after independence towards sustainable development of the Thar desert and endeavoured to make sustainable use of its biological resources for the economic prosperity of its people and the ecological security of the region.

Potential for Rangeland development in the Thar Desert:

a) Improved strains of pasture grasses and legumes

The Thar desert holds a big promise for rangeland and fodder development. To help achieve a breakthrough in the yield of different promising grasses and legumes, an exhaustive germplasm collection of over 1600 species has been built up and maintained at the Central Arid Zone Research Institute, Jodhpur. A number of promising cultivars have been identified. The important cultivars are: CAZRI-358, 75, of *Cenchrus ciliaris;* 76, 175, 296 of *Cenchrus setigerus;* 317, M-20-5, 319 of *Lasiurus sindicus; 490,* 491 of *Dichanthium annulatum;* 331, 333 of *P. antidotale;* 144, 1258, 1462, 1626 of *Lablab purpureus;* 752, 466, 1433 of *Clitoria ternatea.* These varieties provide high and nutritive forage for much of the year. They are drought resistant, hardy, stable, persistent and aggressive in rangeland development and possess high seed yield ability, high nutritive value, fast regeneration and good germination (Saxena & Prakash 1992).

b) Some High Yielding Pasture Grass Varieties In The Thar Desert of Rajasthan

i. Marwar Anjan *(Cenchrus ciliaris)*

Marwar Anjan was selected from

[1]Quital = kilograms

germplasm received from Australia. It is a tall, thick-stemmed, erect and drought-hardy perennial species. The leaves are broad, long, droopy and remain green until maturity. It is very adaptable, has high tillering ability and is quick to regenerate. It possesses a stout root/rhizome system. It gives two to three cuttings per year. It yields 70 quintals[1] of "green fodder" and 30 quintals of dry matter per hectare under arid conditions. It has 8 per cent protein and about 60 per cent digestibility. It produces 1 to 1.5 quintal/ha seed even after one cutting of fodder. It is a persistent and aggressive variety of grassland and remains productive for four to five years under proper management systems. It is sown at the onset of the monsoon with a seed rate of 5 to 6 kg/ha.

ii. Marwar Dhaman *(Cenchrus setigerus)*
Marwar Dhaman is selected from exotic material and adapts well to the arid and semi-arid regions of India. It is excellent for grazing purposes due to its thin stem and leafy foliage. It is a drought resistant, hardy perennial which forms clumps at the base. It is an early maturing variety, flowering between 45 to 55 days, is high in tillering, regenerates well and is capable of giving two to three cuts per year under rainfed conditions. It provides an average yield of 40 quintal/ha green fodder and 15 quintal/ha dry matter in arid regions, whereas in semi-arid areas, the yield doubles. It contains 9.5 per cent crude protein and 65 per cent digestibility at half bloom stage. Its pasture remains productive for four to five years. It is moderately resistant to major insect pests.

The use of these improved grasses for reseeding the rangelands, the depleted Orans or village grazing lands and gochar lands assume great importance for meeting the grazing needs of the ever growing livestock population of the Thar Desert of Rajasthan (Sinha 1990).

Potential for horticulture in the Thar Desert

Various fruit plants and their cultivars adapted to grow in different agroclimatic arid conditions within the Thar Desert have been identified (Dass 1990). They can be grown on a commercial scale with drip irrigation facilities. They are:

(i) Ber *(Zizyphus mauritiana)*
Ber is the most drought-hardy fruit tree found growing wild in the Indian desert and is an important source of leaf fodder and fuel. Ber (Z. *mauritiana)* cultivar, *tikadi*, is popular in certain locations of the Thar Desert. Among the improved Ber cultivars introduced from other regions of the country, the early-maturing cultivars have proved to be the best because their fruit bearing synchronises with the period of maximum natural moisture availability. Other cultivars, e.g. *Gola, Seb, Mundia, Katha* and *Chomu* have proved better in these regions.

(ii) Date-palm *(Phoenix dactylifera)*
Date-palm cultivation in the Thar Desert arid lands has considerable promise because of the amount of heat-unit accumulation. Several promising varieties of date-palm are the *Hillawi, Khadrawi, Meedjool* and *Shamaran.*

(iii) Pomegranate *(Punica granatum)*
The pomegranate is another drought-and salt-tolerant fruit tree. The cultivar *Mrig bahar* is generally grown. The cultivars *Mandor (Jodhpur), Saharanpuri* and *Jalore Seedless* have also been tried. The orchards needs some irrigation.

Evaluation of as many as 36 cultivars from different sources, showed that the Jalore Seedless- - was the most promising variety of pomegranate in terms of yield, size of fruit, colour, sweetness and soft seededness. This cultivar was found to be ideal for various desert districts of Rajasthan where dug well water even of high salinity in the range of 4 mmhos/cm or canal water is available.

(iv) Guava *(Psidium guajava).*
Although frost susceptible, is very drought-hardy. Orchards are seldom watered after the fruit harvest in places where water is scarce until the advent of the monsoon rains. Varieties *Allahabad Safeda* and *Lucknow-49* have given the best performance as far as the yield and the quality of fruit is concerned in the arid zones of Rajasthan.

(v) Sweet orange *(Citrus sinensis)*
The finest quality of blood-red malta fruits are produced under the arid conditions of Sriganganagar district in the north western arid zof the four varieties of sweet orange, namely *Musambi, Jaffa, Navalencia* and *Valencia Late, Musambi* gave the best results in arid conditions with regard to yield (100 fruits per tree) and quality of fruit (26 per cent juice content).

(vi) Sour lime *(Citrus aurantifolia).*

At Jodhpur, sour lime, *Kagzi* has excelled. The yield per tree is about 100 kg, with the juice content being 30 per cent to 35 per cent.

(vii) Grape *(Vitis vinifera).*

A large number of cultivars of grapes have been tried at Jodhpur. Of them, *Beauty Seedless* has been found to be the hardiest. Although *Thompson Seedless* has given the best-quality fruit, it progressively bears less fruit after a few good seasons. Vineyards of other varieties, e.g. *Anab-e-Shahi, Selection-7, Kandhari* and *Black Prince*, are adjudged hardier and more drought resistant than Thompson Seedless, suitable for growing in the Thar Desert of Rajasthan.

(viii) Papaya *(Carica papaya).*

Papaya develops an excellent flavour under the hot and dry conditions of an arid region. Papaya growing is, therefore, becoming a popular enterprise in the Thar Desert of Rajasthan. The commonly grown cultivar is *Honey Dew* which gives 30 to 50 kg of fruit per plant. Other cultivars, namely The *Washington, Barwani Yellow* and *Coorg Honey*, are new introductions into the Thar Desert and are flourishing. The cultivar *Washington* has yielded 40 to 60 kg of fruit per plant.

(ix) Lasoda or Gonda *(Cordia myxa).*
The Lasoda is drought-tolerant tree which hardly needs any irrigation after a year's growth. The small, roundish, green fruits are borne in clusters, and have a slimy and acrid pulp around a hard stone. The fruits are harvested when green and are used for making pickle.

Other fruits which have performed well in the Thar Desert are mulberry,

phalsa (Grezvia sub-inequalis), custard-apple *(Anona squamosa)* and Wood apple *(Aegle marmelos)*. A few promising varieties of watermelon and chillies have also been identified.

Desert plants as a source of industrial raw materials

Studies to identify and explore the possibilities of exploiting desert plants of economic importance have revealed that Thar desert plants hold big promise as industrial raw materials (Singh & Pandey 1983).

a) ***Raw material for Explosives Industry***

Candelilla wax, which has great industrial potential, has been isolated from *Euphorbia antisyphilitica*, a desert plant of Mexican origin which has adapted well to the Thar Desert of Rajasthan. The wax has been found suitable for end-use in the manufacture of explosives. Candelilla wax can also be used as a substitute for Carnauba waxes. At present, both waxes are imported.

b) ***Raw material for the Soap Industry***

Jal (Salvadors oleoides) a desert plant which yields 40 - 50 per cent non-edible oil from its seed kernel has its valuable use in the soap industry.

Tumba *(Citrullus colocynthis)* grows wild in the Thar Desert even under very low rainfall conditions. Its seeds yield oil which is used for soap making. Studies of the economic characteristics of its fruits, collected from more than 50 locations in western arid regions of Rajasthan, show that a good amount of genetic variability exists with regard to fruit size, seed weight and oil content indicating prospects for its mass production in the Thar Desert. The variation in the oil content of the germplasm collection is 8-33 per cent whereas the recovery of oil in factories is 14-15 per cent.

c) ***Raw Materials for the Drug and Pharmaceutical Industries***

Diosgenin, an important raw material for steroid hormones and oral contraceptives, has been isolated from the roots of the desert plant *Balanites roxburghii* with a 0.81 to 1.47 per cent yield. The fruits of this tree have been found to be a rich source of diosgenin. The fruit samples collected from Jodhpur and Barmer districts give, on an average, 1.8–2.9 per cent of commercially acceptable diosgenin. Some trees have also been identified the fruits of which yield three per cent diosgenin. With the success achieved in vegetative propagation by air layering technique, it is now possible to grow trees the fruits of which would give a uniformly high yield (3 per cent) of diosgenin. Besides diosgenin, its seed kernel also gives a bland yellow oil a 45 per cent yield which increases the overall value of this desert plant.

Scoparone, now under clinical trial as a hypotensive and tranquilizing agent, has been isolated from the inflorescence of *Artemisia scoparia* at a 0.91 per cent yield. In addition to scoparone, two more coumarins, and five flavonoids have been isolated and characterized.

Ephedrine from the stems of *Ephedra foliata* has been found to be an effective cardiac stimulant for the heart, and also useful for bronchial asthma. E. *foliata* grows profusely in the Thar Desert.

Isohexenylnaphthazarins are considered a new class of drugs and some of them possess anti-cancer properties. Five isohexenylnaphthazarins have been isolated from the roots of *Arnebia hispidissima*, a desert plant from western Rajasthan.

Withanolide D and Withaferin A from the leaves of *Withania somnifera*, which grows profusely in the desert region is emerging as a valuable medicinal plant with anti-cancerous and anabolic properties. They have significant anti tumor activity in-vivo against "sarcoma 180 cells" in mice. They also inhibit RNA synthesis in them. The roots of *Withania somnifera* are highly "anabolic". Dried root powder has been found to accelerate growth in children and retard the process of ageing in older people.

The desert plant *Tribulus terrestris* has several chemical compounds which are proving useful in the treatment of urinary diseases. *Calotropis procera* which is one of the dominant flora in the Thar Desert yields valuable drugs from its flowers and leaves for the treatment of chronic bronchitis and asthma.

The medicinal oil bearing *Eucalyptus* species namely *E. sideroxylon*, and *E. viridis* have been studied. The essential oil from *E. viridis* is rich both in oil (1.082.1 per cent) and cineole contents (93 per cent). At present the chief source of medicinal oil in the country is *Eucalyptus globulus* in which the reported cineole content is 60 per cent.

Rotenone which is the most effective insecticide among rotenoids has been isolated from *Tephrosia villosa*. Another source of biopesticides is Guayale *(Parthenium argentatum)*, which grows wild in the Thar Desert of Rajasthan.

d) ***Raw Materials for Perfumeries***

The essential oil extracted from the leaves and inflorescence of *Cymbopogon martinii var motia* is in great demand in the perfumery industry, especially for its high geraniol content. Jojoba *(Simmondsia chinensis)* whose oil is equivalent to Sperm whale oil is in high demand in perfumery industries. Jojoba grows well in the Thar Desert.

Commiphora wightii and *C. mukul* which grows naturally in several parts of the Thar Desert is emerging as an important medicinal plant for the cure of chronic diseases. Its gum-resin exudate from the bark forms the "Indian Bedenium" (Guggal) which is used in the perfumery industry to manufacture *agarbatti* (perfume sticks).

d) ***Raw Materials for the Petroleum Industry***

Some species of xerophytic plants which grows profusely in the wild in the Thar Desert e.g. *Euphorbia Caducifolia, Jatropha curcus* and *Calotropis procera* are very promising sources of rich hydrocarbons (C-15 compounds) and are classed as petro-crops. Euphorbia burns fiercely upon combustion and its latex is now being processed in the United States to obtain petroleum products. The oil obtained from the latex of *Jatropha curus* is very close to diesel oil in chemistry. The latex of *Calotropis procera* which grows profusely and is one of the most successful colonisers of the Thar Desert holds exceptionally big promise as a petro-crop (Sinha 1993).

Cattle Rearing Potential in the Thar Desert

Cattle like sheep, goats and camels are an important livestock species of the Thar Desert. A large percentage of the livestock found in the desert, are nondescript. There are some important dairy breeds e.g. *Tharparkar, Rathi* and *Gir*; draft animals breeds e.g. *Kankarej,* and *Naiguri,* and dual purpose breeds of cattle. The usual husbandry practice is to raise the sheep and goats in mixed flocks.

The sheep population in Rajasthan forms about 20 per cent of that of India, and 63 percent live in the Thar Desert. The sheep produce about 15.47 million kg of wool, which is about 45 per cent of the total wool production of the country. Twenty five per cent of the wool produce of the desert is fit for apparel production. The important breeds of sheep are *Chokla, Pattanwadi, Magra, Marzvari, Nali, Pugal* and *Jaisalmeri*. The first two breeds produce medium apparel or good carpet-quality wool, whereas the other five breeds produce medium to good carpet-quality wool. Most of these breeds are lighter in body weight and produce small lambs and have lighter fleeces. Improvement in the production of wool and its quality regarding the apparel wool is possible by crossing the carpet-wool breeds such as *Chokla, Pattanwadi* and *Nali*, with exotic fine-wool breeds, such as the *Merino* and *Rambouillet*. The exotic inheritance at 50 per cent seems to result in the maximum overall improvement. Selection within the other breeds producing wool *(Marzvari, Magra, Pugal, Jaisalmeri)* for fleece weight will improve both wool production and quality for carpet making (Anonymous 1988).

The goat breeds of the Thar Desert are reputed for their high milk production potential and are prolific breeders even under adverse conditions. The important breeds of goats in the area *are Marwari, Jhankrana, Sirohi, Beetal, Jamnapari* and *Barbara*. The *Jamnapari* and *Beetal* are heavier and taller breeds. The *Barbara* is a short and light breed and the other breeds are medium in size and bodyweight. Most of the breeds are highly prolific and twins and triplets are quite frequent. Some of these breeds, e.g. *Marwari,* produce hair which is shorn and has a good export market. The improvement of the nondescript goats for milk production can be brought about through upgrading them with breeds such as the *Beetal, Jhakrana* and *Jamanapari*. The improvement of the three above-mentioned breeds for milk production can be done through selection within the breeds and also by crossbreeding them with exotic dairy breeds, e.g. the *Alpine and Saanen*. Crossbreeding with the above exotic breeds would produce much faster growth and would also reduce the age at which the first kidding can take place.

CAZRI Jodhpur has, produced a new breed of milch goat from Rajasthan desert and has named it as the *Parbatsar* breed. This breed has distinctly superior potential as a milk-yielder for the desert region (Anonymous 1995).

Buffaloes are mostly of the *Murrah* breed or its grades and of the *Mehsana* breed, which are good for dairying. Their average milk production is better than that of cows, but they are seasonal breeders and have poor reproductive efficiency. Their breeding capacity can be increased through selective breeding and cross-hybridisation.

In spite of the large genetic variability present, selection among or within breeds of livestock is slow because of the very low level of performance. It may take about 75 years to double the milk production in the case of cattle through selection. Crossbreeding with superior exotic dairy cattle, e.g. Holstein-Friesian, Brown Swiss, Jersey and Red Dane, improves milk production to an economic level and also improves reproductive efficiency. Exotic inheritance around 50 per cent is found to be optimum in the Thar Desert (anonymous 1988).

Potential for Pisciculture (fish farming) in the Thar Desert

The arid zones of Rajasthan, wherever sufficient surface water resources, sweet or saline are available, there is the potential for fish farming, both for freshwater and marine fishes. The availability of water from the Indira Gandhi Canal has raised the possibility of large scale pisciculture in the Thar Desert. In Sikar and Jhunjhunu districts, experimental ponds have been made to rear common carp *Rohu, Katla* and *Mrigal* and good results have been achieved. On an experimental basis *Prawns* are also being raised in saline waters in the Thar Desert. Fingerlings of the carp *Cirrhinus mrigala* (av. wt- 40 gms) were released in a tank in the desert region of Barmer. Body weight increased seven times within three months. In one of the bigger tanks (630 m^3) constructed by CAZRI at Barmer, fish culture is giving good results. The weight of breeder fish (Chinese carp) increased by 34 times within four months of their release. The fingerlings gained more than six times their weight in just 2.5 months. There is a bright future for pisciculture in small ponds in the Thar Desert (Anonymous 1995).

Potential for Agriculture in the Thar Desert

The main crops in the Thar Desert are *bajra* (pearl millet), *jowar* (sorghum), *sesamum*, wheat and gram. Mustard has become another valuable crop for the Thar Desert recently with the development of canal and sprinkler irrigation. Together these crops account for more than two-thirds of the total area cultivated in the *Kharif* and *Rabi* seasons. *Bajra, jowar* and *sesamum* on the one hand, and wheat on the other represent two different types of sustainable food crop production in the Thar Desert. The former, all of them traditional crops, are preferred by farmers for their drought-resistant qualities. As the traditional cereals such as *bajra* and *jowar*, grown in the *kharif* season (June-October) are multipurpose crops grown for grain, fodder, fencing and thatching material (Sen and Bansal 1979).

The availability of irrigation water from the Indira Gandhi Canal, which brings sweet Himalayan water to the thirsty Thar Desert and the profitability of particular crops have been two key factors promoting crop intensification in

District	Bajra		Wheat	
	1976/1977	1987/1988	1976/1977	1987/1988
Jaisalmer	*	0.32	*	0
Bikaner	**	1.57	6.6	0
Barmer	0.6	3	3.77	0
Jodhpur	7.72	21.5	27	18.24
Churu	0.46	8.1	28.7	99.6
Nagaur	2.4	16.45	18.6	12.04
Jalore	7	33.62	53.11	3.85
Jhunjhunu	@	60.2	@	50.43
Pali	40	49.5	25.51	0.52
Sikar	5	23.11	78.4	42.4
Ganganagar	4.63	43	47.04	
Arid Zone	4.47	20.05	39.26	48

*Included in Jodhpur. **Included in Churu. @Included in Sikar

Source: NORAGRIC Occasional Paper Series C (Development & Environment No. 13, 1994).

Table 1: High Yielding Varieties of Bajra and Wheat grown in the Thar Desert of Rajasthan (per cent of the area sown)

(I) Kharif Crops	(Intensity 47%)	(II) Crops	(Intensity 63%)
1. Vegetables	1.0	1. Wheat	30
2. Cotton	16.5	2. Mustard	10
3. Groundnut	5.0	3. Gram	20
4. Pulses	7.5	4. Sugarbeet	2
5. Fodder crops	4.5	5. Berseem (as fodder)	1
6. Bajra	12.5		

Source: NORAGRIC Occasional Paper Series C, No. 13, 1994)

Table 2: The revised Cropping Pattern in the Thar Desert of Rajasthan after the introduction of the Indira Ghadi Canal

the Thar Desert. Farmers with access to irrigation have been responding to price signals by switching to more profitable crops. In recent years, areas cultivated with cotton (*kharif*) and mustard (*rabi*) have increased due to their higher profitability. Currently, mustard is the major *rabi* cash crop in Jaisalmer and cotton is the major *kharif* cash crop in Ganganagar. Three hundred and ten thousand hectares of cotton were cultivated in 1987/1988 (Shanmugaratnam 1994).

At present, about 63 per cent of the total area of the Thar Desert is officially treated as agricultural land which includes the net sown, current and longer-term fallow lands. In the districts of Ganganagar, Bikaner, Barmer, Jodhpur and Churu, crop production has extended far into the marginal lands. Of these districts, Ganganagar has the largest share of the total cropped area irrigated (almost 80 per cent in 1987/1988) due to the Indira Gandhi Canal system. Bikaner, has undergone unprecedented land conversion for crop production only partly due to the Indira Gandhi Canal and other sources of irrigation in the district.

Intensive crop production and the green revolution in the Thar Desert of Rajasthan takes place within the 1.3 million hectares of assured irrigation. More than half of this land lies in a single district of Ganganagar. This irrigated land, however, is fragile as it is predisposed to salinisation and alkalinisation due to subsurface drainage problems and waterlogging in many areas. The sandy soils have a low productive potential and are more susceptible to wind erosion. Some strains of wild wheat, barley, rice, millet and sorghum have been found to grow well in the saline soils of the Thar Desert in Rajasthan. Their germplasm could be used to create salt resistant new crops to reclaim the saline aridlands of the world.

Agroforestry through the use of biodiversity in the Thar Desert

Farmers in the Thar Desert of Rajasthan practice agroforestry by making use of biodiversity. *Bordi* a nitrogen-fixing legume crop mostly grows with *Bajra* (pearl millet), the plants are not cleared. While ploughing and weeding, bordi plants are not removed. Bordi plants sprout each year from the root stock, which is left in the fields in the preceding year. The plants also establish themselves from the seeds which fall in the fields. Twenty to thirty years ago an acre of land sown with *bajra* contained about 100-120 plants of *bordi*. However, with the introduction of the tractor the majority of bordi plants got removed and the density per acre has reduced to only 25-30 bordi plants. Most knowledgeable farmers lament the reduction of bordi plants, particularly with regard to its excellent feed, fencing, fertilizer and food values.

The leguminous tree *Khejri (Prosopis cineraria)*, in the Thar Desert of Rajasthan grows well in combination with crops such as *bajra*, legumes (moth-moong) and oil seeds. The density of this traditionally preferred tree on one acre plots under crops, was about 25 to 35 trees. The introduction of the tractor for cultivation purposes has affected the density of these trees on the field boundaries. The khejri provides livestock feed (leaves) vegetables and timber. When left unpruned the leaves that fall on the ground add fertility to the soil (Swaminathan & Ravindran 1993).

Concluding remarks

Today there are many reasons for scientists and planners to concentrate on studies of arid zones. The spectre of an ever increasing human population holds a tempting prospect to many of the vast empty lands and deserts as future areas of human settlement and agricultural production.

There is some anxiety among certain sections of the Indian ecologist community about ensuing changes in the natural ecosystem of the Thar Desert and the cultural transformation of its inhabitants. But that is inevitable. History shows us that science and technology has affected human culture, raised human hopes and aspirations since the very beginning when the first wheel was invented. We cannot possibly suppress the hopes and aspirations of the desert people and keep a large section of Indian society away from the mainstream of development which is their legitimate right.

The Thar Desert of India will be reclaimed in the near future to feed our growing millions, for good or for evil, only time will determine. We cannot afford to keep a large landmass of earth unproductive and useless. Our aridlands are our future food banks, which will allow us to draw on its resources for time to come provided we use them more judiciously and sustainably, without impairing its carrying capacity. However, this will be achieved at a price: the total transformation of its natural ecosystem. Our growing population, pressing socio-economic and political exigencies will perhaps care very little for such a transformation of one of natures wonders (Sinha 1993b).

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Water Erosion Indicators[1]

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Introduction

The total area of Kenya is about 583,000 km2 of which 17.7 per cent is traditional agricultural and forest land. The rest can be considered as either arid or semi-arid land (rangelands or grazing lands). Kenya, being an agricultural country, depends almost entirely on the maintenance of productivity on its small proportion of arable land.

Steep ridges and valleys descending into permanent rivers are dominant features of the high and medium rainfall areas of Kenya. In semi-arid and arid areas where the rainfall is generally low, unevenly distributed, and of short duration, soil erosion is also prevalent due to the high rainfall intensities and low water-holding capacity of the soils (see fig. 1).

Most arable land and rangeland is affected by some degree of land degradation caused by erosion. The soil erosion problem is largely ecological and socio-economic, and the variables and interrelations are a major factor in understanding the complexity of the soil erosion problem. Some of the important factors are:-

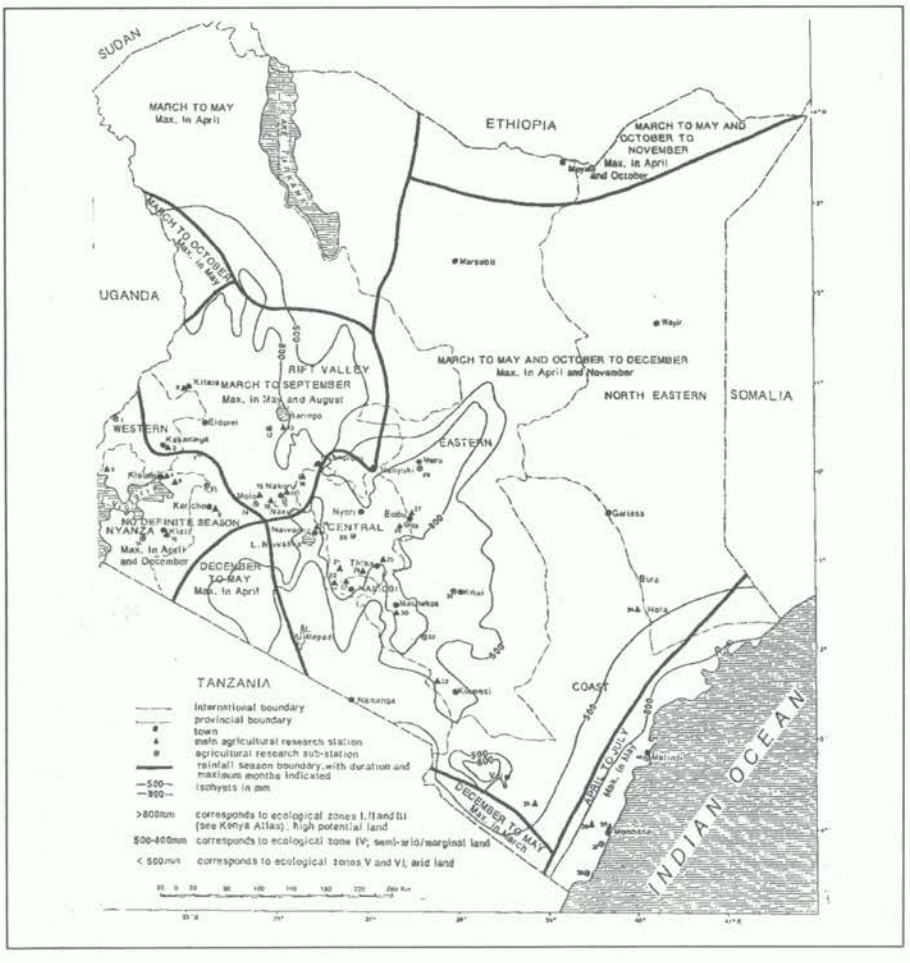
- The amount of ground cover present when the erosive forces of water are introduced;
- The erosivity of the rainfall;
- The erodibility of the soil;
- The angle and length of the slope;
- The volume and velocity of runoff.

Numerous studies have been conducted to assess the nature and extent of soil erosion in Kenya. They indicate that the major forms of erosion are sheet, rill, gully and riverbank erosion and that areas prone to gullies include bare land, animal tracks, faulty drainage from roads and neglected rills and furrows. Dunne (1978) estimated that up to 35 per cent of the sediment load from 61 catchments in Kenya originated from roadside gullies and an equal amount was derived from footpaths and cattle tracks.

Erosion in natural forest is reported to be minimal and within the soil loss tolerance. Encroachment of the forest areas for grazing, harvesting of forest products and cultivation is, however, posing a real threat to the environment, particularly where conservation measures are inadequate.

Erosion of cultivated land is closely related to rainfall, landform, soil, footpaths and cattle tracks use and level of conservation. The areas at greatest risk when conservation measures are not employed include:

- Steep slopes, those beyond the legal limit set by the Agricultural Act (Slope greater than 55 per cent);



Agro-climatic zones based on rainfall

[1]National Land Degradation Assessment and Mapping in Kenya

- Land under annual crops that is clean-cultivated before the onset of the rains;
- Soil with a surface sealing problem and where destruction of natural soil aggregation and stability by inappropriate tillage systems is common;
- Cultivation up and down slopes (mainly due to hoe cultivation of steep slopes);
- Land clearing and/or cropping that leaves the soil exposed during heavy rains or winds; and
- Poor land use planning and cultivation of marginal areas.

Erosion of grazing land has, and continues to be, a major problem particularly in semi-arid and arid areas. This is caused by overgrazing, poor quality pasture and concentration of livestock around watering points and dips.

Communal land generally experiences high rates of erosion. This can be attributed to improper siting of buildings and concentration points for livestock watering, dipping facilities and domestic water supplies, as well as inadequate control of runoff from such areas.

Stream bank and bed erosion is not a major problem in tributaries and rivers which have rock bottoms and fully defined flow paths that are well vegetated. However, some rivers, especially in semi-arid and arid areas, flow through alluvial plains forming meandering channels whose paths are influenced by floods, the physiography and the character of the vegetation of the flood plain. Little is known of the rate of lateral erosion and the morphological impacts on the channels.

Causes of water erosion:

Soil erosion is essentially a two component process:

(i) Loosening or detaching of soil particles caused largely by raindrop impact and scouring by flowing water; and

(ii) Transportation of soil particles, by flowing water.

Erosion occurs when farming practices fail to take into account soil, that is, the ease with which soils can be washed away. Overstocking and overgrazing have caused untold damage in some areas of Kenya. In these areas, where vegetation has been depleted, soil is compacted and a lot of runoff is generated which leads to severe erosion.

Another major cause of erosion, especially in arid and semi-arid lands, is the opening up of saline and alkaline soils. These are soils which have an inherent poor structural stability. Thus, when vegetation is cleared the soils are exposed to rain drop impact and hence, accelerated erosion leading to the formation gullies. The gullies in these soils are very difficult to reclaim once they are initiated.

Other examples of inappropriate farming techniques which cause erosion include deep ploughing of land, lack of crop rotation, the planting of crops and ploughing down the contours etc. Nearly always, it is exposed land which erodes while land covered with vegetation is stable.

Types of water erosion:

Splash erosion

This occurs where vegetative cover is stripped away and the soil surface is directly exposed to raindrop impact. Raindrops striking on bare soil break the soil aggregates separating the fine particles and organic matter thus destroying the soil structure. If the soil is on a slope, gravity will cause the splashed particles to move downhill.

The factors influencing splash erosion are:

- Raindrop size and its impact energy;
- Soil structure;
- Slope of the land;
- Ground cover etc.

Sheet erosion

This is the most insidious form of soil erosion, whose occurrence often goes unnoticed when the whole surface of a field is gradually eroded in a more or less uniform way. The only evidence of sheet erosion may be that the roots of trees or crops or the bottom of fence posts become increasingly exposed. Yet by the time the farmer notices he may have lost tons of soil per hectare.

Rill erosion

This form of erosion begins when shallow surface flow starts to concentrate in low spots on the soil surface. As the flow changes from sheet flow to deeper flow in these low areas, the velocity and turbulence of flow increases. The energy of this concentrated flow is able to both detach and transport soil particles. This action begins to cut tiny channels called rills (small well-defined channels) that are at most only a few centimeters deep.

Gully erosion

Gullies are formed when runoff cuts rills deeper and wider or when flow from

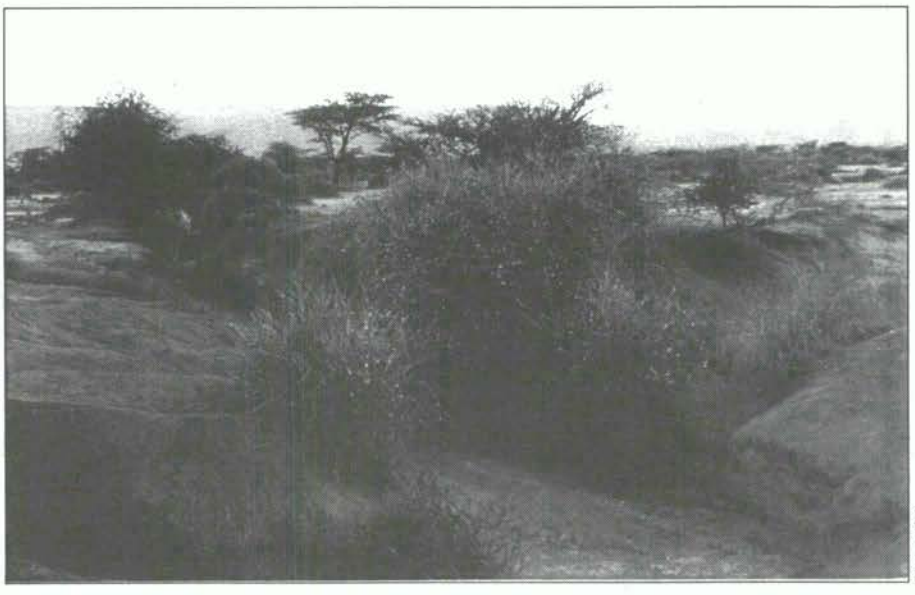


Photo IPA

Gully erosion in Kajiado District, Kenya.

several rills comes together to form a large channel. Gullies can expand both uphill and downhill. In addition, large chunks of soil can fall from a gully headwall in a process called mass-wasting. This soil is later carried away by storm water runoff.

Land slide

A land slide is usually a process of geological erosion, and although its occurrence may be accelerated depending on the circumstances, i.e., slippage of gully sides, it can occur without any intervention by man. It is prominent in high rainfall areas with deep soil where water infiltrates the bed rock vertically and then laterally along the bed rock. Recent examples can be found in Kandara and Kangema in Murang'a and Mukurweini.

Factors influencing soil erosion:

The four principle factors affecting soil erosion are climate, soil characteristics, topography and ground cover.

Climate

Climate affects erosion potential both directly and indirectly. Rainfall erosivity i.e. the momentum energy of rainfall is the driving force of erosion. The erosive power of rain is determined by the rainfall intensity (mm/hr) and droplet size.

Soil characteristics

Soil erodibility is influenced by slope, soil type, climate, soil surface characteristics, susceptibility of top soil to surface sealing and crusting, organic content etc. Table 1 shows the four general soil characteristics important in determining soil erodibility.

Topography

The slope lngth and slope steepness determine the velocity of runoff. The energy (and thus the erosive potential) of flowing water increases as the square of the velocity. Long, continuous slopes allow runoff to build momentum. The base of a slope is more susceptible to erosion than the top because runoff has more momentum and is more concentrated as it approaches the bottom of the slope.

Soil Property	Influence on soil erodibility
Soil texture	Determines the detachability of soil particles, rate of infiltration and thus runoff (coarse textured soils have low erosion potential; clay particles bind the soil together and make a soil resistant to erosion; finer particles are more susceptible as they travel great distances before settling).
Organic mater content	This improves soil structure and increases content permeability, water holding capacity and soil fertility. Organic matter in an undisturbed soil or in a mulch covering on a disturbed site will reduce the runoff and consequently, erosion potential. Mulch on the surface also reduces the erosive impact of raindrops.
Structure	Soil structure determines the ability of the soil to aggregate and to absorb and retain water. When the soil surface is compacted or crusted, water tends to runoff rather than infiltrate. Soil with high water holding capacity reduces runoff and encourages plant growth.
Permeability	Soils with high permeability produce less runoff which minimizes erosion potential. The higher water content of a permeable soil is favourable to plant growth.

Table 1. Soil factors influencing erodibility

Ground cover

Ground cover includes vegetation and surface treatments. It influences erosion in the following ways:

- Reduces raindrop impact on soil surfaces;
- Slows the velocity of runoff;
- Holds soil particles in place;
- Maintains the soil's capacity to absorb water.

Assessing soil erosion hazard

Soil erosion is a complex process, involving the transformation of rainfall energy into downslope sediment movement, either by rainsplash or by overland flow. The rate of soil erosion can be assessed using a wide range of techniques.

The common ones include:

(i) Small plots can be treated with simulated rainfall and the runoff and eroded sediments monitored over a range of land conditions;

(ii) Sheet and rill erosion can be monitored by placing troughs at the foot of plots or slopes or by measuring exposure of pins hammered into the ground;

(iii) Monitoring exposure of roots of some identified trees and grasses;

(iv) The amount of soil loss through sheet wash and rill erosion can be monitored through measurement of sedimentation rates of rivers and dams;

(v) Long-term effects of erosion can be mapped with the aid of remote sensing techniques. Large scale aerial photographs or satellite imagery could be taken after a given number of years and utilized for assessing changes in land use and vegetation and thus identify terrains and soils that face erosion hazards.

There are natural detectable references which have been used to evaluate the lowering of soil surface. The ones commonly used are exposure of tree roots, fence posts and mounds of residual soil.

It is possible to reconstruct the recent erosion history of an area by truncation of soil profiles from the height of residue

soil pedestal, or from the exposure of tree roots. Care should be exercised when using these methods, and local undisturbed soils and tree roots need to be examined in detail. Before such a measurement is done, the investigator should examine roots of trees of the same species in neighbouring areas as some trees even on undisturbed sites grow with part of the roots above the ground surface.

Fence posts often show marks indicating the position of the soil surface at the time of installation if no mounds are made. The difference between this height and the present soil surface divided by the age of the fence line gives the soil erosion rate (Dunne,1978).

Mounds of residual soil protected under the canopy of trees while the surrounding is lowered can serve as a useful indicator of the original soil elevation. The main problem with this technique is estimating the time over which erosion has taken place. This problem can be solved if there is evidence that erosion was accelerated after human interference whose starting date is known.

Impact of erosion on land productivity

Land productivity is the capacity of a soil in its normal environment to produce a particular crop or sequence of crops under a specified management system.

The impact and extent of soil erosion are inseparable in this country. The quantitative determination of the soil erosion is not documented i.e talking about tons/ha has no meaning unless the judgement of impact on land productivity is done.

The little, scattered information and documentation about erosion in Kenya shows that accelerated erosion is a problem of considerable magnitude.

Soil erosion decreases land productivity through the loss of:

(i) Soil water available to plants, - this is reduced by changing the soil water holding characteristics of the root zone, by reducing the depth of the root zone and hence the volume of water that can be held;

(ii) Plant nutrients are lost when eroded soil particles carry attached nutrients into streams. Farmers always tend to add a lot of inorganic fertilizers to maintain yields;

(iii) Soil structure - poor soil structure leads to more erodibility due to lack of stability of the soil clods. This is manifested by surface sealing, crusting and poor seedbeds. Crusting and sealing reduces seedling emergence and therefore low moisture which leads to poor productivity of the crops. Crusts and seals also reduce the infiltration rates thus generating runoff which initiates soil erosion;

(iv) Topsoil within a field - erosion does not occur uniformly across the field due to runoff networks and topography. This leads to nutrient losses which are very valuable for plant growth;

(v) Rapid population growth also reduces land productivity due to the intensive use of land and the opening up of new, fragile lands.

Soil erosion indicators of land degradation

Crusting and sealing

Soil sealing and crusting are caused by various factors; which include:

(i) Low organic matter;
(ii) Dispersion of clay;
(iii) High silt/clay ratio;
(iv) High bulk density.

All these have an effect on the soil structure. The above factors lead to low structural stability of the soils. Soils with low structural stability are prone to water erosion. When these soils are not covered with good vegetation or any other surface cover, then any small rain shower has a tremendous erosional effect on these soils.

When a soil is found to have low organic matter, high dispersive clay, high silt/clay ratio and high bulk density, there is sufficient reason to be concerned about the possibility of serious soil erosion. If such areas are not protected from soil erosion, they will eventually turn into badlands and hence reduce yields. All the listed soil properties have a direct effect on erodibility in the Universal Soil Loss Equation (USLE).

Saline soils

Saline soils are characterized by high amounts of soluble salts. Some of these soils have high salt contents near the surface. Plant growth in saline soils is adversely affected by soil-water availability because of the soil solutions high osmotic pressure. Toxic concentration of specific ions may also affect plant growth. This will always lead to poor vegetation cover. These soils have electroconductivity values of more than 4 mmhos/cm.

Sodic soils

Sodic soils have a very unstable structure due to the high concentration of sodium in the soil exchange complex. They also have a high exchangeable sodium percentage (ESP). When the ESP is over 6 per cent, then the soil is considered to be sodic and when it reaches 15 per cent then it is considered critical. Sodic soils are prone to degradation due to their poor structural stability.

Erosion features

The main erosion features are rills, muddy water and mud flows, turbidity, gullies; exposed roots, exposed parent material, uneven top soil, deposits of debris and soil on gentle slopes, exposed roots in stream channels, soil movement (dune formation); sediment deposition in reservoirs, vegetation species changes, land slides, etc.

Study approach and methodology

Kenya Soils and Terrain Database (KENSOTER)

In 1993, KSS embarked on creating the KENSOTER database on a 1:1m scale using a World Soils and Terrain Database (SOTER) methodology (Van Engelen and Wen 1995). This was done in collaboration with UNEP and the International Soils Reference and Information Centre (ISRIC).

So far, the KSS staff have collected and input all available data in the country on soils, terrain, climate, vegetation and land use into a digital database for 397 map units, hereafter referred to as SOTER units. Two hundred and sixty six SOTER

units out of the total number of 397 have profile data. Data on slope steepness and length are also available. There is very little data on vegetation cover.

SOTER provides an orderly arrangement of natural resource information through the creation of a computerized database containing all available attributes. When linked to a Geographic Information System (GIS) the natural resources can be displayed as a separate layer of overlay, or in tabular form.

One of the main advantages of storing soil and terrain information in a digital database rather than as conventional multiple purpose maps, is that tailor-made thematic maps can be derived on request, using the database as a basic source. The derivation of water erosion risk maps is one important application. Shields and Coote (1989) proposed the use of SOTER with Universal Soil Loss Equation (USLE) Wischmeier and Smith (1978), because it is the best known and most extensively applied method for estimation of soil loss. Rademacher (1991) suggested that other relatively simple erosion models can also be applied to SOTER e.g Soil Loss Estimation Model for Southern Africa (SLEMSA).

SOTER Water Erosion Assessment Programme (SWEAP)

ISRIC has developed SWEAP. This computer programme is designed to facilitate the use of the SOTER database for erosion hazard risk prediction. The programme is composed of two subsystems: a user interface or menu, and the actual model.

Some of the main characteristics of this programme are:

- Two alternative erosion assessment models, based on SLEMSA and USLE, can be selected;
- The programme uses a "time step" of one month. Seasonals dynamic of crop cover and rainfall erosivity are accounted for within the programme;
- USLE model employs Wischmeir and Smith "K-nomograph";
- Optionally, crop cover (C) can be read directly from file, or calculated from relationships between C and leaf area and cover;
- Crop management is taken into account by adjustment of the crop protection factor, crop residues are assumed to decay exponentially with time after harvest;
- A simple agro-ecological zoning module is built into the programme to calculate potential growing period when needed;
- A user friendly menu oriented interface to assess erosion risk under different land use systems or scenarios;
- Conversion tables are stored in external ASCII files that can easily be adapted as required. Results must be interpreted in terms of abstract "erosion hazard units" (EHU's), rather than as quantified estimates of potential soil loss.

Having just completed the creation of the KENSOTER database, the KSS embarked on the application of SWEAP using the USLE erosion model.

SWEAP units are supposed to be presented at a mapping unit level which covers large areas. At smaller scales, (SOTER 1:1 million) uniform slopes hardly occur and some places will be eroded whereas others will receive sediments. Therefore, SWEAP results are interpreted such that A is an abstract indication of erosion hazard, expressed in erosion hazard units (EHU) (Stocking *et. al.* 1988) rather than quantified estimates of soil loss in tons ha/yr.

Collaboration with ISRIC

ISRIC has provided guidance to KSS on the application of the SWEAP model using the KENSOTER database. Some of the major issues discussed with ISRIC concerned the demand by the programme for complete climatic data (rainfall, temperature, humidity, sunshine hours etc.) for SOTER units with annual cropping (AA units) as their land use. There are very few climatic stations in Kenya with this type of data.

Results

Erosion Surveys conducted by Kenya Soil Survey

The KSS has produced a soil erosion hazard map based on an earlier assessment (Gatahi and Okoth, 1990).

Kenya Soil Survey has been conducting erosion hazard surveys for areas where reconnaissance soil surveys have been conducted at scales 1:100,000 and 1:250,000 for high and low rainfall areas respectively. However, in 1990 KSS developed a water erosion hazard map for the whole country at 1:1 million scale. This map has been updated wherever possible and together with the status maps derived from the KENSOTER database, has been digitized and has been incorporated into the GIS database. The results have been reviewed during national and district workshops. A few anomalies were noticed but the assessment was considered reasonable at a scale of 1:1 million.

The application of the SWEAP

Experience from this project suggests that the SWEAP programme is useful but still needs further evaluation and improvement. The main problem in its application (like any programme of its kind) is procurement of appropriate parameter values to be used in transfer functions and conversion tables, and to define their range of validity.

There are also some practical problems in the application of the programme in the USLE model which was intentionally designed for erosion assessment at the farm level (plot):

(i) Some of the input data needed to feed this model (e.g K values, rain erosivity and the C factor) are not available for all SOTER units and therefore are not included in the KENSOTER. For example, for the model to be able to calculate the growing period for annual crops, it requires all the climatic parameters within the climatic stations (climatic parameters). There are 1,027 stations scattered all over the country. Out of these only 35 have complete data and the rest have mostly rainfall data. Therefore, the model has to be adjusted to be able to use the available data only;

(ii) To calculate the erodibility of a particular soter unit, the model requires soil data on organic carbon, structure, drainage and texture. To

get the rest of the soil information, synthetic profiles have to be generated for the whole country using expert guesses of all parameters;

(iii) It was not possible to apply the SWEAP programme to a selection of soter units which are not sequentially arranged;

(iv) The programme requires a complete set of climatic data in order to calculate the growing periods of annual crops and hence the ground cover.

Recommendations

(a) In order to facilitate application of the SWEAP, every effort should be made to fill data gaps in the KENSOTER database;

(b) SWEAP should first be tested on representative pilot catchments to assess its reliability. The programme can then be intensively used and the results validated and extrapolated to other areas. Sensitivity analysis should be done to the model before it is used on a large scale;

(c) There is a need for further studies to integrate SWEAP, especially on climate, soil, land use and vegetation datasets.

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Strategy to Combat Desertification in Central Asia

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Summary

Central Asia includes five countries: Kazakstan, Uzbekistan, Kirgyzstan, Turkmenistan and Tajikistan. This region occupies the area of 3,994 thousand square kilometres, with a population of 53.8 million. The population has more than doubled in the last 30 years. Desertification in the subregion is caused by human activities: over-irrigation, overgrazing, cutting trees and shrubs, construction work, etc.

People living in the zone affected by desertification suffer from many diseases caused by the consumption of polluted water and contaminated food. A rough estimate shows that desertification costs Central Asian countries three per cent of national income per year. Desertification control includes preventive measures, corrective measures, measures on the full rehabilitation of degraded lands and supporting measures. The International Convention to Combat Desertification promotes new approaches through the realization of National Action Programmes to Combat Desertification. Two countries of the subregion - Kazakstan and Turkmenistan have signed the Convention and have already developed the National Action Programmes to Combat Desertification.

Causes and sequences of desertification

The above five countries of the subregion proclaimed their independence from the Soviet Union in 1991. The land area and population of these counties are given in Table 1.

Countries	Land area thousand km^2	1959	1970	1979	1989	1996
Kazakstan	2,713.3	9.293	13.009	14.68	416.538	16.791
Uzbekistan	447.4	8.119	11.799	15.391	19.906	22.193
Kirgyzstan	198.5	2.006	2.934	3.529	4.291	4.461
Turkmenistan	488.1	1.516	1.159	2.759	3.534	4.500
Tajikistan	143.1	1.981	2.900	3.801	5.112	5.707
Total	3,994.4	22.975	32.801	40.164	49.381	53.786

Table 1: Land area and population of Central Asian countries (A.G. Babaev, N. G. Kharin, 1994)

These countries have much in common: the physical environment; economic heritage from the former USSR: similar traditions in agriculture; and a similar culture and religion (Islam).

High air temperature in summer, scarce atmospheric precipitation and long periods of drought are the main climatic features of the territory. Atmospheric precipitation totals 80-150 mm in the desert, 250-350 mm in the piedmont plains and 400-500 mm in the mountains. According to N.G. Kharin *et. al.* (1993) seven per cent of the territory is severely affected by desertification, 34 per cent is moderately affected by desertification and the rest is slightly degraded. Desertification in the subregion is mainly caused by human activity: overgrazing, over-irrigation, cutting trees and shrubs, the uncontrolled movement of motor vehicles etc. Water from two big rivers - the Amudarya and the Syrdarya - has been diverted for irrigation. As a result the surface of the Aral Sea was reduced from 64.1 thousand square kilometres in 1960 to 34.1 thousand kilometres in 1991.

Population growth is one of the major factors of land degradation. Table 1 shows that the population more than doubled over the last 30 years. In general the demographic process in Central Asia is following a pattern common to all developing countries: "high birth rate - high mortality" contrary to the model for developed countries: "low birth rate - low mortality".

The size of agricultural lands is given in Table 2.

Categories	Kazakstan	Kirgyzstan	Uzbekistan	Turkmenistan	Tajikistan	Total
Arable land	36.000	0.573	4.183	1.233	0.822	42.775
Haymaking land	0.300	0.166	0.119	0.009	0.030	0.624
Rangeland	180.000	5.233	23.144	34.527	3.435	2465.339
Total	218.300	6.340	31.670	/37.100	5.000	298.410

Table 2: Distribution of agricultural land in Central Asian by categories (A.G.Babaev, N.G.Kharin,1994), thousand hectares

Irrigated farmland occupies 8.672 million hectares. Cotton is cultivated in all countries of Central Asia. The production of cotton in 1992 (thousand tonnes) was: in Kazakstan 315.0, in Kirgyzstan 68.0, in Uzbekistan 6,292.0, in Tajikistan 920.0, in Turkmenistan 1,457.0. Livestock numbers (million heads) totalled: cattle 17.4, sheep and goats 64.1, pigs 4.9, horses 2.0, camels 0,23 (A.G.Babaev, N.G.Kharin, 1994).

In the zone affected by desertification, the people consume polluted water and agricultural products contaminated by chemicals. A special study was conducted by the World Bank in Turkmenistan. Infant mortality in the country was the highest in Commonwealth of Independent States (CIS) (46 per 1,000 births) and longevity was the shortest (66 years). In Tashauz Velayat, of Turkmenistan located in the lower reaches of the Amudarya, people suffer from respiratory and infectious diseases. Only 10.4 per cent of the families in the rural areas of Velayat had access to water-lines, 35.2 per cent used hand pumps and 44.6 per cent consume water from wells.

According to information from the World Health Organization (1995) in areas bordering the Aral Sea the following health problems are common:

- Diseases of the kidney and liver, arthritis, chronic bronchitis, enteric fever, hepatitis A,
- High infant and mother mortality;
- An increase in the number of inborne diseases;
- Children's diseases, spotted fever, tetanus etc;
- Diseases caused by the consumption of polluted water and environmental pollution, especially diarrhoea;
- Respiratory diseases, especially affecting children;
- Anaemia, most women suffering from it.

Desertification being a destructive process naturally causes economic and social damage. In our opinion, economic losses due to desertification include the following:

Direct losses (income forfeited)

- Loss of animal production on grazing lands;
- Loss of agricultural production on irrigated and dry lands;
- Loss of wood in degraded forests;
- Loss of other forest products;
- Loss of fish production.

Indirect losses

- The Expense of rangeland regeneration;
- The Expense of rehabilitating irrigated and dry farmlands;
- The Expense of regenerating forests;
- The Expense of controlling wind erosion;
- The Expense of controlling water erosion.

The economic losses caused by desertification in Turkmenistan have been calculated (National Action Programme, 1996). Direct and indirect losses totalled about US$347 million a year. At a rough estimate, desertification in Central Asia costs three per cent of the national income of all countries.

It is more difficult to calculate the social losses caused by desertification. They include the damage to human health, shorter lifespans, loss of recreational lands, and the damage to future generations.

Convention to Combat Desertification - new approaches and new hopes

The United Nations Convention to Combat Desertification (CCD) was adopted in 1994 and more than 100 countries have signed it. Only two countries in Central Asia - Kazakstan and Turkmenistan - are signatories.

The CCD promotes several new approaches in desertification control and gives hope to those countries which survive under severe ecological constraints. The concept of sustainable development is of great importance here. The CCD recommends socio - economic factors causing desertification must be taken into account. Ordinary people working in deserts often try to get an immediate income. They exploit drylands for survival. Unfortunately this approach leads to land degradation and impoverishment.

The CCD promotes a new instrument in desertification control at the global, regional and local levels (Articles 11, 12, 13,14). All measures on desertification control are realized through National Action Programmes to Combat Desertification (NAP). The NAP in Turkmenistan (National Action Programme, 1996) includes the following sections: the development of a national monitoring system, a strategy of utilization of water resources, conservation of biodiversity, melioration of irrigated farmlands, range management and improvement, conservation and regeneration of forests, stabilization of moving sand dunes, improvement of nature conservation legislation, ecological

education, research activities and international cooperation.

The NAP will be realized over many years through priority projects. However, the Government of Turkmenistan has no funds to implement this programme in full.

The CCD says that governments should create an "enabling environment", stimulating the implementation of NAP. The governments must issue and improve legislation which should be aimed at improving the income of the local population. Local people will be active partners of the process. People working in agriculture will take more responsibility for desertification control. Economic stimuli could play an important role in anti-desertification activities.

What about the Central Asian countries? The creation of an enabling environment is a thing of the future. Political, economic, ecological and social constraints are the main obstacles to sustainable development and desertification control. A conference on the problems of the Aral Sea was held in Ashgabat in July 1994. High officials from Central Asian countries and members of the International Foundation for Saving the Aral Sea discussed the problem of desertification control in the subregion. Each country promised to contribute one percent of the national income towards rehabilitation of the Aral Sea. But not a single member State to date has paid what is due. (Aral Sea, 1994).

Economic constraints are determined by the transition from a planned to a market economy. The newly independent countries inherited an economic system whose operating mechanism was developed during the existence of the USSR. Many obstacles in economic development arose due to unreasonable distribution of industrial enterprises, especially those which remained under the control of Moscow. The break of economic ties with the former Soviet Republics, the absence of hard currency and the introduction of national currencies aggravated the economic situation.

Ecological constraints are due to drought and desertification. Vast areas affected by desertification and the scarcity of water resources determine the low yield of agricultural crops. Yield of grain crops totalled (MT per hectare): in Kazakstan 0.85, in Kirgyzstan 3.22, in Tajikistan 1.60, in Turkmenistan 2.43, in Uzbekistan 2,45, and for cotton: 2.64, 2.10, 2.94, 2.34, 2.36 (A.G.Babaev, N.G.Kharin, 1994a).

The summer of 1995 was especially hot and dry. The State programme "Grain" proclaimed in Turkmenistan (B.Dzhumaev,1995) was aimed at grain self sufficiency. But because of the dry summer and bad management the programme failed. In the same year the yield of grain crops in Kazakstan totalled 0.5-0.7 MT per hectare.

Social constraints are due to low standards of living. In 1994, the minimum monthly salary totaled (in US dollars): in Kazakstan 0.99, in Kirgyzstan 3.75, in Uzbekistan 11.70,in Tajikistan 4.65, and in Turkmenistan 15.0 (A.G.Babaev, N.G.Kharin,1994). The introduction of the national currencies stimulated the further impoverishment of the people. Galloping inflation and the shortage of food are the reasons why two-thirds of the population live below the subsistence level. Ration cards on key food stuffs in Turkmenistan cannot solve the problem because the rate of food giving by ration cards is miserable.

Economic reforms in the subregion could stimulate activity on desertification control. According to A.G.Babaev, N.G.Kharin (1994a) the process of privatization of state property has begun in all countries under consideration.

In Kazakstan there are six national joint-stock companies, 18 State joint-stock companies and 48 State holding companies. Land tenure reform in Kazakstan embraces many different forms: personal, cooperative, and agricultural associations etc. The rural population gets land shares which can be used at their own discretion.

In Turkmenistan the programmes "10 Years of Stability" and "New Village" have been developed. In accordance with these programmes farmers can get plots of land up to 50 hectares on lease or in private use. But these reforms are going very slowly and only five per cent of production falls under the non-governmental sector.

In Uzbekistan 54,000 enterprises were privatized by the beginning of 1994. The private sector produced two thirds of dairy products, 70 per cent of the meat, 40 per cent of potatoes and 50 per cent of vegetables. Privatization embraced all branches of the natural economy.

In Kirgyzstan and Tajikistan the transition to market economy is at the initial stages.

The CCD proposes to replace "a top-down approach" by "a down-up approach". That means more active participation by local communities. During the Soviet period all measures on desertification control were realized on instructions given by administrative bodies. The role of local populations was passive. New policies on land privatization could stimulate ordinary people as new land owners. This being the case, the psychology of decision makers and local people should be changed.

All the countries of the subregion have developed new legislation on nature conservation and management of natural resources. New departments of nature conservation have been set up, for example: the Ministry of Ecology and Biological Resources in Kazakstan, the State Committee on Natural Conservation in Uzbekistan, the Ministry of Natural Resources Management and Nature Conservation in Turkmenistan etc. Several legislative regulations have been passed on land and water codes, land-tenure codes, forest codes, conservation of wildlife etc. The results of the activities of these administrative institutions will have a positive effect in future. The decree issued by A. A. Niyazov, the president of Turkmenistan, is a step in the right direction. According to this decree citizens of the country were provided with free water, natural gas and electricity. As a consequence people in the rural areas stopped cutting down trees and shrubs for fuel. This should help stimulate the regeneration of desert vegetation.

Measures to combat desertification depend upon the level of land degradation

According to methodology (N.G. Kharin *et al.*, 1993) for assessment of desertification, ecosystems were divided into three classes;

Slightly degraded ecosystems. They include ecosystems from non-degraded to slightly degraded, with loss of biological productivity of less than 10 per cent.

Moderately degraded ecosystems include lands which have lost their productivity by 10 to 50 per cent.

Severely degraded ecosystems include drylands from severely degraded to full loss of biological productivity.

According to our understanding measures on land rehabilitation can be illustrated in Table 3.

Urgent measures should be taken to improve the status of irrigated farmland because the population needs more and more food.

Capacity-building usually includes measures on ecological education, strengthening the knowledge base and training personnel. Capacity-building could embrace a set of actions which are necessary for the formulation and implementation of urgent remedies on desertification control. Priority should be given to capacity-building at the local level. A successful implementation of NAP depends on the awareness of the population and the participation of NGOs, political parties, women, war veterans etc. "National Awareness Day" on desertification control conducted in Turkmenistan in March 1996 demonstrated the importance of supporting measures on desertification control (N.G.Kharin,1996).

The CCD stresses the role of science and technology in desertification control (Articles 17 and 18). A well developed system of training personnel was created in Central Asia during the Soviet period. This system was destroyed in 1991 after the proclamation of independence. Newly independent countries are now trying to create a new system of public education

Concept	From none to slight desertification	Moderate desertitification	Severe to very severe desertification
Preventive measures	Conservation and rational utilization		
Corrective measures		Rational utilization combined with partial melioration	
Measures on full rehabilitation of degraded lands			Melioration of the whole area
Supporting measures	Capacity-building, training research, etc.		

Table 3: Measures on land melioration depending on the level of desertification.

Land use	Conservation and rational utilization	Rational utilization with partial melioration	Melioration of the whole area	Total
Forests	22.561	10.438	0.672	33.671
	67	31	2	100
Rangeland	16.997	7.145	0.492	24.634
	69	29	2	100
Irrigated farmland	0.867	7.025	0.780	8.672
	10	81	9	100

Table 4: Measures on land melioration in Central Asia,million hectares/ percentage

and training specialists. The collapse of the economy and the low standard of living are the main obstacles.

Added to which, the mass migration of Russians and other non-Moslems from Central Asia is leading to the loss of technical potential and is contributing to the brain-drain. N.F.Glazovsky and A.S.Shestakov (1995) give the following reasons for such migration: sovereignization, nationalism, economic crises, ethnic discrimination and armed conflicts. According to experts (I.Gritsenko,1994) about 11 million migrants will go to Russia in the near future. The Russian government has developed a special programme to accommodate these people.

Traditional and local technologies could also play an important role in desertification control. For example, portable apparata for water purification are used in many villages of Turkmenistan. But only a small quantity of these purification devices have been produced. Production of potable water on an industrial basis is more effective. A special plant producing and bottling fresh water was built in Ashkhabad in 1991 (A.G.Babaev, N.G.Kharin,1994). Daily production of fresh water totalled 300,000 1.5 litre bottles. But this plant could not satisfy all the potable water needs in areas affected by desertification. At least 20 such plants should be constructed to solve the problem of water supply.

According to Articles 11 and 12 of the CCD and Article 5 of the Regional Implementation Annex for Asia (United Nations Convention, 1994) countries affected by desertification could strengthen their efforts in the framework of NAP and regional programmes. The Parties of the CCD will ensure systematic observations on land degradation and will create an early warning system. According to proposals of the Desert Research Institute of Turkmenistan, (N.G. Kharin *et al.*, 1990, National Action Programme,1996) a Desertification Monitoring Centre (DMC) will be set up in each country of Central Asia.

The DMC will summarize information collected by specially trained personnel in administrative counties and provinces. Several physical and socio-economic parameters will be assessed. Basic datasets will include :

Climate variables (albedo, air temperature, wind velocity, dust storms);

Soil and water variables (ground water, major surface water, water erosion, wind erosion, soil salinization, soil compacting and sealing);

Vegetation variables (plant species, woody biomass, fodder biomass, loss of plant and animal species);

Land use variables (land use system, land tenure system, change in land use, structure of sown areas, yield of major staple crops, composition and number of livestock);

Socio-economic variables (human population, animal pressure, population changes, seasonal and annual migrations of population, infant and adult mortality, length of life, human disease status, per capita income,income distribution, sources of income, market prices of key food stuffs, energy availability and prices).

Monitoring will also include compilation of small scale (1: 250000 - 1: 5000000) desertification maps on an annual basis. Low resolution space imagery obtained from meteorological satellites can be used for the assessment of land degradation. Large scale desertification maps will also be compiled on key areas. High resolution aerial and space photos will be used in this mapping. Creation of databases and development of GIS are also components of desertification monitoring.

Annex II of the CCD contains a "Regional Implementation Annex for Asia". This Annex promotes a regional instrument of implementation of the CCD. Countries affected by desertification could join their efforts in the framework of subregional and joint action programmes. This is why the countries of Central Asia need a special subregional programme which can help to harmonize and strengthen National programmes.

Conclusion

When will people start their activities on desertification control? Partners could begin their efforts now on a "step by step" basis.

The Convention calls for the preparation of national action programmes (NAP) in all affected countries based on a participative and "bottom-up" approach. Some of these are now well under way with varying degrees of participation and support in the Central Asia. Local communities will play a key role in formulating and implementing programmes. They will also be active in designing and carrying out the resulting projects. The discussions and effective communication between the local and national levels will be vital. Non-governmental organizations are granted an unprecedented role in the elaboration of the NAPs. NGOs tend to be well organized, close to the community level, and able to draw on a pool of skilled and experienced people. The Convention recognizes these strengths and makes specific provisions for NGOs to become active partners in their process. The effective coordination of National authorities and other relevant actors, such as local communities, donor countries, intergovernmental and non-governmental organizations is fundamental in the elaboration and successful implementation of the NAPS.

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Eight - Year Performance of *Eucalyptus camaldulensis* in Waterspreaders in a Sandy Desert [1]

Ahang Kowsar, Sayyed Morteza Mortazavi , and Mansour Niazi Ardekani [2]

Abstract

Clear cutting of scrubland for conversion to cropland and the removal of bushes and shrubs for fuelwood have accelerated the pace of desertification in arid areas. Tree planting on eroded farms and depleted rangelands is a logical method of wood production which may mitigate, or even reverse, the processes leading to desertification.

A 200 ha flood water spreading (FWS) system was constructed in 1983 in a sandy desert in the Gareh Bygone Plain (GBP) in southern Iran (Islamic Republic of). Nine month old polyethylene bag-grown seedlings of *Eucalyptus camaldulensis* were planted at three metre intervals adjacent to the upslope toe of the channel banks in the winter of 1983. These trees have been flood-irrigated from between once to eight times a year.

A 25 ha FWS system was constructed in 1984 in the GBP. The same type of seedlings as above were planted on a three metre square spacing in sedimentation basins in January 1986. Flood irrigation was as above.

The survival rate of the eight-year old trees, which had been irrigated during most of the flood was above 85 per cent. All mortality occurred within the first year. Stem - and fuelwood production of the trees for the three readily distinguishable sections of the FWS system were as follows:

The average height and diameter at breast height (DBH) of the 99-month old trees planted at a density of 17 stems per ha in one row by the upslope toe of the banks, was 14.0 m and 18.0 cm, respectively. The average yield was 2.573 m^3 of stemwood and 0.772 m^3 of branches (fuelwood) per ha (0.418 m ha year for total wood production).

The average height and DBH of the 102-month old trees, planted at a density of 1,100 stems per ha in a sedimentation basin, which were irrigated in every flood event, was 10.7 m and 12.2 cm , respectively. The average yield was 60.073 m^3 ha-1 of stemwood and 18.022 m^3 ha-1 of fuelwood (9.761 m^3 ha-1 year-1 for total wood production).

The average height and DBH of the 102-month old trees, planted at a density of 1100 stems per ha in a sedimentation basin, which did not receive floodwater for a duration of 28 months, was 9.5 m and 10.5 cm, respectively. The average yield was 39.109 m^3 ha-1 of stemwood and 11.732 m^3 ha-1 of fuelwood (6.355 m^3 ha-1 year-1 for total wood production).

These results, although preliminary, are very encouraging and may be utilized with confidence in the planning of economically viable projects in similar environments.

Introduction

The world is facing an energy crisis. During the 1970s, more than 1.5 billion people depended on wood for 90 per cent of their cooking and residential heating requirements, and another one billion depended on such for 50 per cent. About 1.42 billion m^3 of wood was used in 1978 to provide 40 per cent of the total heating needs of some 2.5 billion people (Anon. 1978, p.5-6; Anon., 1980, p.1-7 ; FAO, as reported by Castro, 1983, p.122-126). Unfortunately, wood consumption has increased ever since. According to the latest statistics, the world economy used 3.4 billion m^3 of wood in 1991. That is 2.5 times as much wood as was used in 1950 - one third more per person (FAO, as reported by Durning, 1994). As half the wood is burned as fuel, firewood consumption in 1991 was about 20 per cent higher than that of the 1970s. Wood is also the primary building material. The per capita industrial wood requirements for Iranian citizens for the year 1994 had been projected at 0.17 m^3, or 12 million m^3 for the country (Shafieefar and Naser Nakhaee, 1989). Although a typical Iranian consumes less than one half of the world average, still, this is an enormous volume of wood for a largely desertic country. These demands will certainly be intensified in the future due to, among other things, the exponential rate of population growth. Granted that the theoretical zero population growth is achievable even today, the world's forest

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resources can supply the requirements for only a few decades.

Conversion of forest and pasture land to cropland and indiscriminate eradication of bushes and shrubs for fuelwood, have disrupted the ecosystem in many developing countries, and exposed the very soil which sustains their people to the hazards of erosion. Soil erosion, which is usually intensified during droughts, has accelerated the rate of desertification. Reversing these trends, though very difficult and costly, is practicable. This may be achieved through the development and implementation of an integrated approach which addresses as many problems as possible and tries to optimize the resources in arriving at an environmentally sound, a technically achievable, an economically feasible, and a socially acceptable solution (Kowsar, 1991).

Although wood production is a logical step in the integrated approach, reforestation and afforestation of the exploited land is nearly impossible; land tenure complications and the diversion of resources which are used in the production of food, feed and fibre today for the production of wood in the future are but two of the insurmountable obstacles in this plan (Anon., 1978, p. 4-15). Therefore, site selection and resource allocation in arid and semi-arid areas should be limited to the problem soils (wastelands) where unwanted waters are available. The GBP in southern Iran provided an excellent opportunity to implement this approach. Artificial recharge of groundwater was the main theme of this plan, while food, fodder and wood production, and enhancement of environmental quality were secondary (Kowsar, 1991).

The objectives of this paper are: (i) briefly present the experimental layout; and (ii) report on the eight-year performance of *Eucalyptus camaldulensis* seedlings planted behind the banks of water-spreaders in the winter of 1983, and in sedimentation basins in the winter of 1986.

Materials and methods

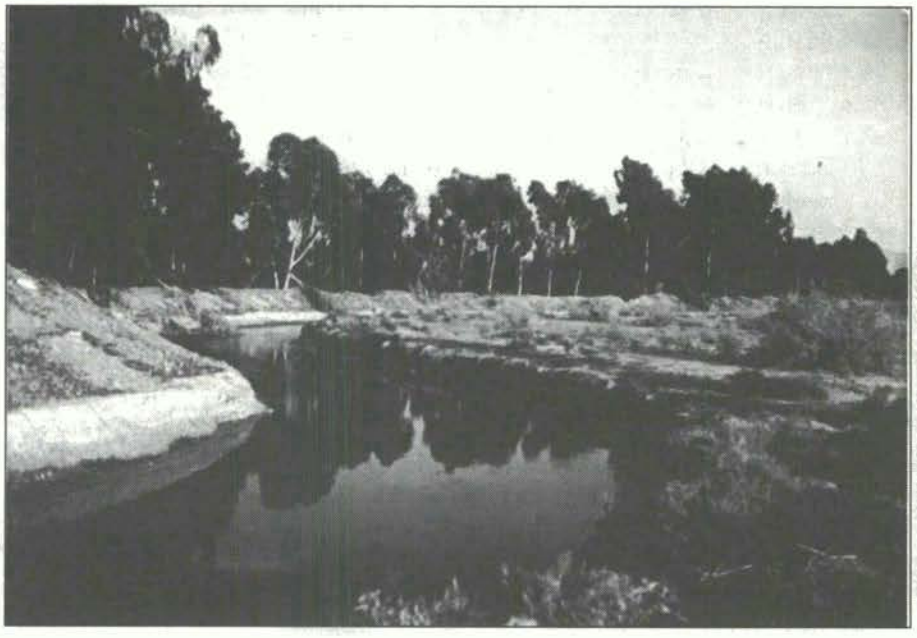
The GBP is located 200 km to the South East of Shiraz, Iran (28 38 N; 53 55 E) on the debris cone of the Bisheh Zard River, an ephemeral tributary which drains 0.4 per cent of the 48,400 km^2 Mand River Basin. The climate is mediterranean with hot summers and cold winters. Mean annual precipitation and potential evapotranspiration are 150 mm and 2,860 mm, respectively (Anon., 1976). The mean annual temperature and the absolute maximum and minimum are 19°C, 43°C and -7°C, respectively (Fasa). Elevation of the site is 1,130 m above mean sea level (MSL). The soil is a loamy sand (coarse-loamy over loamy skeletal, carbonatic (hyper) thermic typic Calciorthids). The water table is below 20 m. A more detailed characterization of the site may be found elsewhere (Kowsar, 1991).

A 200 ha flood water-spreading (FWS) system was designed and constructed in January and February 1983 according to the procedures outlined by Quilty (1972) and modified by Kowsar (1991). A total of 3,550 nine month old, perforated polyethylene bag-grown seedlings of *Eucalyptus camaldulensis* were planted in February and March 1983 in one row adjacent to the upslope toe of the banks of the channels at three metre intervals (at a density of 17 seedlings per ha). The planting lines were ripped to a depth of 35 cm, using bulldozer mounted rippers. Flood irrigation of most of the seedlings on 19 and 20 January and 6 March 1983 eliminated the need for watering the seedlings immediately after transplantation.

A 25 ha flood-water spreading system was constructed in January and February 1984 following the same method as above. The whole area was ripped to a depth of 50 cm in January 1986 following the flood of 19-20 December 1985. A total of 6,885 bag-grown seedlings of *Eucalyptus camaldulensis* were planted at three metre intervals in the first two sedimentation basins during the third week of January 1986. The third basin was mix-planted to 5,975 seedlings of *eucalyptus* and *acacias* which will be reported on in a separate paper. Flood irrigation of the site on 8 March 1986 made further watering of the newly planted seedlings unnecessary.

All seedlings were protected from browsing for about nine months. Fertilizer, in the form of sheep and goat manure, was brought in by floodwaters and spread on the site. Moreover, the presence of dissolved and suspended load carried parent rock nitrogen in the floodwater may not be ruled out. Pest management or any kind of aftercare has not been practised.

Survival of the trees planted behind the banks was determined in November 1983, in March and April 1987, and again



Two year old eucalyptus

in April 1991. Diameter at breast height and total height of 50 per cent of the single-stemmed trees were measured randomly to the closest 0.1 cm and 0.1 m, respectively, during the fourth week of April 1991. The total yield of each stem was estimated by taking a cross section at breast height, the total height of the tree, and the form factor of 0.5. This volume was multiplied by 17 to obtain the potential yield per ha. However, since only 85 per cent of the well-irrigated trees survived, the actual yield was only 85 per cent of the potential yield. Furthermore, branch (fuelwood) production was assumed to be 30 per cent of the stemwood yield.

The 14 September 1988 breaching of the main channel, which irrigates the site, caused an uneven distribution of floodwater in the first sedimentation basin until 26 January 1991; the western section, which covers about 21 per cent of the area of the basin, received more water than the rest of the site. Therefore, the trees on the western section were more robust than their eastern counterparts. Moreover, presence of a knoll in the second sedimentation basin prevented inundation of the land in that part; the entire crop of seedlings planted on that knoll died during the first year.

Every living tree in the sedimentation basins was counted and marked in February 1994, and the survival rate was calculated accordingly.To accurately estimate the wood yield, four, 30-by 30 m plots, each containing 100 trees, were selected at random in each of the western and eastern sections of the first basin for the reason given above. Three plots of the same dimensions, containing 100 trees each, were also selected randomly in the second basin. The height and DBH of each stem (about 25 per cent of the trees had more than one) were measured as above on 16-17 August 1994. The volume of a representative tree of each section was determined by averaging the height and DBH of all the stems contained in either four or three plots. The form factor of 0.5 was also chosen for these trees. Moreover, fuelwood production was considered to be 30 per cent of the stemwood yield. The stems with less than 5 cm DBH were not included in the analysis.

Results and discussion

Performance of the Trees Planted by the Banks

Survival of the eight year old trees, planted by the upslope toe of the channel banks, was outstanding. Survival of the well irrigated seedlings, which was 75.5 per cent in November 1983 increased to 85 per cent in April 1987 (Table 1, channels 1-4). Growth of stem sprouts on the trees, whose crowns were considered dead in 1983, contributed to a 9.5 per cent increase in the survival of the well irrigated trees in 1987. All mortality occurred within the first year. The survival rate in April 1991 was exactly the same as that of 1987.

Although only 66 per cent of the seedlings planted by channel 6 were alive in April 1987, this, for a tree known as the river red gum in its land of origin, is phenomenal. The floods, which entered channels 1-4 twice, and the flow that inundated channel 5 once during 1983, did not reach channel 6; therefore, the seedlings planted by this channel had to endure about 11 months of drought (21 March 1983-27 February 1984; Table 2). Total precipitation form 10 November 1982 to 26 February 1984 was approximately 170 mm. Apparently, this meager amount, which carried the surviving seedlings to the next flood, preserved their growth potential, because they have been competing successfully with the better-watered trees ever since.

Wood yield data are presented in Table 3. It is worth emphasizing that the trees, which were originally planted as windbreaks, may supply more than 0.4 m^3 of a thermally efficient wood per ha per year. Thus, an owner of a 20 ha field may easily produce his own yearly firewood needs (assuming, of course, that both stem-and branches are burned). Moreover, this volume may be more than doubled if two rows of seedlings are planted instead of one, and if the dead seedlings are replaced.

Performance of the trees planted in the sedimentation basins

The heavy floods of 19 to 20 December 1985 and 8 March 1986 (Table 2), which wetted the soil profile to a depth of at least 5 m, provided an ideal soil water condition for the success of the experiment. Replenishment of the consumed water during the timely floods of 29 July and 6 August 1986, as well as the deluge of 30 November to 7 December 1986, provided the seedlings with the opportunity to show their potential. These flows and the floods in the following years prepared the trees to endure a 12.5 month drought period (10 January 1990 to 26 January 1991). In addition, as mentioned earlier, the eastern section of the first sedimentation basin received either no flow or a very limited volume of floodwater from 14 September 1988 to 26 January 1991. The entire area experienced another severe drought in 1993 - 1994; the first effective rain after mid March 1993 fell on 10 March 1994.

The survival rate of the eight-year old trees planted in the first basin was a remarkable 87 per cent (Table 3). However, the demise of the entire block of seedlings planted on a knoll, which was not flood-irrigated due to its position, decreased the survival rate in the second basin to 68.5 per cent. Disregarding the "knoll block", the survival rate was 87 per cent.

Channel	No. of seedlings planted	No. of living tees	Success, %
1	333	298	89
2	573	473	83
3	637	537	85
4	560	477	87
5	627	482	79
6	820	538	66
Total	3550	2805	79

Table 1 . Survival of the Eucalyptus camaldulensis *seedlings planted adjacent to the upslope toe of the channel banks five and eight years after planting .*

Date	Estimated peak flow (1) ,m^3,s^{-1}	Duration,hours	Volume of diversion, million m^3
Nov. 10, 82 40	Sampling for quality determination		
Jan. 19-20,83	48	24	0.07
Mar. 6, 83	30	19	0.07
Feb. 27, 84	70	20	1.10
Mar. 21, 84	40	5	0.40
Mar. 22-23, 84	50	34	1.80
Mar. 24-26, 84	60	48	2.60
Mar. 28-31, 84	60	40	2.10
Jan. 4,85	30	17	0.92
Jan. 23-24,85	40	20	1.20
May 12, 85	30	2	0.10
Dec. 19-20, 85 (2)	70	26	3.10
Mar. 8,86	80	24	3.20
Jul. 29,86((3)	100	13	1.00
Aug. 6,86(3)	100	14	1.10
Nov.30-Dec. 1,86	200	24	3.90
Dec.2-3,86	300	26	7.80
Dec.4-6, 86	130	34	2.40
Dec.6-7, 86	100	8	0.60
Aug. 18,87	20	2	0.07
Jan. 18,88	100	15	1.90
Feb. 23-25,88	30	50	2.70
May, 5,84			
Sept. 14,88			
Feb. 15,89			
Feb. 4,89			
Mar. 14-15,89			
Mar. 29,89			
Jul. 18,89			
Dec. 17,89			
Jan. 9-10,90			
Jan. 26,91		14	
Feb. 20-21, 91		11	
Feb. 27-29,91		40	
Mar. 5-7, 91		36	
Mar. 13-14, 91		29	
Mar. 29-30, 91		12	
Aug. 8, 1991			
Dec. 8, 1991			
Jan. 3-4, 1992		16	
Jan. 21-22, 1992		30	
Dec. 21-23, 1992			
Feb. 8-9, 1993			
Mar. 10, 1994			
Mar. 27, 1994			
May 6, 1994		5	
Aug. 6, 1994			
Aug. 15-16, 1994		14	
Sept. 2-3, 1994			
Nov. 18, 1994			
Nov. 25, 1994		23	

1. The slope-area method has been used in estimating peak flows.
2. Diversion from the Tchah Qootch River and four minor waterways was started on 19 December 1985.
3. The duration of these two events was reported by a watchman; other events were timed by the research personnel whose particular dates.
4. Temporary closing of the station at the study site made the data collection impossible. Dates and duration of some of the flood events were obtained from a watchman.

Table 2. Characteristics of flood events of the Bisheh Zard River from November 1982 to February 1988 and the dates of flood occurrence through 1994 .

The eight year old trees in the Sedimentation Basins

Despite the two, one-year droughts experienced by the trees at the ages of six and eight, the wood

yield in the well-irrigated section of the first sedimentation basin was phenomenal; the mean annual increment (MAI) of 9.761 m^3 ha-1 at eight years of age in a 150 mm annual precipitation zone was excellent by any measure (Table 3). It is of interest to note that despite the current stocking density of 809 living trees per ha, there were, on average, 1,090 stems per ha, which is very close to the density of 1,100 originally planned.

The MAI of the moderately- and poorly-irrigated trees of 7.173 and 6.355 m^3 ha-1, respectively (Table 3), are considered satisfactory under such desertified conditions.

Planting location and irrigation condition	Planting density trees ha^{-1}	Survival rate per cent	Average height m	Average DBH cm	Stemwood* yield m^3ha^{-1}	Fuelwood yield m^3ha^{-1}	MAI m^3ha^{-1}
Behind the banks, well irrigated	17	86	14.00	18.00	2.602	0.780	0.423
Sedimentation basin, well-irrigated	1100	87	10.71	12.22	60.073	18.022	9.761
Sedimentation basin, moderately-irrigated	1100	87	9.66	11.03	44.145	13.243	7.173
Sedimentation basin, poorly-irrigated	1100	87	9.48	10.48	39.109	11.732	6.355

* The form factor of 0.5 was used in estimating the stem volume.

\+ The volume of branches (fuelwood) was taken as 30 per cent of that of the main stem.

Table 3. Planting density, survival rate, average height and DBH, and wood yield of the eight year old, flood-irrigated trees in the Gareh Bygone Plain, Iran (Islamic Republic of).

Economic feasibility

There is no ready market for *eucalyptus* wood at the present time. However, if the much talked about pulp and paper mill materializes in Fars Province, then the opportunity to commercialize this afforestation project will arise. It is, therefore, appropriate to present a simple analysis for the benefit of concerned individuals.

The following assumptions were made in performing this analysis:

- The FWS site and floodwater are obtained free of charge;
- The total cost of maintenance for 10 years is 40 per cent of the original outlay for earthmoving and masonary work;
- Three successive 10-year coppice rotations are possible;
- The eight-year average pole and fuelwood production of 5.971 and 1.791 m^3 ha-1 year, respectively, are applicable to the 10-year period, and the two successive coppice rotations as well;
- The principal and dividend should be returned after 10 years;
- The stabilization of the drifting sands, the aggradation of soil, the mitigation of flood damage, the artificial recharge of groundwater and the enhancement of environmental quality are intangible benefits rendered to the community in lieu of the rental and water charges.

The average cost of FWS system construction, planting and maintenance on a per ha basis are itemized below (based on January 1995 market prices):

Design and supervision	@ 10,000 rials hr^{-1}*	5,000 rials
Surveying	@ 5,000 rials hr^{-1}	1,000 rials
Bulldozer rental	@ 30,000 rials hr^{-1}	120,000 rials
Masonary structures	@ 50,000 rials m^{-3}*	50,000 rials
Gabion structures	@ 10,000 rials m^{-3}	5,000 rials
Trees	@ 200 rials $tree^{-1}$*	200,000 rials
Tree planting	@ 50 rials $tree^{-1}$	50,000 rials
		Total 431,000 rials
Compounded yearly at 15 per cent for 10 years		1,743,826 rials
Maintenance for 10 years		68,000 rials
		Total 1,811,826 rials
The average benefits for a 10 year period are:		
Fuelwood	@ 25,000 rials m^{-3}	447,750 rials
Pole	@ 50,000 rials m^{-3}	2,985,500 rials
		Total 3,433,250 rials

Ratio of benefits to costs for the first 10 years:
3,433,250:1,811,826=1.89
(Note: 1 US $ = 1,750 and 2,345 rials at official and floating rates, respectively.)

It is obvious that the costs for the two successive 10 year rotations are almost nil, because *Eucalyptus. camaldulensis* is a vigorous coppicer; hence, almost the entire income may be counted as benefit.

*hr^{-1} - per hour
*N^{-3} - per cubic meter
*$tree^{-1}$ - per tree

Practical implications

Survival and growth of flood-irrigated *Eucalyptus camaldulensis*. in a 150 mm rainfall sandy desert in southern Iran is outstanding.

Disregarding the benefits accrued through groundwater recharge, forage production, drifting sands stabilization, soil aggradation and environmental quality enhancement, afforestation projects with this eucalyptus species are still financially viable.

Reclamation of deserts through the wise utilization of floodwater offers a practicable solution to the problem of the exploding megacities. Should the unemployed country people and nomads decide to return to their lands of origin, and should the governments plan to give them wages, not alms, there is a good chance not only of stopping desertification, but of curing many city-related ills as well.

Acknowledgements

The student body of the Salman Parsi High School, Miandeh, Fasa, planted the eucalypt seedlings in 1986. The Floodwater Spreading Group of the Research Institute of Forests and Rangelands was instrumental in the success of this project. A. Zargar and K. Najafi determined the survival rate. This manuscript has been typed by Mrs. Nabati and Mr.S.Nafissi . I am grateful to all of them.

Dedications

This paper is dedicated to the memory of Haj Mohammad Pashali, whose vision and hard work contributed greatly to the success of our desertification control projects.

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Contribution of Fuelwood Harvest to Land Degradation in Kenya

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Abstract

Fuelwood is a predominant source of energy in Kenya. In 1987 it accounted for 73 per cent of national energy and will continue to feature prominently in the national energy balance. It will also continue to supply the energy needs for the bulk of the population. Woodlands generate a significant proportion of the fuelwood consumed in the country from standing stock and annual increments through selective cutting of suitable woody species for charcoal and firewood. Current trends in wood harvesting indicate an excess of depletion over restoration especially in areas with high human population concentrations. The impact of excessive fuelwood harvesting is a reduction in the quality of woodlands, loss of biodiversity, and watershed degradation. It also causes imbalance in the emission of greenhouse gases that contribute to the phenomenon of climate change and desertification where a period of exceptional aridity is coupled with exceptionally rapid population growth.

Unsustainable wood harvesting also leads to fuelwood shortages and a decrease in suitable species for charcoal. The shortages force households to use agricultural residues which are normally used to maintain soil fertility. Under conditions of high population concentrations fuelwood supply for rural homesteads and small urban centres is localised placing stress on nearby woodlands. In major urban centres supply is external and places a continuous impact on fuelwood availability in fragile areas. Cities close to the arid and semi-arid lands (ASALs) are therefore sources of land degradation pressure. Fuelwood demand is expected to rise to 57.3 million tonnes by the year 2005 while supply of fuelwood from these areas will decline from 14.7 to 12 million tonnes and the deficit rises to 27.5 million tonnes. The deficit of suitable fuelwood is therefore considered an important indicator of land degradation.

A study of fuelwood deficit has been undertaken under the national land degradation assessment and mapping project. Information on vegetation derived from past studies and satellite imagery was used to generate various classes of wood cover and wood quantity. The resulting information was used to create maps showing areas classified as woodlands, shrubland and grasslands or a combination of any two of the biomass classes, which happen to be the sources of fuelwood in Kenya. These maps when overlaid with human population and the per capita annual demand for fuelwood showed areas of expected fuelwood deficit. Data on the suitable wood species was also obtained and put in the database.

The results of the study suggest that most of the sources of fuelwood are concentrated in rangelands south of the equator. Places such as Narok, Kajiado, Kiboko, Kibwezi, Taru, Bachuma and Samburu are already major sources of charcoal for Nairobi and Mombasa. The northern rangelands tend to have less fuelwood. The majority of woody species in the northern rangelands have less than 5 cm stem diameter and are therefore unsuitable for charcoal production. Such wood is also uneconomic to harvest on a commercial basis and hence the lower hazard of land degradation.

Without fuelwood there is no hot food, however, trees provide much more (shade, fruit, building material)

Introduction

Energy is an essential input in all productive processes of an economy and is a basic human need. Biomass (woody biomass, non-woody biomass and dung) provides approximately 14 per cent of the world's primary energy, equivalent to 25 million barrels per day and is a major fuel in developing countries. In Kenya's rural areas, and for a large proportion of urban households, the main source of energy for cooking, heating and in some cases even lighting, is fuelwood. It is also used extensively in rural industries such as brick and tile manufacture, agricultural food processing, alcohol beverage production, wood processing, bakeries, restaurants etc. Burning of crop residues and the use of kerosene are, however, on the increase due to dwindling supplies of firewood, but fuelwood is still the preferred fuel, especially in low income households. Fuelwood constitutes over 70 per cent of the total energy requirement in Kenya.

At present, Kenya's existing sources of woody biomass (including forests, savannah woody rangelands and farm woodlots, or shrubs) are feared to be insufficient to meet future wood-based energy needs. The overall national energy policy objective is to ensure adequate and efficient supplies of energy at the lowest cost possible and to achieve greater self-reliance in energy supply in the long term. Since fuelwood will provide a significant amount of the national energy needs for the foreseeable future, it is necessary to ensure adequate supplies of wood to satisfy demand. This implies strategies for sustaining fuelwood yield, demand management, and protection of the environment. This objective can be achieved by developing programmes that encourage the widespread planting of on-farm trees, promotion of private woodlots, and the development and use of efficient charcoal stoves and charcoal production kilns. A key issue is the sustainable harvesting of an increased area of forest, farm trees, and woodlots, instead of the current practice of clear-felling and over-harvesting savannah rangelands and highlands.

Management policy seeks to alleviate fuelwood deficits through an improved efficiency in charcoal production, fuel substitution, commercialization of charcoal production, the pricing and marketing of fuelwood and charcoal, networking with non-governmental organizations (NGOs), and the strengthening of implementation agencies. An enhanced wood supply policy would support intensified on-farm and urban forestry, including promotion of fast growing high yield trees, land acquisition for afforestation and compatible production methods. Afforestation efforts that aim only at increasing the area under woodlands may not balance the impact of selective and clear-cutting activities, since available woodlands which are unevenly distributed are limited by size and productivity. Balancing demand and production is an issue that is complicated by competing land uses and limitations of land tenure systems. If demand exceeds supply, the fuelwood deficit would be an important contributor to land degradation.

Fuelwood in Kenya is obtained from forests, woodlands, shrubs and on-farm trees. Forests cover less than three per cent of the land area, 80 per cent of which is located on high potential land that covers less than 20 per cent of the country. Forest plantations provide fuelwood for industry, while statistics on the use of indigenous wood is not officially available. There are high concentrations of human population near forests in the high potential tree areas, and there is not sufficient wood to meet the needs of local communities. The deficit is supplied by woodlands and shrubs (from the relatively dry and drought prone ASAL areas which constitute about 80 per cent of the country's land area).

In principle, all types of wood can be used as fuel for cooking, heating, and for small-scale industrial purposes. If wood is abundant, then only particular categories of wood are used. In time of scarcity, the order of preference decreases successively; less preferred categories will be used (De Gier 1989). The terms accessibility, value, acceptability, and preference vary according to the user, purpose, and place. For example, wood that is used to prepare a meal for one or two persons may not be unsustainable for preparing food for large numbers of people.

Most energy consumed annually in Kenya comes from wood, mainly as firewood for cooking and heating in the rural areas, and as charcoal in the urban areas. Fuelwood demand includes demand for wood used in charcoal production and demand for firewood. The demand estimates are based on the Rural Household Energy Survey undertaken by the Ministry of Energy in 1988. The present and future supply of wood resources in Kenya will depend on the interaction between wood demand, the stocks and yields of woody biomass, the competing uses of land, geographic factors influencing access and transportability, household labour, economy, and land tenure.

Objectives, scope and definitions

The overall objective of this study was to examine the availability and suitability of wood species as indicators of land degradation hazard within various vegetation communities of Kenya. The scope of the study was limited to:

- Assessment of natural woodlands outside managed forests since the latter are not freely available for fuelwood;
- Assessment of fuelwood species according to their suitability for charcoal and fuelwood;
- Availability and suitability of fuelwood for communities living in major urban centres and rural centres.

Fuelwood suitability and availability are an indicator of woodland quality. Such indicators are used to assess the potential impact of demand on fuelwood supplies and woodland degradation hazards by considering the impact of socio-economic demands on fuelwood species of value as well as the quality of woodlands. It will also be essential to consider the impact of socio-economic demands on the quantity of biomass including the capability of woodlands to maintain ecological functions. The assessment results are used to manage socio-economic activities that affect functioning of woodlands, including supply of fuelwood and the quality of woodlands.

Ryan and Openshaw (1991) categorized biomass fuels as: woody biomass; non-woody biomass; and animal

residue (dung). Woody biomass may be burnt directly as fuelwood or first converted into charcoal before being used. Both woody and non-woody biomass may be converted into liquid fuels such as ethanol and methanol or may be used as feedstock for thermal power generation. Ryan and Openshaw (1991) further suggest that woody biomass comes from any ligneous plants such as trees, bushes or bamboo. Non-woody biomass comes from leaves, herbaceous plants, and crop residues. Animal residues mostly come from cattle dung although it could still come from any other animal excreta.

The following definitions were adopted in this study:

- Fuelwood - wood that is used directly in combustion as firewood;
- Charcoal - fuel that is produced after burning wood under the controlled supply of oxygen;
- Woodfuel - a combination of fuelwood (firewood), charcoal, and other wood-based combustible products;
- Woody biomass - total wood mass.

Methodology

The methodology used involved satellite imagery interpretation, field measurements, literature search and Geographical Information Systems (GIS). Several criteria were examined and the following procedure was used to identify fuelwood-based indicators of land degradation:

- Vegetation classes showing certain levels of concentration of woody biomass;
- Assessed quantity of wood in each category to determine available wood;
- Assessed various species of fuelwood for their suitability for charcoal or firewood;
- Analysed population concentration and availability of suitable fuelwood in various communities.

Remote sensing techniques were used to assess, map, and monitor vegetation resources, especially woody biomass. The spectral response patterns on satellite show spatial distribution, composition, structure and status of vegetation. Such information, when supplemented with that obtained from field surveys provides quantitative information on the categories of woody biomass observed.

Landsat Thematic Mapper (Landsat TM) imagery was preferred for mapping of classes due to the following special characteristics:

- Spatial resolution: A TM imagery which has a spatial resolution of 30 x 30 metres is good for discriminating vegetation from other land resources;
- Synoptic coverage: TM scene covers an area of 185 x 185 km in one frame which is economical for very large areas.

A total of 35 Landsat TM images acquired at different dates were interpreted at a scale of 1:500,000. It was possible to recognize and distinguish forests, woodlands, shrublands, and grasslands. The high resolution of the imagery allowed further categorization of biomass classes into closed, dense, open, or sparse vegetation, using the classes of Grunblatt *et. al.* (1991) with 33 possible classes of vegetation. This provides a two dimensional (2-D) classification which indicates degree of openness in woodlands and guided mapping of woody biomass of varying quantities ranging from forests with high woody biomass content to pure grassland which is expected to have no woody biomass. The vegetation map produced introduced a modifier based on height (tall, low and dwarf). This is a three dimension (3-D) physiognomic classification whose structure indicates a classification of biomass into volume categories of wood. It provides valuable back-up for combining, describing, and mapping of woody biomass types. It also facilitated estimation of plot biomass in areas where ground checks were not done.

Stratifying of woody biomass by classes and describing them required visits to representative fields. This exercise was carried out on a road transect through the northern rangelands from West Pokot to Samburu. A similar transect traversed the southern rangelands from Narok to Kitui. The two transects provided a reasonable coverage of the entire spectrum of vegetation communities, and hence the variety of woody biomass types in Kenya. Sample sites were selected along the survey routes. In each stratum woody biomass classes were checked and volume measurements made. The choice of strata sampled depended on variations in biomass, while the sample sites depended largely on communication routes.

Although a similar study in Uganda (Uganda Forest Department 1992) used destructive sampling (on 10 x 10 metres plots), a choice was made at each site for the following: 10 plots measuring 10 x 10 metres, five plots of 20 x 20 metres, two plots of 50 x 50 metres, and one plot of 100 x 100 metres. It was considered reasonable to choose one plot of 100 x 100 metres, except in cases where penetration of shrubland was difficult. In such a case two or more plots of 10 x 10 or 20 x 20 metres were chosen at random. In each plot, measurements were made on DBH, tree height and crown depth. This was used to calculate the commercial tree height. The major fuelwood species were also identified. A total of 107 plots were sampled.

Charcoal production studies complemented by field measurement in Kenya showed that wood species with diameters of five cm were considered reasonable; a two cm base limit had been shown to provide realistic assessment in a similar situation in Uganda (Uganda Forest Department 1992); the latter measurements were selected for this study. Total wood contained in each biomass class was estimated using tree volume, plot volume, and biomass class volume which was then converted into weight using the formulae developed by Agatsiva (1987). The weight of each tree was obtained by multiplying the tree volume by a constant 0.95 that gives fresh weight and includes branches as part of the weight. It also takes into account the conical shape of a tree. Fresh-weight is converted to dry weight by a factor of 50 per cent for most of the tree species (Uganda Forest Department 1992). The averages for each biomass class sampled in the field were computed and values assigned to similar biomass classes which were not field checked.

The resulting maps from remote sensing were digitized and the area of each class was calculated automatically using ARC/INFO software. The areas of all classes belonging to the same wood biomass level were added to obtain national aggregate data. The resulting wood concentration map was merged with another map whose attributes were location boundaries and population concentrations. Calculated production was multiplied by a factor of 0.2 to obtain

the ultimate amount of fuelwood that can be taken out sustainably. The suitability of various species for charcoal was obtained from interviews with charcoal traders along the survey routes. This information, complemented by field measurements, revealed the suitable species in Kenya.

Population census data of 1989 was extracted for each location and a map prepared to show population concentrations in various parts of the country. The human population data was used to calculate the demand and supply dynamics. A per capita consumption figure was adopted and used for each district according to earlier surveys (Ministry of Energy 1988). For Turkana and Marsabit districts, a per capita consumption figure of 600 kg was used. For Taita Taveta and Kwale Districts a per capita consumption figure of 844 kg and 985 kg respectively was used. Finally, the population and associated fuelwood demand data was overlaid with fuelwood availability in order to identify areas of deficit and therefore an indication of potential land degradation.

Results and discussion

The fuelwood indicators assessed produced maps and statistics showing:

- The distribution of fuelwood in Turkana, Taita Taveta and Kwale districts;
- The comparisons between population distribution and fuelwood quantities in the three districts;
- Areas of fuelwood deficit given a specific per capita requirement in the specified districts.

Fuelwood sources in Kenya may be variously classified as woodlands, shrubland, and grasslands or a combination of any of the biomass classes. In Kenya, the sources comprise gazetted indigenous and plantation forests, ungazetted forests, or forests on farmlands and woodlots on private lands. The sources vary in amount, concentration, and types of biomass. Woodlands are usually over four metres high and these represent the densest areas where trees, shrubs, and riverine woodlands dominate. Shrublands do not exceed four metres in height and are dominated by multi-stemmed tufts. Most of the wood suitable for charcoal is concentrated in shrublands and woodlands. Grasslands contain trees and shrubs of varying heights but the quantity of fuelwood is much less than that of other categories of vegetation.

The distribution of fuelwood sources shows a diversity with 40 possible combinations of woody biomass categories.

Commercial species from gazetted forests are used for wood feedstock in the construction, pulp and paper industries. Indigenous forests cover a total area of about 1.2 million ha. It is estimated that about 5,000 ha are lost each year to both authorized and illegal excisions. KIFCON (1993) estimated that the average indigenous forest growing stock is 176m^3/ha, which includes stem and branch biomass. The assumption is that on average about one per cent of this volume (1.76 m^3/ha) can be harvested as sustained yield, comprising on average 27 per cent timber, 13 per cent poles, and 60 per cent fuelwood (KIFCON figures). The accessible sustainable annual fuelwood is, however, 0.9 m^3/ha.

Approximately 80 per cent of Kenya comprises either arid or semi-arid lands (ASAL) and contains more than 70 per cent of the country's forest resources. Therefore, people in these zones do not usually face wood shortages because the lands are sparsely populated by nomadic pastoral people who, in most cases, do not cut down trees for firewood, but instead gather fallen wood. However, most of Kenya's charcoal is produced from trees in ASAL for use in urban areas such as Nairobi, Mombasa, Kisumu, Eldoret and Nakuru, causing serious deforestation in many semi-arid areas. With the rising urban population this situation is expected to deteriorate. Woodlands, shrublands, and wooded grasslands cover about 37.6 million ha. They are found mainly in the rangelands, but also in the high and medium-potential areas. Like the indigenous forests, this naturally occurring woody vegetation is under threat. Clearing usually happens as a consequence of land adjudication, and also because of other pressures such as charcoal production. On the other hand, where tenure has been established, trees are also being protected and planted. The Kenya Forestry Master Plan (KFMP) estimated that the average growing stock of the woodlands, bushlands, and wooded grasslands is about 15.9 m^3/ha of wood biomass, and the annual increment is about 0.115 m^3/ha (KFMP 1994). Production from woodlands and bushlands is 89 per cent fuelwood (KFMP study of woody biomass outside forests). Sustainable annual fuelwood production is two per cent of inventory resources.

In the absence of any intervention to prevent influx of populations from the high potential agricultural areas to the rangelands, it is likely that charcoal production will become the primary rather than secondary objective of land clearing operations especially in marginal areas and rangelands. There are no mechanisms for ensuring that these operations will be carried out on a sustained yield basis or in an environmentally sound way. In ecologically fragile areas, these types of harvesting operations would be devastating and would have irreversible negative impacts on soil and water resources and on agricultural productivity.

Most farmlands are found in the high potential agricultural lands which cover less than 20 per cent of Kenya's land area. More than a quarter of the country's wood supplies are located in these areas and most of these resources are in protected forests. These areas accommodate 80 per cent of the population of Kenya with high potential for annual biomass production, yet they are the hardest hit by fuelwood shortages. Households regularly cut branches from trees or gather dead wood on their own land or on neighbour's lands, and this accounts for more than 40 per cent of Kenya's fuelwood supply that comes from agricultural land. Farmlands and settlements, including urban land cover about 9.5 million ha. The Kenya Forestry Master Plan (KFMP) estimated biomass outside the forest (on the farmlands and settlements) as being about 7.9 m^3/ha of wood biomass, and that this stock increases at an annual rate of 0.46m^3/ha. Fuelwood production from farmlands and settlements is 73 per cent firewood (based on the KFMP study of woody biomass outside forests). The accessible sustainable annual wood production is 5.4 per cent of inventory (corresponds to 90 per cent accessibility), plus three per cent of inventory (biomass growth accessed for fuelwood). Most charcoal

production is from land being cleared in preparation for agricultural development. These operations are usually small-scale and incremental activities whose primary objective is to facilitate land clearing, and not specifically to produce charcoal.

Forest plantations cover about 170,000 ha. This estimate includes only those plantations that are under the management of the Forest Department, and excludes private plantations (which are included in farmlands). It is estimated that the average growing stock of the forest plantations is 347 m^3/ha of wood biomass. This rather high estimate is explained by the large proportion of over-aged stands. Until recently, the harvesting of industrial wood has been at a rate below the average replanting rate, but the failures in plantation establishment since the mid-1980s, which are still continuing, are threatening the long-term supply of industrial wood.

Most of the suitable species are in the northern rangelands where pressure exists and charcoal is made from less suitable species when the suitable ones are cleared. At Melua near Rumuruti, *Olea africana* is preferred for charcoal and field surveys shows that most of it has been cleared. *Euclea divinorum* is the next preferred species for charcoal. At Radat near Marigat in Baringo, most suitable species are being cleared and *Balanites*, which has high calorific value but was never favoured because of its crumpling nature, is now being used for charcoal. This means that when suitable wood species are cleared any other species can be selected and cleared to meet the charcoal demand.

Available wood ranges from 0.1 tonnes/ha in poor woody biomass cover categories to 317 tonnes/ha in woodlands of tall and bigger tree cover. This represents the standing or wet weight. Accessibility of some of this wood is sometimes hampered by poor roads, rugged terrain, security, and land tenure, etc. (Table 1). Most of the wood is concentrated in the southern rangelands such as Narok and Kajiado, while Kiboko, Kibwezi, Masongaleni, Taru, Bachuma and Samburu are major charcoal producing areas. These major producing areas are found along the Nairobi - Mombasa road; they are the major charcoal supply sites for Nairobi and Mombasa markets. Between Makinnon Road and Maji ya Chumvi (a distance of about 40 km) along the Voi-Mombasa Road, there are more than 30 charcoal and wood selling points with each selling point handling between 40 and 50 bags of charcoal each day. The majority of trees in this area are of a diameter of less than 12 cm. At this rate of exploitation these areas could become deficit areas in the near future. The northern rangelands have less fuelwood since most woody species have less than five cm stem diameter and therefore are unsuitable and often uneconomical for charcoal production. Consequently, they present little threat to land degradation. Areas of high woody biomass concentration coincide with areas of high population concentrations. However, demand zones are often located far away from markets and therefore it is uneconomical to transport charcoal. For this reason, charcoal production is not a threat to land degradation in the short run. Wood production from other lands consist of 95 per cent fuelwood. Accessible sustainable annual wood production is two per cent of the inventory (or 33 per cent accessibility).

Year TOTAL	Indigenous		Woodland/	Farmlands/FD Forest
	Forests	Bushlands	Settlements	Plantions
1992	1,179.0	10,170.4	5,231.9	342.1	16,923.4
1995	1,165.5	10,585.4	6,145.8	353.5	18,250.2
2000	1,143.0	10,507.6	7,746.2	415.6	19,812.4
2005	1,120.5	10,429.8	9,417.7	351.9	21,320.0
2010	1,098.0	10,352.0	11,079.4	360.8	22,890.3
2015	1,075.5	10,274.2	12,946.8	380.2	24,676.7

Source: Kenya Forestry Master Plan

Table 1. Accessible sustainable fuelwood production by land use

Scenarios of fuelwood Supply and demand dynamics

In assessing the demand and supply dynamics, it is important to make several assumptions for estimates of fuelwood and charcoal supply. These scenarios were based on the following assumptions:

- Population on projections used are those developed jointly by the World Bank and the Central Bureau of Statistics (CBS) for the period 1980-2000;
- Per capita wood consumption per district is based on calculations from Rural Household Survey undertaken by the Ministry of Energy in 1988. For districts not covered by the survey, estimates extrapolated have been used;
- About 80 per cent of the population of each district was used to calculate demand;
- Eighteen per cent (18 per cent) of the urban population use charcoal and improved cook stoves;
- On average, each urban household uses at least 2.5 kg per day, (this is a conservative estimate);
- One ton of charcoal requires 8.5 tons of fuelwood at an efficiency of 10-14 per cent.

Using the above assumptions, the estimated demand for wood energy would increase at an annual rate of 6.5 per cent up to the year 2010, after which demand would grow at an annual average rate of 3.8 per cent; and the annual rate of increase in charcoal demand projected at 11.4 per cent will result in a shortfall of about 23.3 million tons by the year 2010. Consequently, it would be necessary to increase stocks to meet current unsatisfied demands as well as provide for rising demand.

The suitability of available wood resources in meeting local fuelwood demand depends on many factors, including the distance to population centres, the income and budget of individual households, the availability of tools for harvesting, and climate. The five factors which influence fuelwood consumption are described below.

Household size clearly plays a major role in determining domestic fuel use. While a large household may consume

more total energy than a small household, its per capita consumption may be lower than that of a smaller household. However, the immediate concern is to meet current unsatisfied demand as well as provide for rising demand. An increase in population results not only in an increased demand for wood and woody products, but also in a growing demand for agricultural products. In other words, there is always competition for land resources between wood requirement and agricultural production. Therefore, progress in one direction can easily lead to a deterioration of conditions in the other. The expansion of the land area under cultivation for food crops is expected to rise from 2.3 million hectares at present to 3.66 million hectares by the year 2000, with the greatest increases in the Coast, Rift Valley, and Western provinces.

There is a relationship between wealth and fuel use. Households with a greater cash income are more likely to use commercial fuels, such as charcoal or kerosene, than poorer households. In a situation of decreasing fuelwood availability, households will search for alternative sources. Within the fuels, a sort of hierarchy exists. Leaving fuelwood, a household could ascend the ladder to charcoal, kerosene, gas, and electricity, or could descend the ladder to agricultural residue and animal dung. Within fuelwood itself another kind of hierarchy exists, going from high quality, dried, deadwood to low quality, green, wet wood. In a situation of fuelwood shortages, a household has either to descend or ascend these ladders. Usually the switch over to charcoal, kerosene, gas or electricity is considered as an improvement in income. But, it is not the case with the rural areas of Kenya. Instead, in a situation of shortages, the rural households are forced to descend the ladder because of the low incomes and the limited access to commercial fuels. In Kenya, when faced with a shortage of wood, wealthier households are more likely to substitute a more sophisticated fuel, whereas poorer households tend to switch to a less sophisticated fuel such as wood of low quality or crop waste. As income increases, energy consumption also increases. Openshaw (1980) noted that rural households increased wood consumption if their incomes increase, but they generally do not switch to using charcoal. For households with similar lifestyles, the income-energy consumption relationship could be anticipated to hold.

The distance from fuelwood sources influences different households in terms of preferences for the type of wood they use. However, if there are no alternatives, they select any wood available. The consumption of fuelwood depends on its availability. If fuelwood is plentiful, little time is used to gather a large quantity, and therefore its opportunity cost (and marginal utility) is relatively low. If fuelwood is scarce, it would require a lot of time to collect, hence its greater opportunity cost (and marginal utility). As a result, less wood is consumed. In many instances, the simplest measure of the availability of fuelwood is the distance travelled to collect it. In summary, the availability of fuelwood appears to determine its price and utilization. Increased fuelwood consumption in marginal and semi-arid areas can lead to an agricultural-ecological crisis. However, to avoid such a crisis it would be necessary to consider alternative conventional and non-conventional energy sources such as biogas, liquid petroleum gas (LPG), and wind. Substitution between different fuel sources occurs primarily because of two factors: scarcity and income. When fuelwood becomes increasingly scarce, not only is it used more sparingly, but greater quantities of alternative fuel are consumed.

Climatic factors influence both the demand and supply of all fuels, especially traditional fuels. On the demand side, temperature variations make it necessary for households to use different amounts of fuel for heating. Seasonal variations in both fuelwood and dung consumption have previously been identified. In tropical areas experiencing pronounced wet and dry seasons, wood is frequently stored during the dry months for use during the wet months. Charcoal is frequently used during the wet season in preference to wood as it is less prone to absorb moisture. On the supply side, in-so-far as rainfall determines biomass production rates, it indirectly influences the consumption of traditional fuels. High rainfall areas are better able to sustain higher levels of wood off-take than are low rainfall areas. Once existing tree cover has been depleted, it is also able to regenerate more quickly. If other factors are held constant (particularly population density), high rainfall areas can provide a sustainable wood off-take and can as such support high consumption levels.

Fuelwood demand and supply and land degradation hazard

The Ministry of Energy, in 1988/89, undertook a household survey in 25 districts with the objective of estimating the current fuelwood demand both in rural and urban households. It shows per capita fuelwood consumption in all districts. Using the 1989 census data, a per capita fuelwood consumption was estimated at 761 kg/year. Statistical data on fuelwood consumption in urban areas was fairly limited as the survey did not cover all the urban centres. However, using the 1980 survey, projections for fuelwood consumption have also been estimated.

The wood resources requirements in Kenya were projected to increase from 20.4 million tonnes in 1980 to 49.7 million tonnes by the year 2000 (O'keefe et al 1984). Shortfalls are expected to reach about 33 million tonnes by the year 2000. It is anticipated that the massive shortfall of wood would severely disrupt the economy and lives of many Kenyans, particularly in the rural areas (Tables 2 and 3). Fuelwood is considered renewable because the trees cut down for use as fuel can be replaced by other growing trees. However, the rapidly growing population has increased demand on wood energy. Forests are cut down faster than they can be replaced thereby creating shortages in wood supplies for cooking and heating, thus increasing the diversion of agricultural residues to fuel use, and the deterioration of physical environments dependent on tree cover.

At least 80 per cent of urban fuelwood demands by households are met by charcoal. Charcoal use amounts to about 1.4 million tonnes annually and, with yields varying from 10 per cent to 14 per

Year	Sustainable Fuelwood Supply	Non-Sustainable Wood Supply from clearing	Total Fuelwood Supply	Fuelwood Demand	Fuelwood Deficit
1992	16,923.4	254.4	17,177.8	18,106.5	1,238.9
1995	18,250.2	261.2	18,511.4	20,106.7	639.8
2000	19,812.4	391.7	20,204.2	23,946.7	1,402.8
2005	21,320.0	520.6	21,840.6	27,693.3	4,087.3
2010	22,890.3	647.2	23,537.4	31,720.0	6,634.6
2015	24,676	770.4	25,447.2	35,880.0	9,122.6

Source: Kenya Forestry Master Plan for Supply, Ministry of Energy - Rural Household Energy Survey 1988 for Demand.

Table 2: Fuelwood supply-demand balance, 000m³ (current trends scenario)

cent by weight this requires 10 to 14 million tonnes of wood. Kenya's charcoal is produced from trees, mainly in semi-arid lands, and cleared agricultural land. Most charcoal used in Kenya is carried by road to the urban areas where it is used. About 90 per cent of Nairobi's charcoal supply comes from Eastern and Rift Valley provinces. Kisumu's charcoal comes from Western and Rift Valley provinces, while much of Mombasa's charcoal comes from the North-Eastern and Coast provinces.

Traditional forest and farm-based wood supplies are being used faster than they are being replaced. The consequence is severe environmental degradation. This crisis could spill-over into other sectors of the economy leading to vicious circles of environmental degradation. If more wood is taken from forests every year (through gathering and cutting, charcoal making, timber and pulp wood production, or land clearing for agriculture) then forests will eventually disappear. This process has been aggravated by the clearing of land for agricultural use, overgrazing, and fuelwood collection. These have been major, and probably more important, contributing causes of deforestation and desertification.

Depletion is long lasting, affecting conditions necessary for communities to secure fuelwood. Unsustainable wood harvesting leads to fuelwood shortages and a decrease in suitable species for charcoal. The shortages force households to use agricultural residues which are normally reserved for soil fertility. Profit motive and consumer preferences cause depletion of fuelwood species at the source. The people engaged in charcoal production and trade are not sensitive and have no incentives to consider the costs of resulting land degradation. In fragile ecosystems, even small scattered population concentrations reduce the ability of the system to sufficiently renew wood. Cities in these regions are pressure points for land degradation. Fuelwood supply is determined by free interplay in the fuelwood market. Pricing motivates charcoal makers to profit. Fuelwood is not purchased but collected for local use since it cannot be economically transported over long distances. Charcoal is preferred by urban consumers because its compactness makes it easier and more economical to transport.

The trends in fuelwood demand and supply are shown in Table 4. Fuelwood demand is expected to rise to 57.3 million tonnes by the year 2005, while supply of fuelwood from these areas declines from 14.7 to 12 million tonnes and deficit rises to 27.5 million tonnes. A policy is needed to promote the adequate supply of fuelwood on a sustainable yield basis to balance demand, given a specific annual per capita requirement for each district (Table 5).

Fuelwood Demand	1995 20107	2000 23947	2005 27693	2010 31720
Accessible Sustainable Supply				
Indigenous Forest	1665.5	1143	1120.5	1098
Woodlands/Bushlands	10585.4	10507.6	10429.8	10353
Farmlands/Settlements	6145.8	7746.2	9417.7	11079.4
Forest Plantations	353.5	415.6	351.9	360.8
Total Fuelwood Supply	18250.2	19812.4	21319.9	22890.2
Deficit	1856.8	4134.6	6373.1	8829.8

*The majority of these deficits are found in the high potential agricultural areas.

Table 3: Projected fuelwood supply and demand on current trends ('000' m³)

Fuelwood balance*	1985	1990	1995	2000	2005
Supply from yield	14.7	12.0	11.9	11.8	11.8
Supply from stock	8.7	11.2	16.9	24.1	18.0
Total supply	23.4	23.2	28.8	35.9	29.8
Demand	23.4	30.5	38.1	47.7	57.3
Deficit	0	7.3	9.6	11.8	27.5

* Million tonnes

Table 4. Trends in fuelwood demand and supply

District	1989		1990		1995	
District	Fuelwood	Charcoal	Fuelwood	Charcoal	Fuelwood	Charcoal
Kiambu	413.8	21.9	517.2	22.9	898.9	92.5
Kirinyaga	319.5	3.2	361.5	3.0	625.7	10.3
Muranga	411.1	10.1	500.2	8.1	927.6	29.3
Nyandarua	467.5	6.3	501.7	0.5	866.6	20.1
Nyeri	300.6	18.9	389.4	15.2	625.4	48.7
Kilifi	177.1	11.2	208.5	13.3	352.1	47.9
Kwale	382.9	3.1	424.3	3.3	769.2	13.1
Lamu	14.9	2.5	15.4	5.4	11.8	31.6
Mombasa	10.1	81.3	0	92.6	3.6	174.7
Taita Taveta	131.2	5.0	175.6	2.8	297.3	9.3
Tana River	436.4	39.0	51.8	2.6	102.5	16.5
Embu	408.2	5.2	460.2	7.2	824.5	27.5
Isiolo	9.1	4.4	21.6	5.8	14.8	19.1
Kitui	60.2	2.5	652.4	2.6	1174.2	9.2
Machakos	881.9	28.8	1017.9	41.5	1183.1	59.5
Marsabit	53.4	6.0	64.8	11.0	65.2	65.7
Meru	1187.1	19.6	1335.3	29.4	1546.3	41.3
Garissa	74.3	6.5	89.5	11.6	104.5	19.6
Mandera	31.3	6.6	50.5	7.2	53.5	8.9
Wajir	86.3	4.5	95.0	9.1	111	14.4
Kisii	683.3	9.5	746.3	11.4	867.7	15.4
Kisumu	153.0	38.2	225.3	54.8	232.8	72.5
Siaya	468.8	5.7	522.2	2.1	606.1	2.8
South Nyanza	468.9	11.8	736.6	6	852	7.9
Baringo	643.6	5.7	275.9	5.8	325.9	8.2
E/Marakwet	165.8	1.1	174.7	0.2	178.9	0.2
Kajiado	55.7	8.5	82.7	7	99.4	11.0
Kericho	586.7	11.1	652.8	14.5	757.3	20.1
Laikipia	156.3	5.3	135.7	15.6	147.2	24.9
Nakuru	550.9	17.7	452.4	67.9	469.0	107.8
Nandi	252.9	2.4	280.8	1.8	339.2	2.5
Narok	178.8	3.4	192.6	7.5	232.8	11.7
Samburu	43.8	2.3	46.2	4.3	49.8	5.4
Trans Nzoia	197.3	10.3	234.6	15.9	285.5	26.7
Turkana	59.7	4.3	79.8	1.9	75.6	2.3
Uasin Gishu	171.8	23.1	307.2	22.9	349.9	34.7
West Pokot	14.2	2.6	162.6	2.5	203.4	4.3
Bungoma	411.8	96.7	460.9	18.2	533.9	25.7
Busia	226.2	4.7	222.7	8.4	251.1	11.0
Kakamega	607.3	17.2	701.3	13.1	810.0	17.7
Nairobi	29.0	233.1	0	159.4	0	329.4
Total	12110.7	801.3	13626	736.3	15751.4	1145.7

Table 5: Fuelwood consumption projections 1989-1995 [000 tons]

Conclusion and recommendations

The use of remote sensing in stratified sampling has been found useful but with some limitations in the gathering of generalized information on fuelwood supply in Kenya. Landsat TM has for this reason been quite cost effective in the collection of baseline data on the biomass categories that were later used in calculating standing biomass that could be used in fuelwood production. However, remote sensing alone cannot be used to identify species suitable for fuelwood production. Fieldwork, although of a limited nature, was used to quantify biomass in each class interpreted from satellite imagery alone. Canopy cover of trees and shrubs prevented ground observation by satellite imagery. For this reason, many areas with severe sheet erosion due to lack of herbaceous cover were not easy to identify on the satellite imagery.

Demand for fuelwood could only be estimated from literature and from computations based on the 1989 population census. In areas where population census was not quite realistic, such estimates of demand for fuelwood were questionable. Information on demand should also be handled with care as it is likely to be misinterpreted when it comes to computing deficits. This is because most of the demand for fuelwood, especially that for charcoal comes from areas far from the source of fuelwood. There is, therefore, a need to improve on assessment of fuelwood deficit in the right places by developing techniques for transferring fuelwood demand to the most likely sources.

Fuelwood shortage is not a common problem in the ASAL areas of Kenya since the population is low and sparsely distributed, and a wide variety of vegetation species are available for use as fuelwood. Exceptions are in areas of population concentration, especially around major urban centres and in areas of low biomass concentrations such as grasslands.

Most shortages experienced in ASAL areas are mainly due to the demand from the high potential agricultural areas as well as the major urban centres. When these factors are put together, there is generally no overall shortage of biomass in the ASAL. For this reason, therefore, there is no danger of land degradation arising due to unsustainable consumption of fuelwood. However, unsustainable consumption is a potential threat given the current rate of population increase in the country. Also with additional factors like clearing of wood for other uses, e.g., for provision of construction timber, paper and pulp, the danger to land degradation may increase.

The results so far obtained will be useful for the planning and management of Kenya's fuelwood resources. The maps produced will form a useful database for future monitoring of trends in fuelwood dynamics in the country.

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Livestock Husbandry and Ecological Stability in Nigeria: The Economic Implications

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Abstract

Arid and Semi-arid Lands (ASAL) in Nigeria carry 55.17 per cent of the estimated 12,906,392 national herd. The sub-humid and humid lands have 43.51 and 1.30 per cent respectively. While the national herdsize cannot be viewed as high, the pastoralists husbandry system relies on "extracting" forage from the rangelands without its reseeding or controlled/rotational grazing. Hence, the estimated dry matter yield of the rangelands was only 58 per cent of the minimum requirement. This paper examines the costs and benefits of the pastoralists husbandry system. Per unit daily social cost was N15.12* and social benefits ₦18.48. The internal rate of return was 22.19 per cent. This was below the 1995 inflation rate of 54 per cent. Hence, theoretically, the pastoralists were bearing only 77.81 per cent of total costs and were receiving a subsidy of 31.81 per cent. Without it, private benefits will be decreasing and in the long run, ecological degradation will be a limiting factor to productivity. This will lead to continuous inflation and an erosion of the pastoralists income and wealth.

* ₦ = Nigerian Naira

Introduction

Agriculture in Nigeria, comprises two main sub-sectors - crops and livestock - which together employ between 65 and 75 per cent of the estimated 100 million people. The activity could be viewed as "extractive" because inorganic fertilizer is generally preferred and crop residues are not recycled but are used for fencing, cooking and for livestock feeding. Rangeland reseeding and development are virtually non-existent and grazing by livestock removes and limits plant regrowth. Controlled or rotational grazing is yet to become the norm. Finally, human activities in the form of settlement, fuelwood extraction, infrastructures development and crop production are denuding the ecology of its trees and shrub canopy thus exposing it to degradation vagaries (UNEP, 1993 and 1994).

Therefore, agricultural activities in Nigeria. can hardly be regarded as having an in-built ecological stabilization capacity. Although for crops, extension delivery systems in the form cropping patterns, soil treatment and its rehabilitation could improve farm plot conditions, the case of the pastoralists is different. This is because they neither possess the knowledge, skills and attitudes nor the required financial outlays needed for rangeland and pasture development.

This situation is further aggravated by the fact that north of latitude ten degrees, there are two further limitations. The first is the rainfall regimen (below 750 mm.) and the second, the ingression of livestock from neighbouring Niger and Chad. The general ecoclimatic conditions of the zone is summarized as follows Federal Department of Livestock and Pest Control Services (FDL & PCS, 1992:426):

> ..the country is divided into four major ecoclimatic zones based on rainfall and crop growing period. These are: Arid - with a growing period of less than 90 days, equivalent to less than 500 mm rainfall per annum; Semi-arid - with between 90 and 179 growing days, and approximately 500 to 1,000 mm yearly rainfall; Sub-humid - with a growing season of 180 to 269 days, and annual precipitation of between 1,000 mm and 1,500 mm; and Humid - with more than 270 growing days, receiving in excess of 1,500 mm precipitation annually. In Nigeria, the Arid Zone occupies some 2 per cent of the country; the Semi-arid Zone, 36 per cent, the Sub-Humid Zone, 47 per cent; and the Humid Zone, 15 per cent. ...

The Humid Zone held 1.30, 21.68 and 15.08 per cent of cattle, goats and sheep respectively. The Arid Zone: 6.21, 2.10 and 2.71 per cent. The figures for Sub-Humid and Semi-Arid were: 43.51, 36.92 and 29.54; and, 48.96, 39.30 and 52.67 per cent respectively. Thus, the Arid and Semi-Arid Lands (ASAL) have 55.17, 41.40 and 55.38 per cent managed within 38 per cent of nation's land (Tables 1,2 and 3). The major limitations to livestock production in the Humid Zone are: presence of endemic infestations, close settlements and culturally, the people are not inclined to this activity. To some extent, these limitations are also present in the southern parts of the Sub-Humid Zone.

Measures taken to improve the rangeland and thereby stabilize some ecological niches for livestock development are within the National

State	Cattle (Total)	Goats (Total	Sheep (Total)	Pastoral (Cattle)	Pastoral (Goats)	Pastoral (Sheep)
Bauchi	1.731	3.466	2.811	1.271	0.028	0.303
Benuel/Kogi*	0.146	2.432	0.863	0.135	0.009	0.015
Borno/Yobe	2.727	3.182	2.424	2.425	0.09	
FCT	0.156	0.144	0.062	0.145	0	0.012
Adamawa/Taraba	1.503	1.97	1.324	1.284	0.007	0.143
Kaduna	1.007	0.966	0.557	0.908	0.011	0.079
Kano/Jigawa	1.01	2.738	2.567	0.753	0.332	0.233
Katsina	0.63	1.079	1.696	0.332	0.01	0.001
Kwara/Kogi	0.562	1.131	0.843	0.514	0.0009	0.063
Niger	1.165	0.968	0.751	1.092	0.002	0.135
Plateau	1.05	1.866	0.964	0.898	0.002	0.113
Sokoto/Kebbi	1.773	2.566	1.466	1.426	0.014	0.54
States Totals	13.46	23.408	17.428	11.183	0.5239	1.646
National Total	13.885	34.453	22.092	11.478	1.142	2.678
% of National Total in Northern States	96.939	67.942	78.888	97.43	4.255	11.633

Table 1: Cattle, Goats and Sheep Ownership Structures (Northern States only)

State	Density/sq.km (Dry Season) Numbers)	Density/Sq.km (Wet Numbers) (Numbers)	Dry season (Cattle	Wet Season (Cattle	Forest Reserve % of Land Area
Bauchi	20.174	33.413	1.303	2.159	12.2
Benue-Koti*	4.539	1.938	0.205	0.876	2.7
Borno-Yobe	25.357	21.499	2.592	2.502	6.7
FCT	17.7	24.867	0.13	0.182	3
Adamawa-Taraba	14.797	18.101	0.352	1.654	2.6
Kaduna	21.921	21.795	1.001	1.003	13.5
	20.282	26.575	0.878	1.15	16.9
Katsina	12.345	16.775	0.534	0.726	12
Kwara/Kogi*	8.373	8.445	0.56	0.566	12
Niger	16.773	19.051	1.091	1.24	4.8
Plateau	16.606	19.724	0.64	1.145	8
Sokoti-Kebbi	14.354	20.226	1.472	2.074	20
Totals			11.082	15.277	

Source: Federal Department of Livestock and Pest Control Services, 1992:433-436

284666.9

Notes:

1. *Kogi State was carved out of both Benue and Kwara State.(after the Census)
2. Livestock populations for these States in 1965 were:
   Cattle: 4,493, Goats: 5,184 and Sheep: 3.490 millions
3. Total Forest Reserves area for these States in 1965 was 284666.90 square kilometers.

Table 2: Seasonal Cattle Densities and the percentage of Forest Reserves (Cattle Producing Areas of Northern States Only)

State	Area (Sq. klm)	Grassland (% Cover)	Shrubland (% Cover)	Woodland (% Cover)	Forest (% Cover)	Forest St Level (ha./t)
Bauchi	64605	1.3	12.6	42.7	0.6	2.42
Benuel/Kogi	45174	5.2	4.7	58.4	6.3	8.23
Borno/Yobe	116400	12.2	21.4	29	0.4	3.45
FCT	7315	0.1	9.4	52.6	1.2	5.02
Adamawa/Taraba	91390	7	6.2	49.2	4.7	5.17
Kaduna	46053	0.3	11.7	44.9	1.1	4.04
Kano	43285	1.4	11.9	9	0.4	1.7
Katsina	24192	1.5	12.2	15.1	0.4	1.3
Kwara/Kogi	66869	0.3	4	73.8	1.5	10.17
Niger	65037	0.6	7	56.5	1	5.36
Plateau	58030	0.6	6.7	47.2	1.5	4.61
Sokoto	102535	3.3	21.7	26.3	0.4	3.77
Totals	730885	33.8				
Average: Stocking Level				4.61		
Effective Grassland Availability (Sq. klm.)		247031.1				
Estimated /DM Yields (tons)		250250.6				
DM Yields (tonnes) from: Sorghum, Cowpeas/G-nuts						
Residues available to cattle:		207925				
Total DM available to cattle:		233175.6				
DM/Cattle/kgs/day available:		3.238				
Nigeria Land Area (sq.klm)	9237.68	3.4	10.9	41.3		5.9
%Northern States:	79.12					

Source: FDL&PCS, 1992:28, 433, 435
FORMECU (1991:4-9)
Rains (1963:22-24)
PTF (p992:62-63)

Table 3: Vegetation and Land Use in the Cattle producing Areas of Nigeria (Northern States)

Grazing Reserves Programme recommended by the International Bank for Reconstruction and Development (IBRD), modified in 1965 and 1988. The concept envisaged the development and provision of adequate forage, water, animal health care products, human health, education and welfare facilities and; marketing channels, and from 1986; limited crop cultivation. It is also to be the nerve centre for improving the knowledge, skills and husbandry attitudes of the pastoralists. In 1995, there were 284 grazing reserve locations occupying 2,774,859 hectares (Table 4). Two of them in Sokoto and Borno/Yobe States are assisted by the European Union (IBRD, 1954; Food and Agriculture Organization - FAO - 1988; Fricke, 1979; FDL&PCS - 1992; UNEP, 1993 and 1994).

State	Area (ha.) Gazetted	Area (ha.) Ungazetted
Bauchi	0.39	0.108
Benue/Kogi	0.0592	0
Borno/Yobe	0.55	0.12
Adamawa/T	0.181	0.114
Kaduna	0.12	0.0334
Kano	0	0
Katsina	0.123	0.123
Kwara/Kogi	0.0858	0.024
Niger	0.068	0.033
Plateau	0.219	0.074
Sokoto	0.978	0
Totals (million ha.)	2.774	0.6294

Source: Presidential Task Force Rep (FGN, 1992)

Notes: No Grazing Reserves in the Southern States of Nigeria

Table 4: Number of Grazing Reserves in Cattle Producing Areas

Problem setting

Problems associated with livestock husbandry and ecology have variously been analyzed. FAO studies showed that rangeland development within and outside the Grazing Reserves Programme will require a minimum annual financial outlay of N120.00 million. FDL & PCS showed that because the pastoralists do not own land, rangeland development cannot be atomized and apportioned to households or herd sizes. The Presidential Task Force (PTF) on alternative feeds formulation, anchored minimization of ecological degradation on growth and development of cereals and grain legumes. Darkoh gave the conceptual background in analyzing pastoralism and ecological degradation while Chou gave a framework for its cost/benefit analysis (FAO, 1988; FDL & PCS, 1992; PTF, 1992; UNEP, 1993:20-24 and 1994:35-41).

Statement of the Pproblem

The Food and Agriculture Organization of the United Nations (FAO, 1988:8) projected that by 1990, Nigeria would have 18.50 million cattle. The Livestock Census Report (submitted to FDL & PCS, 1992) showed that only 13,885,813 cattle of which 93.13 per cent were in the northern States could be determined. The growth rate for all categories of meat and eggs was only 1.52 per cent between 1990 and 1994 while the national herd was growing at the rate of 2.44 per cent. This is below the 1979 rate of 3.50 and the required offtake of 9.10 per cent.

Since the introduction of the Structural Adjustment Programme (SAP) in 1986, the Federal Government has been pursuing a policy of phasing out or minimizing subsidies to most welfare-oriented projects. The goal has been stated as encouraging the groups or communities that benefit from such projects to contribute meaningfully towards its sustenance and development.

Phasing out subsidies will reduce the intake of inputs by crop farmers. Reduced cropping intensity through the use of high-yielding varieties will perpetrate subsistence farming. These would imply reduced availability of cereals and crop residues for livestock (PTF, 1992).

The problem

Ecological settings and attendant endowments are regarded as social goods by users. The implication being that in both the short and long run, localized ecological degradation will prevail. This imposes private costs arising from low productivity as well as social costs to the nation. Hence, it is justifiable to ask this question: What are the social costs/ benefits associated with livestock husbandry in Nigeria? The obj*ective* of this paper is to answer this question.

Materials and methods

The report submitted to the Federal Government in 1992 by the Resources and Inventory Management (RIM) on the Livestock Census carried out was extensively reviewed and used for this paper (Tables 1-3 and Figures 1-4). PTF's Report was also used. Other sources were: FAO (1985, 1988), the European Union-assisted Grazing Reserve Reports under the Sokoto State Environmental Protection Project (SEPP) and other relevant literature.

Financial analytical frameworks were used to determine costs and returns and hence internal rates of returns. The latter would show the level of subsidy that would (or would not) be required. Although rangeland products are social goods, shadow prices were assigned using current market prices. Together with calculated returns, the objective of this paper was attained. Microsoft Windows Works software was also used.

Results and discussions

The results are presented in four tables and five figures. Table 1 shows that the pastoralists were managing 97.43, 4.60 and 64.82 per cent of the cattle, goats and sheep in Nigeria respectively. Figure 1 shows the relationship of such a structure within the twelve northern states. The impact points of the tables and figures are as follows: the pastoralists do not manage most of the goats that are associated with localized ecological degradation. Second, they are by implication through their transhumance, the major diffusers of overstocking and overgrazing. Control measures, through the sustenance of the rangelands, grazing reserves and fodder banks would require that similar attention be paid to goat husbandry.

Table 2 shows cattle densities and wet and dry season cattle numbers. There are three impact points associated with this Table. The first is that the densities are relatively low but because rangeland is the main source of fodder and no hay conservation prevails, the rangelands are already above rational stocking rate levels because they can only produce on the average, 3.28 kilograms of dry matter per day while the minimum requirement is 5.58. Actual transhumance comprises only 27.460 per cent of the national herd. The implication being that intra-State transhumance is higher than inter-State. Hence, 72.540 per cent are either semi-settled, settled or practising intra-State transhumance (herd-splitting instead of nomadism).

Consequently, the attribution of ecological degradation to transhumance should be appropriately weighted. This is further highlighted in the two Figures. Figure 2 shows the densities while Figure 3 the dry and wet season densities and the percentage gazetted as forest reserves. The impact points are that States in Arid and Semi-Arid Zones have relatively high densities. Based on their ecoclimatic conditions they should therefore, be accorded highest priority in ecological stabilization and development thrusts.

Table 3 shows the vegetation and land use situations of the states. It highlights the various parameters presented in the body of the paper. The accompanying Figure 3 shows that vis-à-vis the percentage of the land area covered with grassland, it is relatively low when compared with woodland. The percentage under shrubs is even higher than that of grassland. The impact points of these are that rangeland development has been minimal. Phasing out of subsidy levels on projects can only aggravate the situation.

Table 5 shows the sizes of gazetted and un-gazetted grazing reserves. Their relatively small sizes are indications that ecological stabilization problems will continue even in the long run. Figure 5 gives the pictorial information. The following points are significant: first, some states do not have grazing reserves or gazetted/un-gazetted ones. While Katsina State has all of its reserves

gazetted. The reason for this is that the first Grazing Reserve in Nigeria was in the Katsina (1965). Second, the sizes of the reserves are relatively small vis-à-vis the dry and wet season cattle densities

Conclusions

The daily social costs were calculated as ₦15.12 per head of cattle with returns at ₦18.48. This positive state of affairs suggests that the pastoralists were making normal profits. However, theoretically they were bearing only 77.81 per cent of explicit total costs. The Government's subsidy level was therefore, 32.81 per cent. Because Nigeria has still not attained self-sufficiency in beef and milk production, it is apparent that the subsidy level was inadequate in improving their husbandry system or in allowing for interventions to be sustained. Consequently, the policy of phasing out subsidies could aggravate the situation.

As already stated, rangeland and pasture development are resource and capital intensive activities beyond the capacities of the pastoralists. Hence, in both the short and long term, State funding and other supports would be required. Therefore, assuming that the cost to the nation is equivalent to the subsidy rate, its phasing out would decrease productivity through ecological degradation by the same rate. This situation would mean disintegration and attribution of social costs amongst the users as private costs. Its aggregation would again fall back on the nation as social costs.

Finally, it is concluded that Nigeria has little option. It should sustain and develop the rangelands and grazing reserves effectively. The financial outlay is bound to be relatively high, but, it may not be as high as the annual average of N350.00 million spent on various policy development activities since 1987.

Note: In 1995, one US-Dollar was eighty-five Naira ($1.00 = N85.00).

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FAO/UNEP Programme on Desertification Control in Latin America and the Caribbean

This article was prepared by the following officers of the FAO Regional Office for Latin America and the Caribbean, Santiago, Chile, who implemented the Programme in close cooperation with the Dryland Ecosystems and Desertification Control Programme Activity Centre, DEDC/PAC, and the UNEP Regional Office for Latin America and the Caribbean, Mexico City, Mexico:

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Introduction

For a long time, the arid lands of the world have been recognized as areas requiring special attention. They total over 6,100 million hectares, representing almost 40 per cent of the earth's surface. It is estimated that 70 per cent of the 5,200 million hectares of potentially productive drylands are threatened by different forms of desertification. This directly affects the welfare of one sixth of the world's population. In Latin America it is considered that 20 per cent of the Region's poor are the result of desertification.

About 30 per cent of the Region falls under climatic conditions of restricted rainfall, the most affected countries being Argentina, Mexico, Brazil, Peru, Chile and Bolivia in descendant order of arid zone surfaces.

Desertification may be characterized by a rupture of the fragile balance that made possible the development of life in dry zones of the planet. That rupture unleashes a series of self-destructive processes in which all elements, which earlier favoured vital processes, intervene. It is well known that the desertification problem is serious and that it will worsen considerably if no measures are taken in this respect.

To face this situation it is first necessary to comprehend the mechanisms that unleash land degradation in dry environments. The adequate management of these mechanisms constitutes the basis for land rehabilitation and sustained development of the arid, semi-arid and sub-humid dry zones. For this reason, this document's objective is to contribute to such purpose through a brief analysis of the causes of desertification and its consequences. Later, a description is included of the FAO/UNEP Programme carried out for the control of Desertification in Latin America and the Caribbean and its most important results.

Causes of desertification

The phenomena of desertification corresponds to a non rational use of natural resources by the population. In vulnerable zones, human activities are the principal cause of the initiation of the desertification process. A change in the components of the natural system can be added, specifically, climatic changes.

Climatic fluctuations constitute an important risk factor which has restrained agricultural development in large arid and semi arid zones in Latin America and the Caribbean. In these areas, the distribution and total amount of precipitation is extremely variable, creating a framework of uncertainty that discourages the use of agricultural techniques that generate greater productivity. On the other hand, the variability of rainfall enhances the fragility and vulnerability of the natural environment which could be degraded if the local community is pressed into using it under inadequate or traditional technological conditions. In the Sahel and South America these short term climatic

fluctuations are very noticeable, and in the latter case, these are in most cases part of what is called the "El Niño Phenomenon".

In recent years, to the normal climatic fluctuations has been added the threat of a climatic change whose effect on arid and semi-arid zones, still remains uncertain, but which could have a strong influence on the inter-annual variability as well as on the intensity of aridness.

Studies in Chile show, that in the present century a sustained decrease of the yearly amount of precipitation has taken place, both in the arid and semiarid mediterranean as well as in the humid and sub-humid climates. These same studies show that the isohyet that determines the southern limit of the Atacama desert may be moving towards Chile's central zone at a rate of 0.3 to 0.4 km per year. Something similar may be taking place in the Sahara Desert. Nevertheless, in contrast to this South Pacific coastal desert dynamic, a counterwise phenomenon is apparent in the South American Atlantic coast.

Notwithstanding the above, it could be said that deserts themselves do not constitute the point where desertification processes originate. Deserts do not supply any of the impelling agents of these processes, except in the case of warm winds. Desertification is commonly initiated during great drought periods in naturally vulnerable zones which are also subject to intensive utilization. They correspond to areas that tend to be located in the surroundings of desertic nuclei, but not inside them. These degraded areas finally join one another extending the process more and more.

The vulnerability of ecosystems in the face of the desertification phenomenon is conditioned not only by pluviometric fluctuations, but also by wind and solar radiation. On the other hand, the soil's relief and condition (texture, structure, chemical and biological richness) and natural vegetation, are other factors determining the seriousness of the desertification process.

From the anthropogenic point of view, the modifying influence of man on natural ecosystems begins at the moment that he or his actions arrive in an area. Primitive man succeeded in establishing a relatively stable relationship with his environment. His range of action and his technological development didn't allow him to entirely harvest the biocenosis. He was only capable of removing part of the biomass and the ecosystem's productivity possibly altering, within very restricted margins, the balance of the affected population.

The preferential settlement of many pre-Columbian people and societies in arid, semi-arid and sub-humid areas, is a well established fact. Apparently, these areas were selected because of their better health conditions as compared with the tropical and southern zones.

Man's technological development, added to a daily increasing population pressure, forced him to intensively affect, directly or indirectly, the natural resources of his environment. Traditionally, the principal objective of the actions on the ecosystem has been to the direct and immediate benefit of man commonly, not enough attention was given to long term effects, because, until very recently, natural resources were considered inexhaustible.

Historically, at the world level and in the long term there has been a close relationship between the rise and fall of some empires and civilizations and the dynamics of desertification. It is thus, that during the development stage of a civilization, available land has been used and improved, providing the basis for a rapid urban and cultural growth. When civilizations have reached their highest point, the demands of society's most prosperous segments and the empire's defence requirements tend to exceed the land's capacity, which is consequently overexploited. During the decline phase of a civilization, care for lands diminishes, and in some cases is aggravated by epidemics or military incursions by emerging neighbouring powers. Finally, land is abandoned, which corresponds to the real meaning of desertification. As a result, a slow recovery of the soil conditions, of the plant cover and of hydric relationships follows.

In the medium term, desertification has been related to changes in the external influences on local socio-economic conditions, which have led to strong population growth, an increase of the welfare aspirations of rural populations and to changes in international agricultural products markets. In the modern context, these external influences extend to the successes or failures of world agricultural research, inadequate exchange terms, fluctuations in the flow of funds from rich nations towards rural development programmes, structural adjustment programmes, and the increase of access to modern war equipment, etc.

The historic component has been a significant one in some cases for natural resource degradation in the Region.

In semi-arid regions of North America many nomad groups developed what is called a "culture of the desert" to survive. There are no indications that such groups degraded the land where they lived.

On the arid coastal valleys of Peru about half a million hectares were irrigated before the arrival of the Spaniards. Waterlogging due to excess water application caused salinization of the lower lands. Probably about 20 per cent to 30 per cent of the irrigated lands were desertified due to salinization. A similar situation might have occurred on irrigated lands of the semi-arid zones of pre-Hispanic Mexico.

The pre-Inca and Inca civilizations of the South American Andean region cultivated crops on the mountain slopes using sophisticated techniques of soil and water conservation. More than one and a half million hectares were prepared with man made bench terraces filled in with soil from the valleys before the Hispanic conquest. Such systems prevented soil erosion and offered good conditions for cropping whenever the structures were well maintained. The Europeans were mainly interested in mining and moved large groups of native people from agricultural activities to work in gold and silver mines. Natural forests in the Andes were depleted for wood for mining. The abandonment of the agricultural lands caused the systems to fail through lack of maintenance and neglect. About 50 per cent of bench terraces were lost and the land degraded by intensive erosion.

With the arrival of Europeans in the Region new plant species, domestic animals, animal traction and cultivation techniques for barren lands were introduced. These new conditions caused an intensification of the use of natural

resources, with a livestock-agricultural-mining orientation. At the end of the seventeenth century, the economy changed to a largely agricultural-mining one and livestock was moved to poorer areas. In many cases, the floristic impoverishment of natural pastures lead to the need for changes in the type of livestock, incorporating more rustic species that could better adapt to the new conditions created by the misuse of pasture resources. This is how areas that initially were capable of raising bovine livestock, had to change to ovine, and finally, caprine livestock.

With the intensification of mining during the eighteenth century, the population increased significantly, resulting in greater pressure on natural resources in order to produce cereals, livestock and fuelwood. Mineral foundries which used considerable amounts of fuelwood were established. In some places, in the past, as in the case of Chile's mediterranean arid climate zone, this has been the principal cause of destruction of wood resources. Later, inhabitants of the valleys began to cultivate areas on slopes and hills, as well as the foothills of the mountain range.

In some areas of the Region, fuelwood harvests for steam engines have produced a strong negative impact on the availability of fuelwood resources. In the semi-arid northwestern part of Argentina there are railroad branches built exclusively for this purpose, that have access to areas where arboreal vegetation was abundant and was constituted by algarrobos, chañares, quebracho and other species.

The present situation in arid and semi-arid zones of Latin America indicates that one of the principal factors behind desertification processes, such as can be found in socio-economically depressed areas, is the over-utilization of soils, by ploughing of non arable lands, uncontrolled fuelwood harvest, overgrazing and poor management of natural dryland pastures. The United Nations Environment Programme estimates that 80 per cent of the world rangelands are affected by desertification. On the other hand, in developing nations, 80 per cent of fuelwood is used for cooking.

In more developed areas, the main activities tending to generate desertification are: agricultural techniques which destroy the soil's structure, particularly excessive ploughing, the use of inadequate agricultural machinery; rich chemical agricultural practices, especially commercial crops; poor management of irrigation, especially in cases where the water table rise favours salinization, alkalinization or even flooding; forest fires in highly populated or touristically developed areas; urban expansion and civil works; and the extraction of superficial materials (gravel, clay, etc).

In the industrialized countries, the condition of sustainability is comparable to that of ecological stability. In the majority of developing countries, with a growing population pressure and low technological contribution, a stable condition represents stagnation at a very low level. In these cases, the sustainable growth goal of agricultural productivity should be compatible with the avoidance of, hidden or apparent, negative environmental effects, that could cause the final collapse of the use of soils.

The impact caused by human societies does not depend exclusively on their density, and FAO considers that concepts such as "admissible maximum capacity" or "critical threshold" should be used carefully because there are a number of cases in which these criteria changed considerably depending on the strategies and technologies used by the people.

Consequences of desertification

The more underdeveloped the country and the poorer its population, the more acute will be the consequences of desertification, which could even mortgage the country's future. On the other hand, the more difficult natural conditions are, especially climatic conditions, the more critical the situation will be.

The effect of drought can be felt both in dry land agriculture as well as in irrigation agriculture, because ground water reserves as well as snow reserves which supply rivers, are diminished, this is also the case with superficial runoff. Likewise, during prolonged drought periods no herbaceous stratum is developed and most bushes remain in a temporarily withered condition, as a strategy to bear the critical period. For this reason, the carrying capacity of grazing areas undergoes dramatic drops, making it necessary to move livestock to more favourable areas to avoid high death rates.

Desertification unleashes a series of self-destructive processes, in which all the elements that used to favour vital processes participate. Thus, the loss of soil caused by wind and water erosion, its chemical impoverishment, the drop of the ground water level, a general alteration of the hydrological cycle, embankment and sedimentation of water flows, invasion of dunes and a lesser natural regeneration of herbaceous and woody plants, are immediate consequences of desertification, and, at the same time, they are the causes of the aggravation of the phenomenon. This translates into a severe reduction of the ecosystems' productivity, which results in a decrease in agricultural, livestock and forestry yields, as well as in the loss of biological diversity.

Desertification is a self-feeding process, often voracious. Affected populations facing desertification react by taking the following actions in their endeavour to survive:

- Intensifying an already excessive exploitation of the more accessible natural resources, at the cost of growing expenditure of human energy;
- Giving away goods and equipment, to face basic expenses or to overcome food crises; and
- Migrating, eventually on a massive scale.

A result of the rupture that leads to desertification, under those conditions, is usually another rupture: the rupture of the community, and even of the family nuclei. Therefore, it can be said that mankind, either as a victim or culprit, is in the middle of the desertification problem.

The final stage of the desertification process leads to the system's loss of information, characterized by genetic erosion, denudation of plant species, deterioration of the habitat, extermination of the most valuable fauna, soil erosion,

salinization or alkalinization, loss of the edaphic structure and natural relief.

The final result, as the scenario for life, is the deterioration of its quality as a productive natural resource and habitat, and of its scenic beauty. Desertification is the mechanism that unleashes depopulation and above all poverty.

International action

Since the 1950s, various United Nations agencies have been concerned with the problems of arid and semi-arid zones. In 1974, the United Nations' General Assembly recommended that the international community, without delay, adopt concrete measures to stop desertification and contribute to the economic development of the affected zones. Thus, in 1977 a United Nations Conference on Desertification was called, in which the Plan of Action to Fight Desertification was adopted, and endorsed that same year by the United Nations General Assembly as one of the principal world programmes. At the United Nations Conference on Environment and Development, in 1992, this subject was analyzed again, and Chapter 12 "Management of Fragile Ecosystems: Combating Desertification and Drought" was approved as part of Agenda 21. Finally, the United Nations Convention to Combat Desertification in the Countries affected by Serious Drought or Desertification, commits signatory countries to prepare and take actions to combat desertification and palliate the effects of drought.

To fight against desertification means making additional development efforts in the areas involved. In any current effort all sectors must be involved: governmental institutions, non-governmental organizations, producers' organizations, universities and the directly affected population.

FAO's position

In the document "Sustainable Development of arid land and Combating Desertification", FAO sets forth its position on the subject and outlines five principles for development in arid, semi-arid or sub-humid zones threatened by desertification, under a participative and global point of view:

- The first principle is of integration, that implies associated short-term needs, as is food, health, education and income, with the ones of mid- or long-term, which include defence, rehabilitation and valorization of the existing resources.
- The second is the principle of concerted action, which is based on the population's participation and is exercised at various levels: the local community; in connection with its own projects; among the communities, to combine capacities in a common area, generally a watershed; of communities with national or regional institutions; and, finally, the agreement between executing agencies and development support agencies.
- The third important principle is the planned geographic approach, whose fundamental instrument is territorial management involving the solution of conflicts regarding the use of resources and interests at the community level, as well as their consistency with the national policy on management and preservation of the natural environment.
- The fourth principle refers to decentralizing decisions and means of action. The base organization is located in rural communities. Technical and managerial functions, as well as the establishment agreements for actions and decisions are exercised at the regional level. At national level, a coordination centre supervises and stimulates the response of national public services to local and regional initiatives; coordinates and integrates national decisions; and promotes the necessary support actions.
- Finally, the principle of the duration and flexibility of aid. This means that governments and donors agree to continue lending their financial support until a stage of maturity is achieved. Flexibility implies the adaptation of technical and financial support to changing local needs and possibilities.

The fight against desertification and the fight against poverty, frequently, are the same fight: they propose sustainable development of arid, semi-arid and sub-humid zones and aim at solving three challenges in connection with natural resources:

- To stop or impede desertification in slightly degraded areas or areas in good condition, through preventive measures;
- To restore productivity in fairly degraded areas, with corrective measures;
- To recover productivity in extremely degraded areas, with rehabilitation and drainage measures.

From the technological standpoint, FAO considers that all lands are usable by man, in that such use is based on the potentiality of the sites in accordance with their present condition. It is thus possible to control desertification in the long term through sustainable agricultural and forest production or through the management of wild areas. The important thing is that the management of arid and semi-arid areas is carried out under a sustainable development approach, which means that the technologies applied are environmentally non-degrading, technically appropriate, economically viable and socially acceptable.

In the measure that human activities, in most cases, are the main cause of the degradation of the natural environment, it is essential that general policies and particular activities which permit or cause degradation be revised. The fight against desertification is not only a technological or financial fight. It should also be understood as a struggle at the political level. Rural populations must have a juridical, legislative, social and economic structure, which should be sensitive and propitious for initiatives aimed at the sustainability of development, in which each individual will have the possibility to select and defend his interests.

The FAO/UNEP Programme of Desertification Control in Latin America and the Caribbean Region

Within the context of these considerations, the FAO Regional Office for Latin

America and the Caribbean, jointly with the United Nations Environment Programme (UNEP), at the end of 1992, started a Programme to Implement Desertification Control Activities in Latin America and the Caribbean Region, where over 600 million hectares are affected by this process.

The Joint FAO/UNEP Programme covered five main lines of action to:

- Provide advice on the preparation and implementation of sustainable development strategies at the regional and national level, such as the National Action Programmes to Combat Desertification;
- Promote technical training through courses, seminars and workshops on subjects pertaining to the development and conservation of the Region's arid and semi-arid zones;
- Participate in the preparation of technical publications on subject of resource management and development of arid and semi-arid zones;
- Support the strengthening of the Technical Cooperation Network on Arid and Semi-Arid Zones, as well as of other networks in the region linked with technical and socio-economic aspects of desertification;
- Provide advice at the regional level, on strengthening the capacity to face the adverse impacts of drought.

Under these terms, technical and financial support has been provided for the formulation of National Action Programmes to Combat Desertification in Argentina, Bolivia, Brazil, Chile, Mexico and Peru.

In connection with the Technical Cooperation Network on Arid and Semi-Arid Areas, a Circular Letter is published quarterly of which 11 issues have been prepared and distributed to date. Within this same line of activities a data bank has been prepared with institutions and persons working on the control of desertification in the Region, for the purpose of improving knowledge on the activity being carried out on this subject. To date there are over 200 institutions registered. For the same purpose, a contest on successful technologies on desertification control is being carried out as a mechanism to create a database which may be disseminated in the Region.

On the other hand, during 1995, actions were started to develop a uniform methodology for the evaluation and monitoring of desertification in the Region.

In addition to the foregoing, studies were carried out to implement a post-graduate and research programme on Range Management in the Region.

The activities carried out have originated the following documents published by the FAO/UNEP Programme, under the Serie: *Zonas Aridas y Semiáridas*

- Consulta de Expertos sobre el Avance de la Agroforestería en Zonas Aridas y Semiáridas de América Latina y el Caribe.
- El Papel de los Animales Domésticos en el Control de la Desertificación. (Also available in English).
- Informe del Taller de Expertos sobre Conservación y Uso Sostenible de la Biodiversidad en Zonas Aridas y Semiáridas de América Latina y el Caribe.
- Informe de la Consulta de Expertos en Manejo de Cuencas Hidrográficas en Zonas Aridas y Semiáridas de América Latina.
- Informe del I Curso/Taller sobre Técnicas Apropiadas para la Propagación de Especies de Importancia Económica para las Zonas Aridas y Semiáridas de América Latina y el Caribe.
- Principios de Manejo de Praderas Naturales.
- Planificación y Manejo Integrado de Cuencas Hidrográficas en Zonas Aridas y Semiáridas de América Latina.
- Conservación y Uso Sostenible de la Biodiversidad en Zonas Aridas y Semiáridas de América Latina y el Caribe.
- Técnicas Convencionales y Biotecnológicas para la Propagación de Plantas de Zonas Aridas.
- Estudios de Casos de Especies Vegetales para las Zonas Aridas y Semiáridas de Chile y México.
- Manual de Captación y Aprovechamiento del Agua de Lluvia. Bases Técnicas. Experiencias en Asia y Africa.
- Manual de Captación y Aprovechamiento del Agua de Lluvia. Experiencias en América Latina.
- Estudio sobre Especies Arbóreas y Arbustivas para el Desarrollo Sostenible de las Zonas Aridas y Semiáridas de América Latina y el Caribe.

Additionally, translations and further publications were made of the UNEP Desertification Control Bulletin, numbers 26 and 27, and widely distributed in the Region.

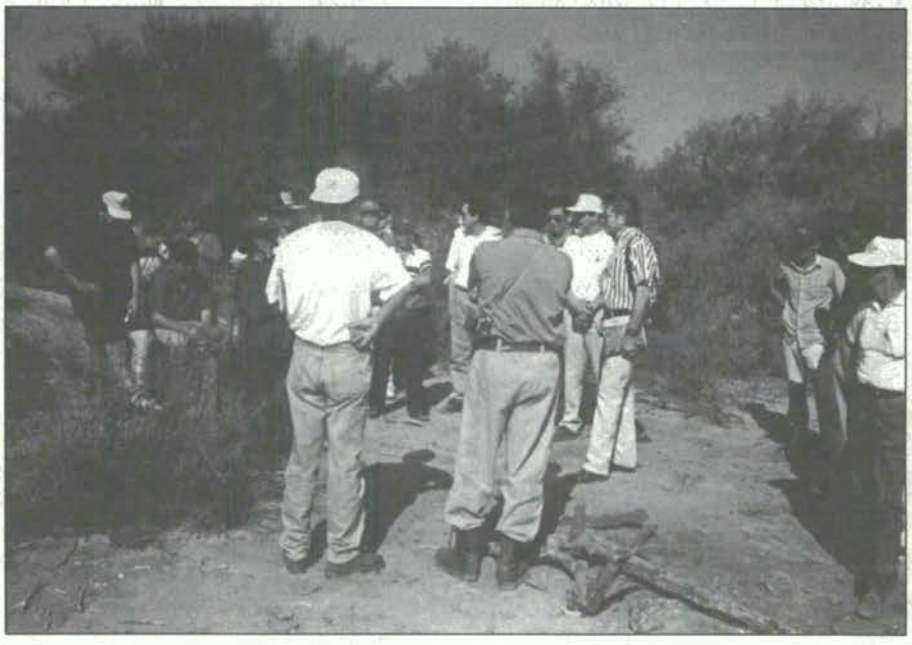


Photo: Kroumatchev, UNEP

Training course on desertification assessment and control in Argentina, Mendoza

Jointly with the Argentine Research Institute on Arid Zones (IADIZA), the Third Latin American Course on Desertification Assessment and Control was organized in Mendoza, Argentina. Subsequently, the Consortium for the Promotion of Training in Diagnosis, Prevention and Control of Desertification was established. It is formed by IADIZA, the Agricultural Research Centre of the Semi-arid Tropics (CPATSA/EMBRAPA) of Brazil, the University of Chile and the Post-Graduate College of Montecillo, of Mexico. These institutions, with the financial and technical support of the FAO/UNEP Programme, decided to join efforts for the purpose of organizing future courses at the highest professional level. During 1995, the Fourth Latin American Course on Desertification and Sustainable Development was given in Montecillo, Mexico, under this method. The Fifth Course will be held in 1997, in Chile.

Another meeting was held in Mendoza, Argentina, under the title Expert Consultation on Watershed Management in Arid and Semi-arid Zones of Latin America and the Caribbean.

The International Workshop on Water Harvest for Sustainable Production in Semi-arid Zones, was carried out in Petrolina, Brazil.

The Expert Consultation on the Advance of Agroforestry in Arid and Semi-arid Zones of Latin America and the Caribbean as well as the Second Latin American Meeting on Arid and Semi-arid Zones, carried out in Mexico City, constitute other activities of the FAO/UNEP programme. In 1995, the Third Latin American Meeting of Arid and Semi-arid Zones, was held in Patagonia, jointly with a Meeting of Coordinators from countries which have already prepared National Action Programmes to Combat Desertification, for the purpose of exchanging experience and proposing future actions.

The First Course/Workshop on Appropriate Techniques for the Propagation of Species of Economic Importance for Arid and Semi-arid Zones of Latin America and the Caribbean, was held in Mexico, as a follow-up to the Workshop on Conservation and Sustainable Use of Biodiversity in Arid and Semi-arid Zones which was held in 1994, in Guadalajara, Mexico.

Results of the programme

During the three years' duration of the FAO/UNEP programme, National Action Programmes to Combat Desertification, were formulated in the six countries with the largest arid and semi-arid zones, and dry sub-humid areas of the Region. Moreover, in the first three countries which formulated these action programmes (Chile, Mexico and Peru), follow-up actions have been carried out aimed at disseminating the Programmes' contents at all technical, political and social levels, in particular, those which are related to the magnitude of the problem and the cost of inaction. In the same way, activities for the control of desertification have been planned through pilot projects. This has contributed to the capacity of the countries in the region to combat desertification.

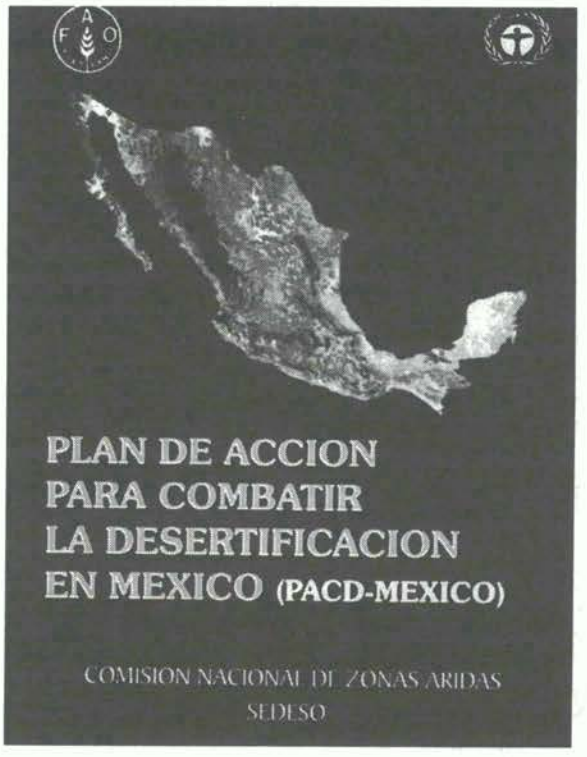
Other countries of the Region, such as Cuba and Ecuador, are carrying out their own National Action Programmes.

As progress has been made in this activity, the application of the basic principles which determine the actions of the process for the formulation of programmes has been improved to include a multi-disciplinary and integrated approach with the full participation of the populations involved.

An average of 20 to 30 persons have participated in each course and workshop held who, upon returning to their country of origin have exercised a multiplying effect concerning the contents of each programme, they have done this through national courses on the same subjects by applying the knowledge acquired.

It is necessary to stress that, through the FAO/UNEP Programme, management aspects have been increasingly incorporated into the former course on desertification which emphasized diagnostic aspects. For this reason, the fourth Course was referred to as "Desertification and Sustainable Development", whose objective was to train participants in the application of diagnostic techniques of degradation processes of natural resources, in methodologies to achieve their prevention and correction, as well as options to face drought situations. In addition, participants were trained in the identification of systems for the use of natural resources and food production, compatible with sustainability of ecosystems, considering traditional and modern techniques.

The preparation, editing, publication and distribution of an average of one thousand copies of the thirteen documents of the Serie: Zonas Arid*as y Semiáridas*,



Plan of Action to Combat Desertification in Mexico

has made it possible for a considerable number of professionals in charge of the management of arid and semi-arid zones, to have access to information which practically covers all the aspects involved in the sustainable management of the said environments.

The translation into Spanish, and the distribution of the UNEP Desertification Control Bulletin (numbers 26 and 27), has made the valuable information on conceptual aspects of analysis and techniques on desertification available to those who might otherwise be limited by language problems.

The Technical Cooperation Network on Arid and Semi-arid Zones which to date includes fourteen countries of the Region, was strengthened through the exchange of information, in the Second and Third Latin American Meetings on Arid and Semi-arid Zones, held in Mexico City (1993) and Patagonia (1995). The preparation of the database for over 180 agencies and 600 people working in arid zone management, the database on appropriate technologies for the control of desertification and the Networks Circular Letter, have contributed to the same end. The later data- base will make available to specialists a great amount of conventional and modern plant production technologies for the rehabilitation and development of arid and semi-arid zones.

Furthermore, the issues of the Circular Letter are distributed to universities, research centres, NGOs and other institutions specializing in desertification control.

The preparation of a unified technology for the evaluation and monitoring of desertification will provide an instrument which is the result of the participation of the best specialists in the subject. This will be of great use to professionals working in the diagnosis of the degradation processes of renewable natural resources, facilitating cooperation among them.

Conclusions

During the development of the Joint FAO/ UNEP programme activities, increasing interest was observed at the level of governments, to carry out National Action Programmes to Combat Desertification. This is the result of the permanent dissemination in the Region of the activities of the countries which have already prepared such programmes or are in the process of doing so. Likewise, great interest has been shown by those participating in the FAO/UNEP Programme activities. NGOs have participated in some of the activities, as in the case of the First Contest on Appropriate Technologies for the Prevention and Control of Desertification, Drought and Soil Degradation in Latin America and the Caribbean.

On the other hand, there is growing interest on the part of persons involved in desertification control, to obtain information on technical aspects related to the subject. This has become evident through the great number of requests for the publications produced by the FAO/ UNEP Programme, and the existing demand to participate in the courses that have been given.

Additionally, it may be pointed out that there is great willingness on the part of persons and institutions to participate in activities requiring regional collaboration. An example of the foregoing is the good functioning achieved during the fourth Course on Desertification and Sustainable Development by the Consortium for the Promotion of Training in Diagnosis, Prevention and Control of Desertification; the interest in contributing to the database of persons, institutions and cases of successful management for desertification control; as well as the manner in which development of a methodology is operating.

Integrated Wasteland Development: NCHSE Experience

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Executive Summary

The National Centre for Human Settlements and Environment (NCHSE)established in 1984 is a non governmental organization active in the field of policy planning and the execution of development projects. The Organization started its Jhabua regional office in 1991. The NCHSE believes that despite an annual average rainfall of 830 mm., what causes regular droughts leading to desertification in the district, is the skewed distribution of rain and the incapacity of the natural drainage system and soil to retain moisture because of gross land abuse over the years. Given rational land use, the protection of vegetation, afforestation and pasture development, minimal water conservation and of course human resource development, the district could be freed from the spectre of drought.

The NCHSE has been working on four different types of development model. These models along with the sponsoring government, corporate and international bodies are given below:

Activity	Sponsoring Agency
1) Wastelands Development	National Wastelands Development Board (NWDB) and National Afforestation and Eco-Development Board (NAEB)
2) Watershed Rehabilitation	Rajiv Gandhi Mission (GOI) Australian High Commission (AHC), and Gas Authority of India Limited (GAIL). Church's Auxiliary for Social Action (CASA)
3) Dairy and Pasture Development	National Tree Growers' Cooperative Federation Ltd., (NTGCF) and National Dairy Development Board (NDDB)
4) Entrepreneurship Development	International Labour Organisation (ILO), funded by DANIDA, CIDA and others

All these projects aim towards sustainable development with the participation of local people.

An evaluation mission of the UNEP visited India to evaluate success story experiments to control desertification. In this connection two complimentary micro watershed projects in Jhabua district the Integrated Wasteland Development Project (IWDP) and the Grant in-Aid (GIA) project, were evaluated during 1994.

The NCHSE was able to achieve all the targets within the stipulated time and cost constraints but more importantly it marked the beginning of the people's own development programmes in a land alien to this concept.

The impact of the success achieved in these programmes is realized in the successful initiation of many new development programmes in the region. The NCHSE has been identified as Project Implementing Agency (PIA) for the Rajiv Gandhi Mission for Watershed Development in Jhabua. The fact that villages which had to be dropped under the 'evaluated' programmes earlier have now demonstrated an interest and have willingly preferred NCHSE to any government agency as their development agent (catalyst), supports this hypothesis.

The wasteland development projects implemented by the NCHSE have not only been successfully implemented but are now being protected by the concerned villagers themselves. They are being emulated by neighboring villagers as well. The NCHSE has concentrated its efforts on a watershed of 5,000 ha containing nine neighboring villages.

Integrated wasteland development: NCHSE experience

Introduction

The tribal populations of India tend to live in the afforested and hilly areas of the country. A characteristic common to all such areas is remoteness and the absence of good communication facilities. The state of Madhya Pradesh hosts perhaps more remote tribal peoples than other states because the state is so large and infrastructural development falls far short of national standards.

The tribal population of Madhya Pradesh constitutes around 23 per cent of the total tribal population of India and the total population of the state (1991 Census), the 'Gonds' are the largest tribal group (47 %) followed by Bhils, which numerically account for 21 per cent of the state's tribal population. The Bhils are concentrated in the western part of the state in the districts of Jhabua, Dhar and Khargone.

Such tribal peoples have a definite way of life and particular socio-cultural and religious characteristics. In the past, a majority depended upon the forests for their livelihoods. But now owing to over exploitation of forests few resources are left. The collection of minor forest produce, for instance the leaves of tendu, p*alas, mahua*, fruits and flowers, etc., barely allows for 20 days employment in a year. In Jhabua the annual fodder deficit is estimated at 1.27 million tonnes which calls for a reduction in the livestock population by 61.5 per cent. Dairying, therefore, is pursued more as an occupation then an enterprise.

The tribal have experienced extensive soil erosion and with the increase in human pressure on land, more and more of this land is being brought under the plough, without adequate soil and water conservation treatment. Stripped of its protective overgrowth and exposed to rainfall, the soils which are generally loose (sandy loam) have been heavily eroded. In the absence of irrigation, single cropping of limited crop species is the norm which gives a poor yield. However, agriculture remains the mainstay of the tribal economy. Their access to government relief work has its logical limitation, as wage labour in backward areas is limited. Seasonal out migration has become a common characteristic of the Bhils for the last two decades. Thus the tribals (Bhils) today have an uncertain future.

The hilly tribal district of Jhabua has recently witnessed the large-scale over exploitation of natural resources. It has been experiencing severe ecological degradation due to anthropogenic and natural factors. The countryside, which three decades ago boasted a thick forest cover of dry to moist tropical deciduous trees is today a barren landscape. Indiscriminate deforestation mainly for the illegal conversion of forest land to agriculture, has been the prime cause of this accelerated devastation. The land has lost its productive potential. The settled 'Bhil', the hunter-cum-cultivators of the past have today lost their identity and are known as 'Mamu', the name given to migrant construction laborers in the urban areas.

The Projects: Conceptual framework

The Integrated wasteland Development scheme

The scheme is largely implemented by State governments, but NGOs with requisite capability may also execute Integrated Wasteland Development (IWD) projects. The basic objective of the scheme is to assist in the startup of pilot projects at the field level: these projects embody an integrated approach to land management and wasteland development, based on village/ micro-watershed level plans prepared taking into account land capability, site conditions and local needs. The hope is to promote optimal land use for both ecological and socioeconomic needs. The scheme also aims at enhancing the content of public participation in the wasteland development programme through mechanisms for people's involvement at all stages and by providing the modalities for equitable and sustainable sharing of benefits arising from such projects. The extension of technologies in special problem areas such as Jhabua (semi-arid and desertic) is also a primary objective of the scheme.

Grant-in-Aid Scheme

Grant-in-aid under the scheme is available to registered agencies, cooperatives and other similar organizations for undertaking work which could include the implementation of small programmes, awareness raising, training and extension, organization of people for regeneration, protection, etc. Projects with a higher degree of voluntary contribution and people's participation are preferred. Similarly, projects involving the utilization of funds under various schemes for different components of an integrated project, and the tapping of institutional finance is also given preference. Funds are released directly to the voluntary agency.

Project achievements

Integrated wasteland Development project

The Project is being carried out in three villages in central Jhabua: Bijyadungari, Kalapan and Piplipada. Private plantation targets were attempted in the three other villages: Thuwadra, Bhoot Barda and Tikrijogi. The villages, with the exception of Kalapan, were not the original target villages. Preliminary discussions with residents of two of the chosen villages made it clear that intended project activities would neither be welcome nor feasible, hence the changes.

The NCHSE, has, in most cases, exceeded most of its output targets:

i. Afforestation of community land, soil and moisture conservation and land preparation: contour trenching and gulley plugging, the digging of pits, cattle-proof trenching and the fencing of 247 hectares in five sites was completed by June 1993. By 1995, 378,505 saplings had been planted;
ii. Plantation on private land - against the target of 80,000 plants, 90,825 plants have been planted over 52.5

hectares of private land. The survival rate however, has not been high;

iii. Pasture development - an area of 120 hectares has been planted with 3,051 beds of grass and 40,299 seedlings, surpassing the original targets of 3,000 beds and 36,000 seedlings;

iv. Free distribution of seedlings - the targeted 100,000 plants intended for private distribution have already been distributed;

v. Water harvesting structures - against eight targeted water harvesting structures four were actually taken up and completed. The villagers of Kalapan preferred a check dam in place of four small structures;

vi. Distribution of fuel and energy saving devices - against the intended 200 fuelwood saving devices, 787 such fuel efficient stoves have been distributed to date.

The achievement of output objectives is not necessarily an indicator of project success but it is an indicator of project efficiency and effective delivery. Over achievement of targets also speaks of the dedication and commitment of the project team.

Grant-in-Aid Project

The first Grant-in-Aid project began in 1992, again in three target villages; Thuwadara, Tikri jogi and Bhootbarda. While GIA has similar goals to IWDP, activities concentrates on supporting individual farmers, woodlots and tree nurseries. In addition, the project includes an environmental awareness component which is less amenable to measurement by outputs.

The project has met and exceeded its targets on physical outputs:

i. Nursery development and sale of seedling by individual farmers: the project trained private farmers of the area in seed germination and nursery techniques and also supplied polythene bags and seeds to individual nurseries.

ii. Distribution of free seedlings to farmers in projects and peripheral villages from subsidized private nurseries as well as a central nursery in project and adjacent villages was also attempted.

iii. Community land treatment; Initially two villages agreed to build stone walls around a tract of community land in order to facilitate unimpeded natural regeneration. The result of this protection was extraordinary. There is evidence of active vegetation succession. The local flora of the region has revived with many original crop trees now standing up to 10 ft high. Of equal interest are the reports of fauna revival in these protected areas. For instance, foxes and rabbits have been sighted by villagers.

Plantations/Woodlands

The afforestation of community land is a major component of IWDP with an output target of 247 hectares and a plantation target of 378,505 saplings planted. The current survival rate of saplings on community land is 80 per cent.

Twelve species of indigenous and exotic trees have been planted on community land: T*erminalia tomentosa, Tectona grandis, Albizzia lebbek, Dendrocalamus strictus, Acacia catechu, Acacia nelotica, Albizzia amara, leucaena leucocephala, Dalbargia sissoo, Emblica officianalis, Tamarindus indica, Eucalyptus* and Guava. Bamboo, Teak, Eucalyptus, L*eucaenea, Albizzia* and acacia varieties are growing well.

In IWDP villages, only two species; bamboo and eucalyptus, were planted on private lands. Bamboo and eucalyptus are popular and were the preferences of the farmers. Eucalyptus produces straight utility poles in roughly less than 10 years. At present, poles are imported from over 1,500 - 2,000 Km. away, from other states, at a cost of about Rs 650.00 per pole in Jhabua. Bamboo has a special peculiarity of producing intermediate crops from year five to 35, when it fruits and reaches maturity. In addition, bamboo has many agricultural and domestic uses: roofing, as irrigation pipes and parts for agricultural tools.

Pasture Development

The planting of pasture grass species on community land and government land has proved to be one of the most successful and welcome project initiatives. It has been proved that the rapid increase in yield, with the accompanying economic returns, has led to land treatment and protection for pasture.

Live fencing and contour trenches have allowed the local grass species to regenerate. In addition, two new species of grass have been introduced: stylosanthus and *pedicelletum* which are nitrogen fixers. A thick healthy cover of grass can be seen in every site during the season.

The key to the success of community pasture has been the almost immediate economic returns for villagers, along with significant increases in yield over the three years of harvesting (See Tables 1 and 2) . Differences in yield are partially due to the quality of land and the level of soil erosion at a particular site.

Year	Site	Area (ha) Beneficiaries	Nos. of production	Total gras	prod. per ha
1992	Kalapan Hatila	18.5	56	9,200	497
	Kalapan Bilwal	19.5	-	-	-
		38.0	56	9,200	497 kg
1993	Kalapan Hatila	18.5	52	4,842	2586 kg
	Piplipada Main	21.5	32	27,105	1261 kg
	Piplidada I	26.5	35	90,585	3418 kg
	Piplipada II	23.0	12	22,777	990 kg
	Bijyadungari	11.0	12	5,184	471 kg
	Kalapan Bilwal	19.5	-	-	-
1994	Kalapan Hatila	18.5	58	31,20	1686 kg
	Piplipada Main	21.5	37	24,676	1148 kg
	Piplipada I	26.5	51	48,286*	1822 kg
	Piplipada II	23.0	25	46,834	2036 kg
	Bijyadungari	11.0	16	10,826	894 kg
	Kalapan Bilwal	19.5	-	-	-
		120.0	187	161,822	1535 kg

*Estimated by quadrant sampling. Harvest in progress.

Table 1: Grass Production and Beneficiaries - IWDP

Year	Site	Area (ha)	Nos. of Beneficiaries		Total grass production	Prod. per ha
1992	Thuwadara	28.0	Thuwadara	17	2,790	100 kg
	/Bhoot Bayada		Bhoot Bayada	29	6,210	
	Thuwadara Devasthan	0.7		5	1,050	1500 kg
		28.7		51	10,050	350 kg
1993	Thuwadara	45.5	Thuwadara	36	26,908	544 kg
	/Bhoot Bayada		Bhoot Bayada	13		5,426
	Thuwadara Devasthan	0.7		4	1,851	2644 kg
		50.2		53	34,185	681 kg
1994	Thuwadara	28.0	Thuwadara	53	37,814	1243 kg
	/Bhoot Bayada		Bhoot Bayada	16	6,938	
	Thuwadara Devasthan	0.7		5	1,700*	2428 kg
		28.7		74	46,452	1619 kg

*Estimated by quadrant sampling. Harvest in progress

Table 2: Grass Production and Beneficiaries - IDP

Although many farmers had previously been growing grass for fodder, most were obliged to buy additional grass to supplement their own production, at RS. 1-2 per bundle. Now the beneficiaries not only have enough grass for their own requirements but are also growing surplus for sale.

The original community and private pasture areas, as with afforestation, were prepared and developed by the villagers on a daily wage payment basis. Now the maintenance and harvesting is carried out by them at no cost to the project. The Keenness of villagers to adopt afforestation and pasture practices and the feeling of ownership of, and responsibility for, the treated community lands indicates the potential sustainability of these initiatives.

Other issues have a bearing on sustainability. These include: maintenance of live fencing, security, land pressure and land tenure. The economic benefits from grass harvesting mean that the beneficiaries have a vested interest in maintaining live fencing and stone walls around the sites.

Fuel Conservation

One of the most welcome project innovations has been the introduction of two fuel-saving devices. A mobile stove, sigdi, and the *chulla*, a permanent structure. The latter was redesigned by village women and has been distributed free of charge.

The projects have been particularly successful in introducing fuel-saving cooking devices. Two kinds of fuel saving device, have been introduced. The 'chulla, is a permanent smokeless stove originally designed by the Madhya Pradesh Energy Development Corporation but adopted with the help of women in the communities. The stove has two plates which allow two dishes to be cooked simultaneously. Women use a combination of wood and dung and straw patties to fuel the stoves. It works on 50 per cent fuel consumption compared with the original chu*llah*.

The 'sig*di*' is a small single surface iron stove that has proved even more popular among village women. A total of 600 sigris have been distributed to date. One reason for the popularity of this fuel saving stove is its mobility; it can be transported when villagers migrate.

Socio-Economic Issues

The two project areas have an entirely Bhil population. An understanding of Bhil culture and a sensitivity to their very specific situation was, therefore, critical to the success of the initiatives. The Bhils feel largely alienated from the rest of Indian society and are now suspicious of outside agencies and government intervention. The NCHSE was conscious of the need to win the support and confidence of the communities and to involve them in the decision-making process.

Bhil Culture and Gender

Two aspects of Bhil culture which are of significance to project activities are: the absence of the practise of primogeniture, thus allowing land holdings to be sub-divided each generation; and the relatively high status of women in Bhil society where work is shared more equitably between the sexes and women are consulted and make key decisions concerning finance and the household.

The Bhil in the project area are a largely unstratified, homogeneous population. Nearly all households either hold title to their land or regard the land they farm as their own. This sense of ownership of land and livestock gives the population a certain autonomy and pride. The Bhils do not observe the custom of primogeniture. This means that land is split between all the sons of a family. As a result, there is increasing pressure on land as the farms are sub-divided.

Although a patriarchal society, the Bhils do not have a dowry system unlike the rest of Indian society. A bride price is paid to the wife's family, but the woman has the right to refuse a husband. Women seem to have a significant voice in farm and household management. Although

certain tasks are traditionally carried out by women, such as water collection and fuel gathering, all other tasks are shared between the sexes.

Population

There has been a more than 50 per cent increase in the population in the project area over the last decade. Even with a downward trend in the birthrate there will be increasing pressure for land over the next decade making any remaining community land vulnerable to encroachment.

The current population of the six project villages is given in Tables 3 and 4. The villages vary in population size from 1,333 in Kalapan to 485 in Thuwadara. The average family size is 6.3 children in Jhabua District. Even if the birth rate should fall it is still likely that there will be extreme pressure for land over the next ten years.

Migration

Seasonal migration by marginal farmers is of major concern as it has adverse effects on health, education and livestock grazing.

Seasonal migration for work is central to the economic survival of most villagers. It also poses a major threat to project initiatives. Nearly 50 per cent of all villagers migrate from November to April/ May. Twenty years ago, the Bhil travelled relatively short distances looking for casual unskilled jobs. Now, however, they are forced to travel much further looking for work.

The seasonal out migration has many ill effects which are mostly social and environmental. In terms of project activities, it is the main contributory cause of overgrazing and underprotected land. The low literacy rate (see tables 3 and 4) means that the Bhils are forced to accept casual labour in the worst working conditions. Health care and education suffer as a result of the migration. Although it is now rare for children under 15 to migrate with families, they have to take over many of the household chores and livestock care and are, therefore unable to attend school in those months. School attendance drops by 50 per cent because of migration.

	Piplipada		Bijya Dungari		Kalapan	
	1981	1991	1981	1991	1981	1991
No. of households	158	202	38	65	166	201
Population						
* Total	848	1233	143	527	909	1333
* Male	409	592	130	266	458	665
* Female	439	641	113	261	451	668
Scheduled Caste	27	34				
Scheduled Tribe	820	1195	243	527	909	1333
Literacy						
* Male	13 (3.2%)	58 (9.8%)	2 (1.5%)	25 (9.4%)	3 (0.6%)	7 (1.1%)
* Female	1 (0.2%)	9 (1.4%)	-	16 (6.1%)	1 (0.2%)	1 (0.1%)

Table 3: Demographic Features - IWP Project Area

	Thuwadara		Tikdi Jodi		Boot Bayada	
	1981	1991	1981	1991	1981	1991
No. of households	78	103	50	69	68	85
Population						
* Total	393	485	309	496	382	612
* Male	200	249	161	235	176	291
* Female	193	236	148	261	206	321
Scheduled Caste	-	-				
Scheduled Tribe	393	485	309	496	302	612
Literacy						
* Male	15 (7.5%)	25 (10.5%)	1 (0.3%)	48 (20.4%)	15 (8.5%)	10 (3.4%)
* Female	1 (0.5%)	5 (2.1%)	-	8 (3.1%)	9 (4.4%)	2 (0.6%)

Table 4: Demographic Features - G1IA Project Area

The project is acting as a catalyst encouraging government departments to work with villagers on those issues which lead to large scale migration. Income generating projects such as fisheries and small-scale cottage industries are being encouraged and supported by the government as a result.

Level of Community Participation

Increased attendance at village project meetings, the formation of a women's group, the introduction of a Community Fund for future maintenance of treated land, a high turn out for environment rallies and a continuing willingness to maintain and protect community land demonstrate a high level of community involvement.

The NCHSE has worked with the project villages for four years and there appears to be a growing sense among the villagers that the project is theirs. Both men and women are enthusiastic about the changes. From the start, the NCHSE took the approach that no activity would either be successful or sustainable without the full engagement of the communities. Regular community meetings with project staff are held every month and consciousness raising workshops are also held. Women's groups have been instituted as a result of these meetings.

Lessons Learnt

Concluding remarks from UNEP's evaluation team which visited and surveyed the project villages:-

Project design

The evaluation team believes the projects are well conceived and encompass most of the necessary and related development concerns. The projects include a monitoring component which has allowed project adoption and flexibility.

The strength of the projects, design, particularly IWDP, lies in its broad-based integrated approach to the targeted area. The project proposals were premised on the need to know and understand fully the target villages, the communities, their resources and the land-use potential. Thus, a central component of the NCHSE activities concerned information about the. areas. This was carried out through baseline surveys and also as part of its study on the sustainable utilization of resources in Jhabua District. This process of data collection and information gathering has led to the transformation of the projects from a top-down approach to a community, needs-based approach.

Integrated project activities

The projects integrate changes in land use and environmental protection with activities intended to improve the standard of living and quality of life of the population. The importance given to the needs and concerns of the people has led to the balanced integration of environmental protection with the on going demands of everyday life of the villagers.

As the project title "IWDP" suggests, the activities are indeed integrated involving three major components:

- Soil conservation measures;
- Afforestation and pasture development; and
- Distribution of subsidized fuel-efficient stoves.

These complementary activities are enhanced by GIA activities which concentrate more on the individual farmer. Since the project began, other activities which have come about through the other district departments, have been supported by project staff and actively embraced by the communities.

Institutional capability and policy

The evaluation team sees the combination of the NCHSE's proven capacity to implement its programmes and its strong and active links with all levels of government as a key factor to the success of the projects. A question mark remains as to whether the NCHSE can influence the future of land- tenure legislation which might help protect treated community land.

The NCHSE is an unusual NGO in manyrespects. Its board consists of committed and dedicated people who have years experience in diverse fields and many of them were once senior civil servants in the State Government. Their experience and connections with people in state and national governments facilitates excellent working relationships at different levels. Because the NCHSE is fully aware of current government policies and evolving issues it has been able to secure funding for its programme.

Land tenure, however, is a thorny issue. Legislation protecting community land from encroachment is rarely enforced. The NCHSE was careful to reassure encroachers around remaining areas of community land that project activities would not interfere with or threaten their 'tenure' on community land. This respect for existing land use has more than contributed to the acceptance of the NCHSE in the community. The District Revenue Department. has little say in land tenure legislation as this is determined at the state level. Perhaps the best hope for the long-term survival of community land lies at the panchayat level.

Community participation

The evaluation team believes that the capacity of the projects to help the target population generate income from project activities is largely responsible for the increasing level of community participation.

The project brief for the evaluation team states that 558 households participated in the project. While the team did not attempt a census, there was ample evidence that more than 558 households are now involved. First, there has been effective project activity in the six target villages with more than two years of financial returns to beneficiaries on project initiatives. Second, the project has distributed a large number of seedlings to farmers in nearby villages who are keen to plant woodlots and are even persuading their relations to participate.

The active participation clearly lies in the high income potential of tree-raising and pasture grass. It is evident that the critical motivating factors for the communities are the short-term benefits and the potential long-term economic benefits. As the communities recognize these benefits and put in place their own mechanisms of management such as the Community Fund, the chances of long-term participation and sustainability are enhanced.

Adoption of technology

Technical knowledge and expertise has been acquired by a relatively large number of target population through the initial process of treatment and planting of community land. In addition, farmers involved in tree nurseries or private woodlot planting gained particular technological expertise.

The high rate of technological knowledge acquisition and adoption in respect of nursery practice,fencing, bunding and channelling for irrigation was evident. Ignorance on two important aspects, the high mortality of seedlings on individual farms and the inappropriate spacing of trees on private holdings was also noticeable. The problem is a lack of knowledge rather than a low-level of technological adoption. The technical support, therefore, needs to be strengthened.

Prospects for sustainability

The overriding question for the evaluation team was wether the project activities could be judged to be sustainable at this stage. However, given the fact that in two years of the three-year life span of the

project, there is strong documented and visible evidence of :

- A turn around in the ecosystem of targeted areas;
- Increasing volumes of high-quality cattle feed have been grown, harvested and sold;
- A reduction in the number of migrating farmers;
- An increase in crop production through two season cropping;
- An increase in secondary income-generating activities e.g. fish farming;
- Many participants now have more income, increased crop yield and they have learnt a wide range of new technologies;
- A reduction in fuelwood consumption;
- An increasing desire and demand for replication of project initiatives in adjoining villages.

The evaluation team feels that the project has great potential for sustainability.

This project is both environmentally and politically viable. The integral elements concerning soil conservation, land-use practices and the introduction of domestic energy-saving devices validate the viability of the project. The fact that governmet policy supports the development of sound environmental protection programmes in scheduled tribal areas confers strong political credibility to the project.

Funding for NCHSE activities in Jhabua has greatly receded recently. The National Tree Growers Cooperative Federation under National Dairy Development Board as well as the Gas Authority of India Limited have concluded separate agreements with the NCHSE to fund its watershed conservation projects in Jhabua. The Rejiv Gandhi Watershed Development Mission and CAPART have opened new doors of institutional support. Above all, the NCHSE has demonstrated its capacity for delivery, a critical attribute to project sustainability.

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NEWS FROM UNEP

Progress Report: Rural Women-Based Integrated Project in Ruvuma Region, United Republic of Tanzania

by Ute Reckers

Project Design:

The Rural Women-Based Integrated Project in Ruvuma, United Republic of Tanzania is a locally-driven resource management project funded by UNEP's Dryland Ecosystems and Desertification Control Programme Activity Centre (DEDC/PAC) and Arab Gulf Fund for United Nations Development Organizations (AGFUND). The project was initiated by the United Women of Tanzania (UWT) and aims at helping the women to undertake environmental improvement activities in 18 villages in the Ruvuma Region in the south of the United Republic of Tanzania. The activities are directed towards tree planting, agroforestry, soil conservation and rehabilitation of water points in order to reduce the shortage of fuelwood, improve soil and water conservation. In this connection, the project facilitates the introduction of fruit tree plantations for the improvement of the nutritional status of the beneficiaries - women and children - and increase family income through the sale of production surpluses.

A series of workshops on environmental awareness among the women and educational field trips to other conservation projects are planned, an orientation workshop and a field trip to a natural resource management project in Iringa have already taken place.

The National Environment Management Council (NEMC) of the United Republic of Tanzania is closely monitoring its activities. The project duration is from December 1996 until May 1997.

The progress of the project implementation as of June was considerable. The women have selected seven of the 12 village supervisors for the selected villages of the project. They will facilitate, coordinate and monitor the activities at village level. This system of supervision is necessary since the villages are quite dispersed within

Tree planting activity by the women of Ruvuma region

Ruvuma Region and distances between some of them are 200 km and more.

In almost every each village except in the remote Tunduru District, one to two nurseries have been established. Preferably the seedlings of indigenous tree species are raised. Some of the nurseries include communal vegetable gardens growing mostly onions, tomatoes and cabbage. A group of women take care of the nurseries. The work is voluntary and the women in charge work on a rotational basis.

The energy-efficient stove project component started with a survey on the material required and resources available and on the needs of the women. Some women will be trained in the production of these stoves which they will later disseminate informing the women about the use and importance of these stoves (awareness raising). Once the stoves are widely accepted the trained women will be able to produce them on a larger scale and sell them.

A survey on the status of existing water supply systems has started. The result will be a list of those water supply schemes which need repair.

As land tenure has become an important issue in the United Republic of Tanzania, property rights play an important role for sustainable long term land management. In order to secure the land rights of the women, especially for communally planted areas, the women are now following all necessary steps to obtain official title deeds. Properly allocated land rights are important as an incentive to continue with the soil conservation and afforestation activities.

The successful continuation of the project will be endorsed by the following efforts:

- the rural women in Ruvuma Region are very committed to the project activities (the national tree planting campaign has a long history in the United Republic of Tanzania),
- tree planting of specific species, agroforestry and soil conservation techniques will be supported on individual plots so that the women see the positive effects more directly and immediately,
- the construction and distribution of energy-efficient stoves will replicate itself through the training of women to build stoves themselves according to the materials available and to their needs. Demand for stoves will be fostered by awareness campaigns.

Constraints

At the village level, trained people, especially women, are rare. In addition, women are often too busy with everyday duties, which makes it difficult for them to take on additional responsibilities like that of a village supervisor. For that reason, a number of women have been appointed temporarily until a better qualified person becomes available.

It is very difficult to find an appropriate village supervisor who is suitable for this task. However, in order to ensure the sustainability of the project the village supervisors should be recruited locally. The project aims at training these key persons in participatory project management techniques to ensure a better participatory modus in the decision-making processes in the villages. Her role will be more that of an animator for village women's groups than of a technical advisor in forestry or agriculture. Gaps on the scientific side can be filled by short-term training provided by the project coordinator or local consultants (ministry extension worker).

All the activities mentioned have started in Songea urban District, Songea rural District and Mbinga District, but not in Tunduru District. The reason for this is that the project vehicle is not yet available. The remote region of Tunduru has therefore not been reached it is 200 km from Songea on a bad, rough road.

The project coordinator and the women are working hard to achieve the requested results, but they suffer from drawbacks such as lack of trained local people, lack of a project vehicle and bad, rough roads to most remote areas which are impassable during the rainy season.

The project in short:

Implementing Agencies:

The Rural Women-Based Integrated Project is implemented by the UWT in collaboration with the NEMC as the executing agency.

Project Duration: December 1995 - May 1997

Outputs:

- Tree nurseries in all 18 project villages established;
- Two hundred ha of communal land afforested;
- Communal vegetable gardens established;
- Water supply schemes rehabilitated;
- Two hundred energy-efficient stoves locally manufactured, demonstrated and disseminated;
- Women in all project villages trained in tree nursery, soil conservation, agroforestry and horticulture techniques.

Impact:

- Environmental awareness raised through workshops;
- Agricultural production improved;
- Nutritional status improved through home grown vegetables and fruits;
- Access to water for irrigation of nursery and vegetable gardens improved;
- Fuelwood consumption reduced;
- Soil erosion reduced.

Monitoring:

- Eighteen village supervisors will continuously report on the progress to the project coordinator;
- Regular UNEP missions will ensure that project progress is in line with project document.

Sustainability:

- Locally driven initiation of project;
- Indigenous tree species planted rather than exotic unsuitable tree species;

- Local women trained in forestry, agroforestry, agriculture and social development chosen as village supervisors;
- Land rights insurance for communal land processed;
- Women's participation institutionalized in women's associations;
- Mechanism for the continuity of the project established;
- Independent fundraising and income generating activities organized.

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9th ISCO Conference Bonn Germany, 26 to 30 August 1996

Conclusions and recommendations

Under the topic "Toward Sustainable Land Use - Furthering Cooperation Between People and Institutions" the Conference brought together 900 scientists, government representatives, representatives of national and international organizations as well as NGOs and networks from 120 countries, discussing the topics of soil protection and soil conservation.

It was stated that the limited availability of soil resources for the production of food and renewable biotic resources caused by a steady growth in population and accelerated soil degradation can have a bigger negative impact on living conditions on earth than the human-induced greenhouse effect caused by mankind. Anthropogenic soil management and land use processes should be considered to be more destructive than climate change consequences -at least during the next decades. A comprehensive analysis of the driving variables for climate change and their effects on soil properties can hardly reveal the required short term indicators for the assumed long term changes in soil quality.

Land needs to be considered as a finite resource. Its allocation must aim to satisfy the needs of the various land users in the most equitable and sustainable way. Combating soil degradation and investing in the conservation of soil resources for future generations will be a major political task promoting sustainable development and nature protection. A global partnership is required to protect and restore the health of the earth's terrestrial ecosystems.

What is required is a holistic approach for the planning, development and management of land resources which methodically identifies human and environmental needs. The process needs to address cross sectoral issues such as responses to pressures on the land caused by poverty, sustainable consumption and production systems, clarification and security of land rights and land tenure and land ownership reforms. Furthermore, this approach requires the integration of issues concerning water resources and biodiversity as they relate to land use. A mismanagement of land and water often leads to land degradation through erosion, flooding, waterlogging and salinity and the depletion of groundwater resources. Moreover, soil and water degradation through contamination by agricultural, urban and industrial effluents is of increasing importance in developed and developing countries.

For formulating and implementing policies it is essential to collect, process and disseminate timely and reliable information and to utilize modern land assessment and evaluation technologies to create sound scientific knowledge for proper decision support.

1. Managing a planning process for the use of land resources with all stakeholders

Land use planning that considers all the functions of the land and that contains full participation of all stakeholders in the planning process is an important tool to implement the recommendations of UNCED's Agenda 21, in particular the section dealing with the conservation and management of resources for development.

2. Creating an enabling environment

National policies directly affect land users. Many national governments are increasingly attempting to integrate environmental, economic and social concerns into national planning processes. The declaration of a national policy on sustainable land use is an important measure that can help bring about necessary political, institutional and economic changes.

Topic 1

Soil conservation and sustainable land use - Erosion, desertification and land use planning

- Management based on the natural watershed unit may be the most effective basis for natural resource conservation in general and water erosion control in particular.
- Consideration of long-term at-site and off-site costs, benefits and environmental externalities of soil erosion must be a part of management strategies. Soil conservation programmes should be given greater priority in the

later context of environmental protection.

- There can be significant interactions between wind and water erosion at the same place. Nutrient loss and enrichment effects of wind erosion require better recognition.
- There is an urgent need to develop geo-referenced information on natural resources and socio-economic conditions, in order to monitor the change of land qualities over time. It is therefore recommended to implement international methodologies such as Soils and Terrain Digital Databases (SOTER) and to link these databases with information on soil degradation and soil conservation following the expert system approach of Global Assessment of Soil Degradation (GLASOD)/World Overview of Conservation Approaches and Technologies (WOCAT).
- The building up of soil organic matter content can be considered to be a capital investment in soil as a national and community level resource. It also constitutes a substantial sequestering of human induced atmospheric CO_2, and therefore would diminish the hazards of global climate change. National governments that are signatories to the Framework Convention on Climate Change and that are considering the concept of "joint implementation" as a means to fulfil their requirements under the convention, may recognize carbon sequestration in degraded or natural low-activity soils as an attractive "win-win" proposition.

Topic 2

New forms of soil degradation

°Diffuse and direct substance input into the ecosystem may in the long term not exceed the possibilities to produce biomass and to filter and transform substances. Therefore, unwelcome inputs of substances have to be minimised by all polluters such as those in industry, the traffic and transport sector, agriculturalists and householders. Since the substance flows in many industrialized countries have already been put off balance to a considerable degree, the measures to minimise substance inputs require planning with regard to areas and time.

The sustainability of all measures considered to be beneficial to soil productivity have to be judged against the background of their long-term environmental effects. Existing soil quality standards are not always sufficiently based on the concept of sustainability, so that many soil "amendments" need to be reconsidered in the light of long term soil protection. "Prevention" should be the leading principle in soil protection, since "rehabilitation" is extremely difficult and often impossible once symptoms of soil degradation are observed.

Other issues which need much more attention are soil compaction and soil sealing. Soil compaction both in agriculture and in forestry is a worldwide problem, which gets more important because of the increasing use of machines, higher frequency of wheeling and increasing dynamic forces applied to the soil. Also surface sealing either by natural processes or by human activities, especially in densely populated areas, leads to a loss of soil functions in landscapes.

Topic 3

Influence of demographic, socio-economic and cultural factors on sustainable land use

- The engine driving the move towards sustainable land management is the provision of people's social and economic needs. All examples of successful conservation projects have as a primary focus the local society and livelihood security. Without these ingredients, no intervention or innovation will succeed. For land management practitioners, it therefore means they first have to listen and learn; secondly, they must match what they have to offer - technologies, education, professional advice, physical resources, money or whatever - with the socio-economic needs of the people, and finally, they must monitor and evaluate what happens.
- Land tenure is fundamental to land management. A tenure regime should be clear, flexible and secure.
- Governments should be the facilitators of change, not the controllers. Soil, land and water resources are both public goods entrusted to society and private goods entrusted to the individual. Administrative, institutional and legal provisions must enable, not generalise.

Topic 4

From soil and water conservation to sustainable land management

- It is recognized that there is a clear gap in information on data for sound soil and water conservation guidelines to assist poor farmers in choosing appropriate technologies.
- Preventing degradation of productive land shall be given more priority than restoring already degraded land.

Topic 5

Furthering cooperation between people and institutions

Monitoring refers to an information system, not just data collection. Data without an audience, an objective and

analysis is a waste of time and effort. Monitoring in the context of sustainable land use has a wide range of audiences, all of whom are stakeholders in the development of more sustainable forms of land use.

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Inter-Agency Task Force Meeting on Desertification in the Near East Cairo, Egypt, 23 - 25 September 1996

Background

Semi-arid and arid areas predominate (about 60 per cent of land area) in the Near East Region. They provide life and support for approximately 200 million people and constitute a valuable resource for livestock and crop, fruit and wood production. In former times, degradation in the region was mostly localized. However, in recent years, the rising need for food caused by rapid population growth, along with a number of political and socio-economic factors contributed to increased misuse and degradation of dry land resources. This has endangered the sustainability of dry land agriculture and significantly reduced its share in the economy and welfare of the region.

Many United Nations and regional organizations/agencies, have been concerned for years with the consequences of land degradation on renewable resources, especially in dry lands. In view of the above precarious situation in the Near East Region, and consistent with the high priority given to dry lands development by UNCED in Rio (Agenda 21) and the International Convention to Combat Desertification (CCD), the FAO Regional Office for the Near East held an Inter-Agency Task Force (IATF) Ad-hoc Meeting on Desertification in Cairo from 23 to 25 September 1996.

Main issues discussed

The IATF meeting discussed the regional issues of desertification and involvement of United Nations and regional organizations in the implementation of the CCD in the Middle East. The meeting recalled that the two principal objectives of the meeting were:

a) To exchange information related to programme activities in supporting national-sub regional/ regional action programmes on desertification control;
b) To identify practical arrangements for the harmonization of various agency activities and to develop a common operational approach and an inter-agency strategy to support national/sub-regional/regional action plans and programmes in the context of CCD.

General recommendations

The meeting came up with the following recommendations:

- Recalling the magnitude of the desertification challenge in the Near East and the imminent entry into force of the CCD;
- Considering the importance of awareness raising on the CCD and the active participation of all the parties in its implementation; and
- Taking note of the New Delhi meeting on the regional action programme for Asia, the Abu Dhabi meeting on a sub-regional action programme for Western Asia and of similar sub-regional consultations in Northern Africa with UMA (Union du Maghreb Arab) and Eastern Africa with IGADD (Intergovernmental Authority on Desertification and Drought), the IATF meeting:

- Invites all concerned United Nations agencies to participate in the forthcoming meetings to assist in the preparation of regional and sub-regional action programmes;
- Calls upon development banks and financial institutions (eg. Islamic Development Bank, Arab Bank for Development of Africa and the Arab Fund for Social and Economic Development, African and Asian banks, regional and national banks as well as IFAD and World Bank) to consider and take appropriate measures for supporting the CCD implementation;
- Invites agencies and institutions to liaise with governments with a view to encourage an early ratification or accession of the Desertification Convention;
- Encourages improved linkages and enhanced networks between all Arab (regional and sub-regional) and international organizations based in the region for better information exchange, for mutual benefit and for the support of the CCD implementation;
- Invites field representatives of United Nations agencies (particularly FAO and UNESCO) to take an active role in the national consultative process leading to the preparation and subsequent implementation of National Action Programmes and Partnership Agreements.

The Republic of Kazakstan

In brief Geographical situation - between 55.5° and 41° North latitude, 46.5° - 83.7° East longitude. Area - 2,272 million km^2. The natural zones - forest-steppe, steppe, semi-desert, desert. Landscape - 90 per cent of the area is occupied by plains. Mountains - the Tien Shan, the Jungar Alatau, the Altai. Seas - the Caspian sea, the Aral sea. Soils -chernozem (black earth), chestnut, brown, grey-brown.

Natural resources and their anthropogenic degradation

Desertification in Kazakstan is connected with the degradation of soils, the loss of biological equilibrium between the animal and vegetation kingdoms, the aridization of climate, the disappearance of birch woods, the drop in ground water, water and wind erosion, and the formation of movable sands - the barkhans. Desertification occurs in all the natural zones of the republic.

Unfortunately, the simultaneous unfavourable effects of both natural and anthroponegic factors have lead to the acceleration and spread of desertification:

- The ploughing of low-productive sandy loam and saline soils during the period of virgin land development has resulted in the deflation and the appearance of dust storms;
- The intensive irrigated farming in the south of Kazakstan has led to erosion and the secondary salinization of soils in the river flood-lands;
- The degradation of pasture lands was the result of overgrazing;
- The development of mining, metallurgical and chemical industries has inevitably resulted in the technogenic degradation of lands (soils are contaminated with heavy metals, oil products and pesticides);
- There is direct evidence of the threat of elimination of a unique area containing arid and sub-arid lands, steppe and piedmont ecosystems. About 50 per cent of the land is in the process of desertification.

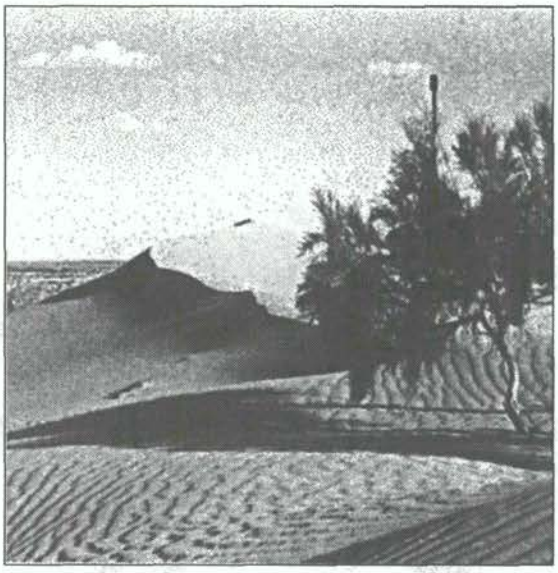
The Aral sea shore

National Action Programme to Combat Desertification in the Republic of Kazakstan

The National Action Programme to Combat Desertification in the Republic of Kazakstan (NAPCD) was developed by the Ministry of Ecology and Bioresources (MEBR) of the Republic of Kazakstan with financial and technical support from the United Nations Environment Programme (UNEP) in accordance with new approaches of the United Nations Convention to Combat Desertification.

The processes of desertification take place in a significant part of the Republic's territory which has already resulted in negative social and economic consequences. At present, 179.9 million hectares or 60 per cent of the country's territory suffers from desertification to a greater or lesser extent. Further degradation of the natural environment against the background of global climate aridization will inevitably lead to irreversible loss of biodiversity, a reduction of land fertility, and to corresponding aggravation of living standards.

The programme includes the deep analysis of the causes of desertification as well as an action strategy involving: desertification processes monitoring, environmental zoning of the republic; improvement of the management system; scientifically justified measures on the prevention of further land degradation; improvement of pastures and hay lands; reduction of the social and economic consequences of desertification and other issues relating to the resolution of the desertification problem.



National Workshop on NAPCD and CCD implementation 4 - 6 November 1996, Almaty, Kazakstan

The workshop on the implementation of the National Action Programme to Combat Desertification (NAPCD) and the United Nations CCD in the Republic of Kazakstan was organized by the Ministry of Ecology and Bioresources with financial support from the interim secretariat of CCD and UNEP.

The Workshop was attended by 40 representatives from the regions (oblasts) of the republic, respective ministries, NGOs as well as UNEP, the Interim Secretariat of CCD and UNCD. The Workshop was opened by the Minister of Ecology and Bioresources of the Republic of Kazakstan, Mr N. Baev. In his opening statement, he said that the development of the NAPCD was of great importance for Kazakstan, where the processes of desertification and degradation were affecting all eco-climatic zones.

The Workshop discussed the national issues of desertification as well as successful ongoing programmes on desertification control in the republic. The three principal objectives of the workshop were:

- To exchange information on programme activities in the regions of the republic of Kazakstan in support of the NAPCD and CCD implementation;
- To discuss coordination and financial mechanisms amongst the regions, government agencies and NGOs on the NAPCD implementation and to identify the role of NGOs in supporting of the programme;
- To identify practical arrangements or harmonization of various agency activities and develop a common operational approach and inter-agency strategy to support the national action programme in the context of CCD.

The Workshop came up with the decision to organize similar workshops on NAPCD implementation in each region (19) of the Republic during the period from November 1996 to June 1997 and adopted the following recommendations:

– Participants of the Workshop:

- Would like to thank the government of the Republic of Kazakstan, UNEP and the interim Secretariat of CCD for the initiative to conduct this workshop and assistance in combating desertification in Kazakstan;
- Note the timeliness of the workshop and recommend the holding of regional workshops in areas of the Republic of Kazakstan exposed to desertification;
- Note the great importance of the United Nations Convention to Combat Desertification for Kazakstan, 60 per cent of which is exposed to desertification and land degradation;
- Encourage the Government and the Parliament of the Republic of Kazakstan to ratify the United Nations Convention to Combat Desertification as soon as possible;
- Note that combating desertification must become a most important element of the national strategy of sustainable development and environmental safety;
- Approve the *National Action Programme to Combat Desertification in Kazakstan* developed by the Interim Working Group under the Ministry of Environment and Bio resources of Republic of Kazakstan.

– The workshop strongly recommends oblasts (administrative

Photo: L. Kroumkatchev

National Workshop on NAP implementation.

districts) exposed to degradation and desertification develop oblast action programmes to combat desertification and drought in 1997.

- The workshop requests the Government of the Republic of Kazakstan to review and include a National Action Programme to Combat Desertification into National strategy of sustainable development in the Republic of Kazakstan and to consider the problem of desertification as a first priority when correcting structural policy micro-economics.
- The workshop recommends the consideration of the natural characteristics of each region, the traditional methods of land use and worldwide experience when implementing national and oblast action programmes to combat desertification in Kazakstan. It is important to emphasize local actions and the active public participation of all, including women, youth and NGOs.
- Participants of the workshop request international organizations and countries/donors to contribute to the implementation of the United Nations Convention to Combat Desertification and the National Action Programme to Combat Desertification in Kazakstan.
- The workshop believes it is necessary to improve national regulatory and legislative bases for environmental protection and natural resource use taking into consideration the experience of other countries exposed to desertification and drought. The workshop recommends the development of indicators and criteria for desertification for Kazakstan.
- The workshop believes that creation of the National Fund to Combat Desertification is perfectly timely to support implementation of the NAPCD and requests UNDP to assist in implementing this programme.
- In order to effectively implement the National Action Programme to Combat Desertification in Kazakstan and to properly coordinate these activities the workshop considers organization of a centre to combat desertification under the Ministry of Ecology and Bio resources of the Republic of Kazakstan to be extremely helpful.
- Include monitoring of desertification in the uniform environmental monitoring system of the Republic.
- Improve environmental training and public outreach systems including rational and careful use of land resources for all public groups.
- The workshop requests international organizations to effectively assist in organizing and conducting training on the rational use of land resources and efforts to combat desertification.
- According to recommendations of the Convention, participants of the workshop consider developing partnerships and strengthening activities with non-governmental, women's and religious organizations on combating desertification and drought to be very important.
- The workshop believes that the publication of the National Action Programme to Combat Desertification in the *Hydrometeorology and Ecology* magazine and in the *Noosphere Zherbesic* almanac will strongly promote awareness and public outreach on the United Nations Convention and National Action Programme to Combat Desertification in Kazakstan.

Regional Conference on the Implementation of the United Nations Convention to Combat Desertification and Drought in Asia 21 - 23 August 1996, Vigyan Bhawan, New Delhi

This regional conference on the implementation of the United Nations Convention to Combat Desertification (UNCCD) in Asia was organized by the Interim Secretariat of the CCD with financial support of Japan and UNEP and hosted by the Government of India. It was to enable an exchange of views between Asian country parties on actions at all levels, including the preparation of National, Sub-Regional and Regional Action Programmes for Asia. It also discussed the possible role of the Training and Research Network on Desertification for Asia and the Pacific (DESCONAP) which in the past was supported by ESCAP, UNDP and UNEP. A strong presence of NGOs assured the participatory approach emphasized by the Desertification Convention.

The Conference held at the Vigyan Bhawan Conference facilities of the Government of India was opened by the Minister of Environment and Forests, in the presence of the Minister of Agriculture and Cooperation Shri Chaturanan and the Minister for Rural Areas and Employment, Shri Yarran Naiduji, the Executive Secretary of the Interim Secretariat UNCCD and the UNDP Resident Representative, representatives of the diplomatic corps, high government officials from 26 countries and NGO leaders. The Conference was attended by approximately 120 representatives from governments, NGOs and regional and international organizations.

Presentations by representatives of countries, international and regional

organizations and NGOs provided an extensive overview on the progress so far achieved in the implementation of UNCCD and its Annex for Asia.

Background papers on actions at national and regional level as well as on participatory approaches served as a basis for the discussions at two working groups. One working group focussed on the Preparation of National Action Programmes and the other working group on the preparation of a Regional Action Programme for Asia. It was decided to split the actions into seven programme areas, and national research institutions in the region were invited to opt for implementing one or more of these programme areas. This approach was chosen to assure as wide as possible regional participation which at one point may, however, require coordination by an institution acceptable to all parties.

The regional conference adopted a draft resolution and the elements of the Regional Action Programme to Combat Desertification in Asia.

Expert Group Workshop of the Scientific and Technical Advisory Panel (STAP) of the Global Environment Facility on Land Degradation, Dakar, Senegal, 18 to 20 September 1996

The opening ceremony was presided over by the Honorable Abdoulaye Bathily, Ministry of Environment and Protection of Nature. Sixty experts from 21 countries and international organizations met to exchange experiences and to share their knowledge.

On the first day, participants met in a plenary session which provided the representative of the Global Environment Facility with the opportunity to inform the participants of the rules and procedures governing his institution. It was also an occasion for a group of experts to take stock of theoretical and practical attainments in the field of land degradation in relation to biodiversity, climatic changes and international waters.

Senegal's experience was presented by a group of experts from various ministerial departments, from governmental organizations and from the academic and scientific community. The ensuing discussion was very fruitful in both the plenary and committee meetings which made it possible to make clear the commonality:

- Of benefits drawn from the application of land degradation control measures;
- To determine the constraints to the implementation and success of integrated projects and programmes on land degradation control;
- To propose new strategies and approaches to eliminate such constraints; and
- Finally to look into the methods for the preparation of projects and programmes on land degradation control integrating the climatic, biological and hydraulical dimensions.

The conclusions of this workshop were presented and upheld by the chairman of the Scientific and Technical Advisory Panel of the Global Environment Facility, at the Council's meeting convened in Washington, D.C., United States. These conclusions will enable the Global Environment Facility to plan better urgent and necessary actions to be taken in order to combat land degradation in arid, semi-arid and sub-humid zones, particularly in Africa.

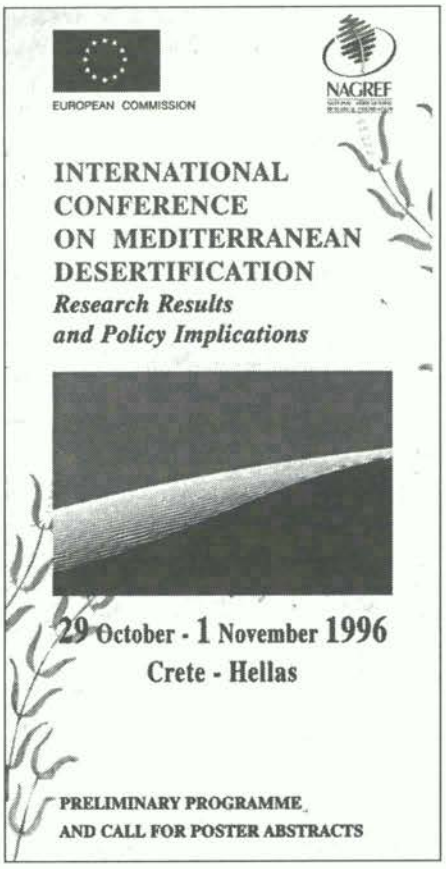
International Conference on Mediterranean Desertification Research Results and Policy Implications 29 October - 1 November 1996, Crete - Hellas

Aims of the Conference

The conference aims to strengthen the visibility of European Community policy action and research in this field, to promote the public and policy makers' awareness of the extent, nature and urgency of the desertification problem and to translate scientific research for policy development into practical action. It is designed to stimulate a wide-ranging and high level exchange of European experience and to encourage interactions between scientists, politicians and decision makers, as well as fostering international cooperation. The conference was an important contribution towards the establishment of action plans as provided for in the International Convention to Combat Desertification.

The Conference was attended by well over 100 scientists and decision makers, as well as NGO representatives from Europe and several experts from America,

Asia and Africa. From the United Nations only the Interim Secretariat of the CCD and UNEP were present. Technical papers presented in eight session and extensive poster sessions provided an impressive overview on activities in the field of Mediterranean dryland research over the last six to eight years. Most of the projects were implemented under collaborative arrangements by a wide range of European institutions with substantial European Union (EU) funding. Part of the discussions were on ongoing and forthcoming 5th EU framework programme research priorities. Efforts were made to identify means and ways to put the scientific research results into a policy and development context as required by the UNCCD. The Executive Secretary of the Interim Secretariat of CCD called upon the EU member countries affected by desertification to also develop National Action Programmes as called for by the Convention. He also appealed to the EU and its member countries to enhance international cooperation in the framework of the CCD



National Action Programmes in the Kalmyk Republic and Turkmenistan

The United Nations Convention to Combat Desertification (CCD) is to be implemented through National Action Programmes supplemented by regional and sub-regional ones. Effective action to combat desertification has to be carried out locally and must be adapted to local circumstances and conditions. But it must also be integrated into national and regional strategies to ensure that it gets adequate priority, to avoid duplication, and to make sure that resources are used as well as possible.

National Action Programmes form the very core of the treaty. The programmes are to identify the factors contributing to desertification, and practical measures necessary to combat it and to mitigate the effects of drought. And they should specify the respective roles of government, local communities and land users and what resources are needed, and which are available.

Within the CCD and UNEP 1995-1996 work programme, DEDC/PAC assisted the governments of the Kalmyk Republic of the Russian Federation and Turkmenistan to elaborate the National Action Programmes to Combat Desertification (NAPCD). The Action programme in Kalmykia was elaborated by the Ministry of Protection of the Environment and Natural Resources and in Turkmenistan by the Desert Research Institute, Academy of Sciences of Turkmenistan. Both action programmes were approved by the respective governments.

International Workshop on the Sustainable use of Rangeland and Desertification Control Jeddah, Saudi Arabia, 3 to 6 November 1996

The Workshop was organized by the Saudi Meteorology and Environmental Protection Administration, Ministry of Agriculture and Water, and the International Fund for Agricultural Development (IFAD). The Workshop was attended by about 30 international experts (from Africa, Australia, Europe, the Middle East and the United States as well as persons from United Nations agencies and regional and sub-regional institutions), and 70 Saudi nationals. The proceedings will be published by IFAD in the form of an analytical book which is expected to attract a wider range of readers. For more information contact Dr. A. E. Sidahmed; E-mail: a.sidahmed@ifad.org or Via del Serafico, 107, 00142, Rome.

The specific objectives of the Workshop were to:

- Identify more precisely the situation and development needs of pastoral nomads in rapidly changing economic circumstances;
- Present an up-to-date record of the capacity and potential of remote-sensing techniques to provide environmental data to planners, administrators and hence to pastoralists;

  and to explore how these technologies can be adapted to pastoral development within an integrated land management strategy and make cost-effective suggestions for their future adaptation to the needs of pastoral nomads;

- Draw lessons from the experiences gained in designing strategies and programmes for sustainable use, improvement and management of the rangeland resources.

The Workshop, after reviewing both the past and present socio-economic situations of pastoral nomads and the status of high technology methods of remote sensing for assessing environmental parameters in the process of land degradation and desertification of rangelands, came out with the following recommendations:

1. Prepare a review of current knowledge about users of the rangelands with a view to developing a profile of their social and economic status and their goals and needs. This review will be a statement of what is known and not known about the various rangeland users. Such information will help in harmonizing land use to avoid conflicts
2. Conduct a nation-wide study to fill the current knowledge gaps, including updating the rangeland surveys to evaluate the status of vegetation and the current inventory of livestock by species and class of animal. Use this as a baseline to develop a long-term monitoring system;
3. Raise awareness among rangeland users of the consequences of the current level of utilization of the nation's natural resources - rangeland, soils, water etc. Increase stakeholder (land user) involvement. Make greater use of the media, especially radio;
4. Develop with the help of the locals and in a participatory approach the National Action Plan for rangelands. Establish rangeland associations to facilitate participatory planning;
5. Compile and harmonize existing data on rangeland status. For those purposes use a multi-disciplinary approach including assessment and monitoring of changes over time of:

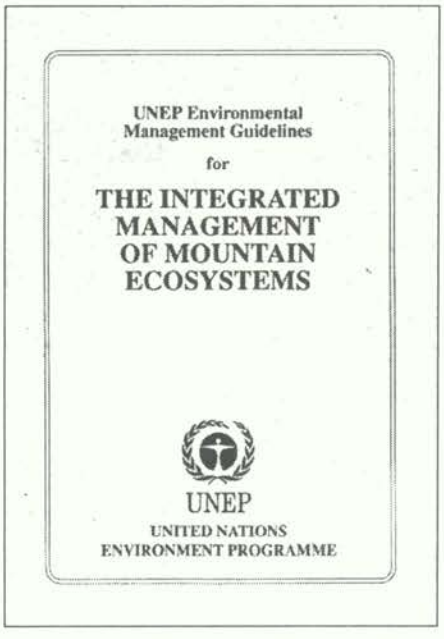
- Climate
- Land use and land cover;
- Vegetation components (dominant species, palatable/non-palatable, annuals/perennials);
- Soil characteristics, topography;
- Socio-economy, population mobility, land availability;
- Land use policy;
- Climate-land surface-human impact-hydrology interaction;
- Grazing pressure (herd composition, distribution and size);
- Biomass supply-demand (productivity, production, consumption, demands);
- Wildlife and pest species e.g. plague locust;
- Production economy, market structure and subsidy policy;
- Use the longest possible data series backwards and forwards;
- Use GIS for multi level and multi scale data management, analyses and spatial modelling of resources supply-demand. Geo-coded data;
- Use remote sensing;
- Complement with ground observations and participatory research based on sampling strategies.

6. Strengthen national range management institutions through the provision of the necessary personnel and funds. Establish environmental education in schools. Establish natural resource management curricula (teaching and research) in the universities to provide qualified personnel to carry out the task of inventory, monitoring and management of the rangelands.
7. Ensure that rangeland rehabilitation is made part of the National Action Plan to Combat Desertification.

BOOK REVIEW

UNEP Environmental Management Guidelines for The Integrated Management of Mountain Ecosystems

The purpose of these guidelines are first to provide general background information useful for integrated land/soil management in mountain ecosystems. Second, the guidelines detail key techniques for integrated management stressing protection, conservation and development as well as methods of planning. There is no attempt at a comprehensive treatment, rather selected techniques aimed at solving the major problems of environmental and socio-economic degradation. The guidelines are intended to be applicable irrespective of location and prevalent socio-economic situations and systems. In a sense, the guidelines may be regarded as a kind of template on which individual users may locate the problems of their own regions and their concerns.



The main focus is on the integrated management techniques which strive to preserve mountain ecosystems from adverse interventions and abuses, or to rehabilitate degraded systems. There is an emphasis on developing country situations where poverty and environmental problems coexist. The guidelines consider what modes of protection are needed to preserve ecological stability and to promote sustainable development, with an emphasis on erosion prevention/control and socio-economic measures. There is a section on appropriate methodologies to be used when planning and designing integrated or comprehensive land/soil management and rural and sustainable development projects. The conclusions are presented in a checklist of desirable actions which are logical derivations from the earlier discussions in the text. To make the guidelines more useful, a list of relevant literature is appended together with addresses for further information.

The guidelines are basically for those working on or studying problems of integrated land/soil management in mountain ecosystems including government agencies and officials at all levels from the international to the local, environmental protection services and agencies, social and political organizations concerned with environmental management, interested scientists, students and others. The guidelines may also be of interest to generalists who are looking for more appropriate models for environmental management. Mountains after all, cannot be divorced from lowlands with which they are in a complex physical and socio-economic interaction, nor can ecology be separated from other disciplines and sectors.

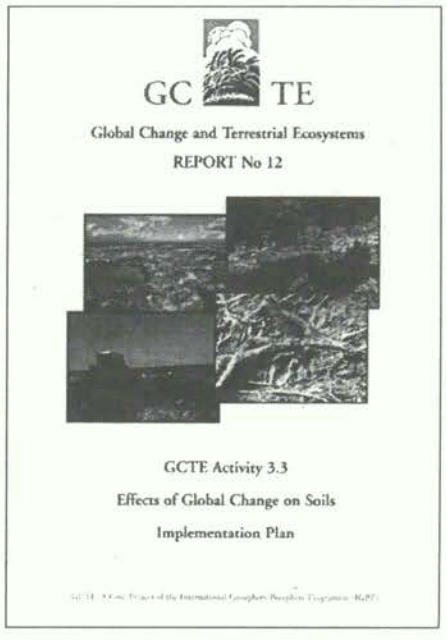
Finally, it is hoped that the local people living in the mountains may refer to these guidelines, not least, because of the increasing recognition of the desirability of local participation and self-management.

One function of a document like this is to generate thought, debate and discussion. That process is now under way in Chapter 13 of Agenda 21 and should be encouraged because identifying adoptable methods for husbanding resources in montane areas and sloping lands generally is a major topic to be addressed more forcefully, especially in the context of popular participation. Implementation of Chapter 13 of Agenda 21 would require identification of priorities within montane areas, and more in-depth treatment of some of the specific situations and geographic areas.

Global Change and Terrestrial Ecosystems Report No. 12 GCTE Activity 3.3 - Effects of Global Change on Soils Implementation Plan

John Ingram GCTE Focus 3 Officer
Peter Gregory GCTE Activity 3.3 Leader

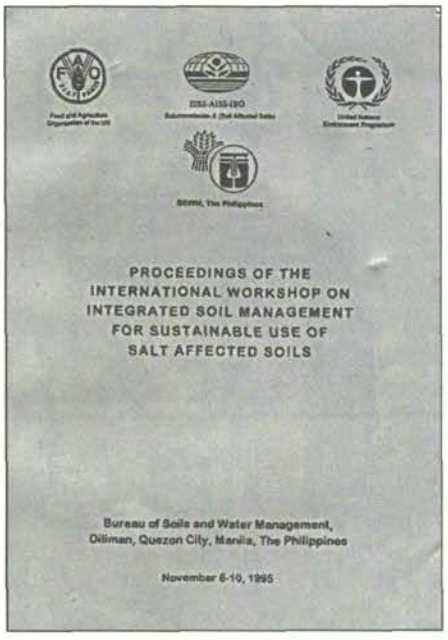
This Report outlines guidelines for the implementation of GCTE Activity 3.3



The Effects of Global Change on Soils. Thirteen projects are proposed, each of which addresses key questions arising from the overall objectives of the three tasks involved. Each core research project will be tackled through collaborative research on an international basis; scientists from around the world are invited to contribute.

The urgency of this research is caused by the rapid rate at which many of the world's soils are changing, and are expected to change over the coming decades. Most of the current change is driven by the high rate of population increase in many parts of the developing world, coupled with increasing rates of environmental and resource degradation worldwide. The resultant pressure for change in land use is expected to be amplified by the impact, over the next few decades, in the climatic conditions, and fertilisation of crop and other plants by increased levels of atmospheric carbon dioxide.

The Implementation Plan results from many hours of discussion by soil scientists at a series of international planning workshops supported by a wide range of national and international donors; special thanks are due to the United Nations Environment Programme (UNEP) for generous support to assist with the costs of coordinating its preparation.



Proceedings of the International Workshop on Integrated Soil Management for Sustainable Use of Salt Affected Soils

Bureau of Soils and Water Management,
Diliman, Quezon City, Manila, The Philippines

November 6 - 10, 1995

The greatest challenge for the coming decades lies in the fact that the production environments are unstable and degrading. Land degradation is proceeding so fast that unless policies and approaches change, many countries will not be able to achieve sustainable agriculture in the foreseeable future. Soil salinization has been identified as a major process of land degradation. The greatest technical causes of decreasing production in many irrigated projects, particularly in arid and semi-arid areas or failure of large areas in rainfed agriculture are waterlogging, salinization and sodication. Because of this and the increasing awareness of continuing soil salinization and sodication, FAO's Regular Programme has been supporting national institutes in countries experiencing problems of salt affected soils to strengthen their experimental programmes on adopted soil management practices for sustainable use of salt affected soils: experiments and demonstrations on pilot farms are ongoing through collaborative projects in twelve countries in different regions of the world. In November 1994, a cooperative project was initiated between UNEP and FAO, in association with Subcommision A (Salt Affected Soils) of the International Society of Soil Science, with the main objective of establishing an International Network on Integrated Soil Management for Sustainable Use of Salt Affected Soils. The twelve countries involved in the ongoing collaborative projects (Argentina, Brazil, Egypt, Indonesia, Iran (Islamic Republic of), Kenya, Mexico, Pakistan, the Philippines, the United Republic of Tanzania, Thailand and Tunisia) are now participating in the Network.

One of the Network activities was to organize an International Workshop on Integrated Soil Management for Sustainable Use of Salt Affected Soils. This Workshop was the first meeting of the Network, and was held at the Bureau of Soils and Water Management, Department of Agriculture, Manila, The Philippines from 6 to 10 November 1995. It was attended by the coordinators of their representatives who are actively involved in the ongoing collaborative projects of the Network, with a total of 17 participants.

The overall objectives of the Network are the dissemination of information, improved coordination among scientists and extension staff, strengthening of field experimental programmes, and extension of appropriate management practices to increase the productiviy of salt affected soils or land irrigated with saline water in participating countries. The primary objectives of the Workshop were to discuss results of the ongoing collaborative projects, information from technical sources on the subject, future newsletter Sustainable Productive Use of Salt Affected Habitats (SPUSH) publications, and future network activities including research and cooperation. The Workshop provided two plenary papers, four technical sessions devoted to discussing country papers, including results of the ongoing collaborative projects in the participating countries, and a paper presented at International Rice Research Institute (IRRI). Future Network activities including collaborative projects, newsletter publication, research and cooperation were discussed during three planning sessions.

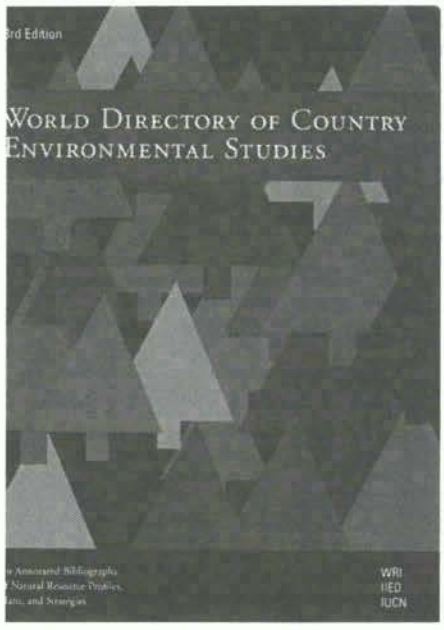
Following the representation of the technical papers Network activities and cooperation, participants formulated recommendations in the areas: i) strengthening technocal research and development efforts in soil management of salt affected areas in participating countries through the established Network with every possible support from international agencies; ii) emphasizing

on dissemination of information, improving coordination among scientists and extension staff, strengthening field experimental programmes and extension of appropriate management practices to increase productivity of saline dryland; iii) methods of soil and water sampling and analysis which should be standardized, including timing and frequency of sampling for better comparison of rsults; iv) the Network is a focal point for inter-country exchange of data and information on sustainable management and environmentally sound utilization of salt affected soils (including visits and training); v) evaluation and testing the effect of integrated management approach technically and economically; vi) farmers are active participants in the development of appropriate management systems. The experimental demonstration pilit farms, if possible, better be operated un farmers' fields; vii) publication of newsletter (SPUSH) every six months; viii) Network meetings to consolidate and discuss results from collaborative projects, cooperation, research and future plans and activities. The second Network meeting will take place for a period of five days in September 1997 in Tunisia.

The Proceedings of this Workshop will help to develop improved communication and exchange of technical information among scientists and extension staff in the field of integrated soil management for sustainable use of salt affected soils and to foster linkages with scientists in developing and developed countries who are involved in similar work.

The World Directory of Country Environmental Studies

The World Directory of Country Environmental Studies was prepared by the World Resources Institute in collaboration with the World Conservation Union and the International



Institute for Environment and Development on behalf of the Development Assistance Committee of the Organisation for Economic Cooperation and Development.

Over the past few years, interest in environmental reporting has greatly increased. Agenda 21 and each of the international conventions — biodiveristy, climate change, and desertification — requires that countries regularly assess their progress toward agreed-upon international and national goals. Just as important, many countries are developing their own national "green plans" and environmental action plans and strategies. A few nations are preparing national sustainable development strategies, and industrialized nations have gone one step further by agreeing to have outside teams of experts assess their progress towards environmental policy goals.

The World Directory of Country Environmental Studies provides bibliographic information and a short abstract of all these efforts. It covers all industrial and transition countries as well as the developing countries of the world. It also includes information on how to obtain full copies of the country report, either from the country publisher or from the Development Information Services Clearing house in the United States.

RESINDEX

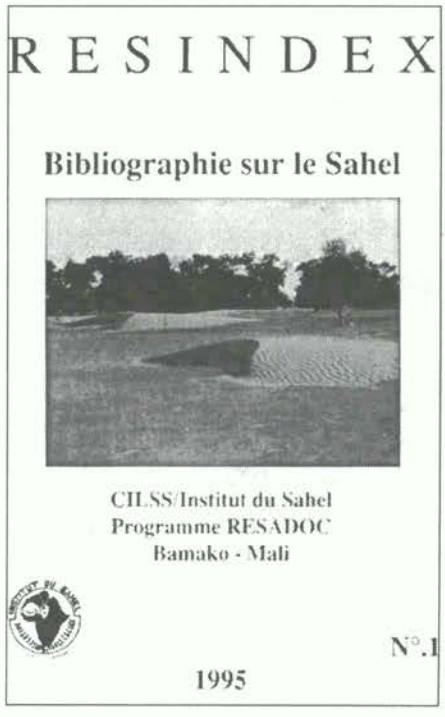
M. S. SOMPO-CEESAY
Directeur Général de
l'Institut du Sahel.
Bibliographie sur le Sahel
CILSS/Institut du Sahel
Programme RESADOC
Bamako, Mali
1995

Le présent numéro du RESINDEX, bibliographie sur le Sahel a été réalisé par le Réseau Sahélien de Documentation et d'Information Scientifiques et Techniques (RESADOC) à partir de sa base de données régionale.

Ce RESINDEX no. 12 contient 655 références bibliographiques publiées de 1990 à 1995 issues des centres participants au réseau.

Pour l'instant, en l'absence de connexion d'accès direct à la base de données régionale, le RESINDEX constitue le principal moyen d'exploitation de cette base. Nous espérons que ce numéro contribuera à une meilleure exploitation des ressources documentaires au Sahel. Nous invitons les réseaux nationaux à augmenter de leur participation à l' amélioration de la base régionale.

Pour nous permettre de parfaire ce produit que nous offrons aux utilisateurs,



aux partenaires de RESADOC et à la communaucé scientifique internationale, nous vous invitons à nous envoyer vos commentaires, remarques et suggestions.

L'Institut du Sahel et le Réseau RESADOC remercient les agences internationales de développement pour leur soutien financier.

Drought follows the plow

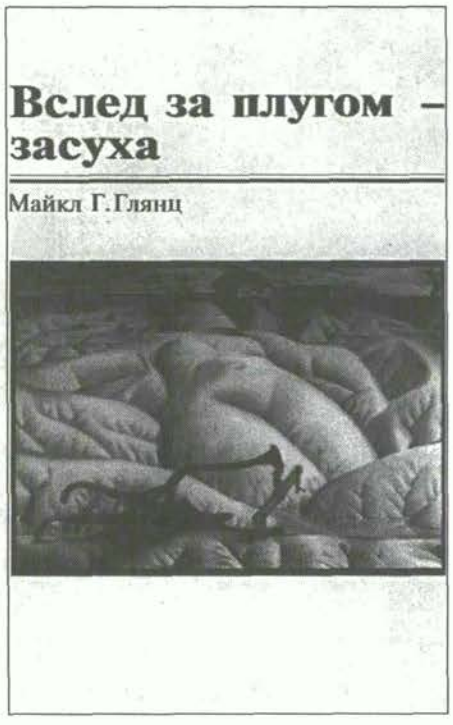
Edited by Michael H. Glantz

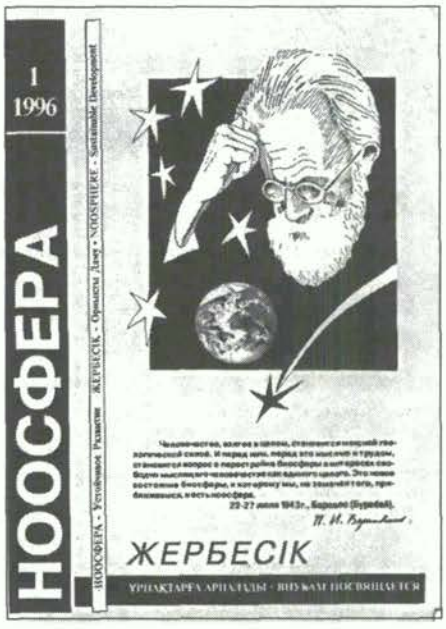
We are now in the "Age of environmental enlightenment". Global warming is seen as a major threat to the wellbeing of the world's communities. Fear abounds, but what does it all mean? Do the scientists know what is going on? If so, what can be done?

Michael Glantz draws attention to the relationship between society and climate change. He examines the notion that "drought follows the plow". The latest predictions are that dry areas will get drier and wet regions wetter, so why are many communities being moved to these dry regions? With contributions from colleagues in the worst hit areas of the world, the author challenges what is a nineteenth-century belief, that human activity can bring an increase in rainfall.

This is a book for all those who want to know more about the threats of global climate change. Policy makers, scientists and the general public worldwide need to read this book.

The book was also translated into Russian for dissemination in CIS countries.





NOOSPHERE-ZHERBESIC ALMANAC

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V. Vasilenko
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430100, PR. Dostyk, 876
Tel: 64-59-93
Fax: 327-2-64-49-95

The first issue of the ecological Almanac *Noosphere-Zherbesic* has been published in Kazakstan. In this issue the main United NatioEnvironment and Development, the Conventions on: Biological Diversity, Climate Change, Combatting Desertification as well as conception of the environmental safety of the Republic of Kazakstan and other documents including comments and overviews. Some of the documents are published in two or/and three languages. The Almanac is well written, and the material is presented in such a way that it can be of interest to specialists in environmental science as well as non-specialists.

Articulating Indigenous Indicators:

A Guide for Community-Driven Project Evaluation Based on a Case Study among the Ariaal of Kenya's Arid Rangelands

This manual produced by ELCI and UNEP presents a method to effectively approach a community-based evaluation of projects. The manual offers practical guidelines on how to apply this method in the field. It provides a methodological basis for development workers to examine:

(1) Who the beneficiaries are;
(2) Whether the project objectives are understood by the target group;
(3) To which extent the activities contribute to the achievement of project objectives as perceived by the communities;
(4) Whether the activities meet the priorities as defined by the people living in communities.

By contrasting the people's perspective and the "official" version of a project, indigenous indicators criteria are elicited. This helps the "outsider" to better understand the way local communities think and perceive of things.

In the first chapter, the reader learns how to define "who exactly are the beneficiaries?" The second chapter sensitizes the reader to "cultural domains"

and how to communicate across cultures. Chapter 3 presents culturally-sensitive interview techniques and how to elicit indigenous narratives. In Chapter 4 the outsider's and insider's view with respect to the objectives and the rationale of a project are contrasted and a project ranking exercise as well as a theme analysis is carried out. The final conclusions in Chapter 5 reveal that a great number of projects, even those claiming to be participatory, do not communicate properly the respective project concept to the beneficiaries, thus producing a lot of misunderstanding and confusion. Therefore, a strategy is proposed on how to overcome this deficiency in project implementation in order to ensure that "true" partnership is strongly sought.

The manual can be obtained free of charge from:

UNEP DEDC-PAC
BOX 30552
Nairobi
Fax (+254-2) 623284
Email: dcpacinf@unep.org

or

ELCI
P O Box 72461
Nairobi
Fax (+254-2) 562175
Email: elci@elci.gn.apc.org

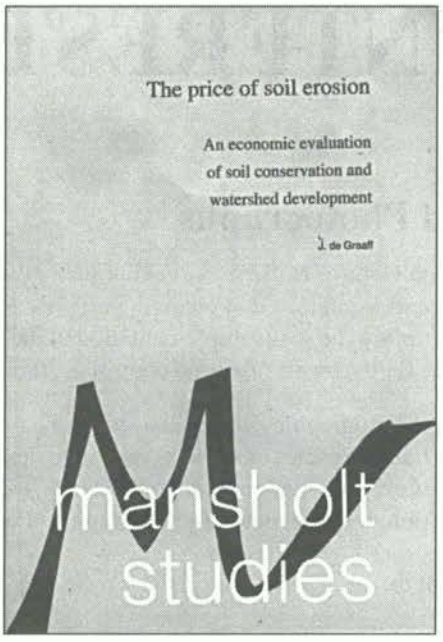
The Price of Soil Erosion

An economic evaluation of soil conservation
and watershed development
(Mansholt Studies No. 3, ISSN 1383-6803)
by
J. de Graaff

Abstract

Soil erosion by water is the principal cause of land degradation, and a major constraint to agricultural development in developing countries. In semi-arid zones measures have to be taken to reduce on-site soil, water and nutrient losses, and in sub-humid mountainous zones the focus should also be on reducing sedimentation of reservoirs and on other downstream effects.

Soil conservation and watershed development activities and projects are hard to evaluate, since neither their effects nor their beneficiaries can be easily detected. Methods are developed to identify potential participants and to assess on-site and downstream effects of conservation measures, by using water and nutrient balances and yield response functions. In the evaluation of these projects cost-benefit analysis (CBA) and multi-criteria analysis (MCA) can complement each other. The two methods are applied to projects in Burkina Faso, Tunisia, Indonesia and Jamaica. The efficiency of the projects can be conveniently assessed with CBA, when the effects can be quantified and valued, while MCA can be used to assess scores on non-monetary attributes of the efficiency, equity and conservation criteria, and to show how conflicting objectives of different actors affect the scores.



This is the third monograph in the series of the **Mansholt Institute,** the graduate School of Wageningen Agricultural University in the field of Social Sciences for Agriculture and the Environment.

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NEWS OF INTEREST

Request for Articles and Photographs

The editorial board of the Desertification Control Bulletin is seeking photographs and articles for publication in the magazine. In particular, the editorial board is interested in receiving articles describing success stories in controlling dryland degradation and desertification, follow-up in the implementation of the United Nations Convention to Combat Desertification and NGO activities in the field of desertification control in all regions of the world, particularly Africa.

The technical advisor is also seeking photographic submissions for use on the cover of the Desertification control Bulletin. Photographs should be colour transparencies of subjects related to desertification, land degradation, humans, animals, structure affected by desertification, reclamation of degraded lands, etc. Please include a brief caption giving a description of the subject, place and country name, date of photograph and name of the photographer.

All contributions should be sent to:

Mr Leonid Kroumkatchev
Technical Advisor
Desertification Control Bulletin
UNEP DEDC/PAC
P O Box 30552
Nairobi
Kenya
Tel: 254-2-623266
Fax: 254-2-215615/623284
Email: Leonid.Kroumkatchev@unep.org

For information regarding manuscripts preparation, please see page ii of this issue of the *Desertification Control Bulletin*.

Call for the submission of success stories in land degradation/ desertification control in drylands for the Saving the Drylands Award, 1998

The front line in the battle against desertification are the farmers, often women and children, struggling to scrape a living from a hostile environment. Throughout most of the drylands they have gained the skills to do this successfully over the centuries and the physical challenge in normal times is something they can handle. Indeed there are unrecognized skills of sustainable management, adaptability, risk assessment and insurance that have been developed in the drylands that need wider recognition and dissemination.

Experience has shown that where communities participate fully in all development phases, success is achievable and in a sustainable manner. Projects or activities of this nature, which have contributed substantially to the control of land degradation and desertification are few in number, compared to the failures, but they deserve more attention than has been the case so far. These *successes* need to be better publicized so that the positive experiences will show the world community that land degradation and desertification can be controlled. They will also serve as lessons for those projects in the process of being designed and implemented. A mood of confidence needs to be created, which recognizes that degraded lands can be, and have been, rehabilitated and made sustainably productive.

With this in mind UNEP decided to solicit the submission of success stories in desertification control. A success story is an activity that directly and substantially contributes to the prevention of dryland degradation or to the reclamation of degraded land, using appropriate resources in a cost-effective manner. It addresses not only the biophysical but also the socio-cultural-economic issues in all their development stages, thus ensuring long-term sustainability. The drylands were felt to be so important that it was decided to create a specific Award *Saving the Drylands* to recognize outstanding activities.

In 1984 ten case studies amongst several submitted to UNEP for consideration for the Award were short-listed for on-site evaluation. Of these, eight (Australia, Senegal (2), Namibia, India, Pakistan and China (2) were finally selected as outstandingly successful and received the 1995 "Saving the Drylands" Award. This year

two projects, one in Sudan and one in India, were the recipients of the 1996 "Saving the Drylands" Award.

It is our hope that through this programme of recognizing outstanding achievements, more people will be encouraged to send success stories to UNEP for evaluation and dissemination. We will then be able to share the lessons learned as well as successful practices. We believe that this in turn will help lead improve desertification control.

For the 1998 nominations for the Award please send a one page summary of the project/activity you are proposing with the following information in the given order: 1. Name of Project 2. Country 3. Location in country 4. Number of people involved 5. Area (sq km) covered by the project 6. Cost of Project (US $ equiv.) 7. Source of Funds 8. Project Period (years) 9. Problems 10. Solutions 11. Results/ Impact 12. Why the project is a success 13. Names and addresses of three referees outside the project 14. Contact person.

In submitting the above project summary please ensure that some climatic and physical information (climatic zone, rainfall, temperature, major vegetation and soil types) is included in point 8. Extra supporting information on the above points may be submitted separately and may also include the following: feasibility studies; community participation; need orientation adaptability, replicability and cost effectiveness; extent of government collaboration; major constraints encountered in achieving success, etc.

Please submit your success stories for the 1998 "Saving the Dryland" Award as soon as possible. Success stories submitted to UNEP by November 1996 will be considered for the 1997 Award.

For further information and for submitting your success stories write to:
Coordinator, Success Story Initiative

UNEP, DEDC/PAC
P.O Box 30052,
Nairobi
Fax: 254-2-623284
Tel: 254-2-623261
E-mail:
elizabeth.migongobake@unep.org

Training Course - Land Tenure and Natural Resource Management in sub-Saharan Africa

The Land Tenure Centre of the University of Wisconsin-Madison and the Institut des Sciences de l'environnement of the Université Cheik Anta Diop of Dakar, Senegal are jointly offering a short course entitled "Land Tenure and Natural Resource Management in sub-Saharan Africa". This three week programme, taught in French, will be offered from 10 to 28 March 1997 in Mbour, Senegal at the Saidou Nourou Tall training centre.

The course has two main objectives: 1) to introduce land tenure concepts and policy issues regarding natural resource use and management in sub-Saharan Africa; and 2) to provide instruction in the use of Rapid Rural Appraisal research methods to analyze tenure and resource use questions at the local level. The course will be taught through lectures, readings, and group discussions. As a complement to classroom instruction, participants will conduct case studies on the tenure situations found in proximity to the training centre.

The course is geared to francophone Africans involved in policy making and project implementation around natural resources. It applies as well to researchers from all countries in the fields of social sciences, economics, or law. The equivalent of a BA or BSc degree is required for participation.

The cost of the course will be US$ 4,400 for the three weeks. Included are full room and board at the training centre, training materials, case study village stays, local transport, and hotel accommodation in Dakar upon arrival and departure. The course fee does not include per diem for the duration of the course in Senegal nor round trip transport from one's home of residence to Dakar.

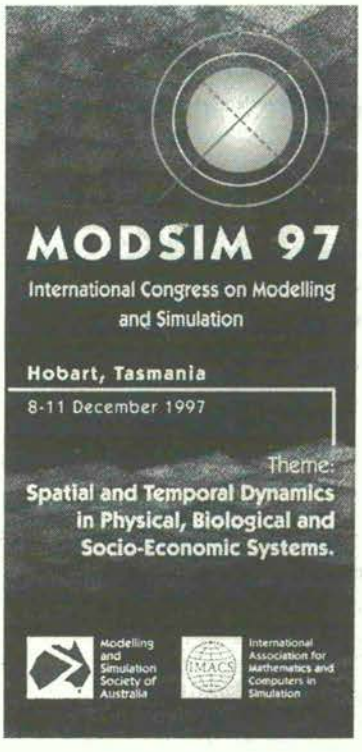
Further information may be obtained from:

*LTC web-page: www.wisc.educ/ltc/training.html
or
**Dr Kent Elbow*
Land Tenure Center
University of Wisconsin-Madison
1357 University Avenue
Madison WI 53715 USA
Tel: 608.262.3657
Fax: 608.262.2141
E-mail:
landtenure.center@mail.admin.wisc.edu

International Congress on Modelling and Simulation (MODSIM 97)

Call for papers on :

- Hydrology, climate, atmosphere
- Fisheries, forestry, ecology, agriculture
- Business, economics, social systems
- Computing, engineering
- Industrial, mining and operations research
- Statistics, risk and uncertainty



- Epidemiology, medical research
- Decision analysis, decision support systems
- General aspects of modelling and simulation
- Selected papers to be published in international journals

Deadlines:

- Abstracts (300 words, in triplicate) by 15 May 1997
- Final papers (6 x A4 pages), along with registration for at least one author, by 15 August 1997
- Please submit by fax or mail to the Congress Secretariat

MSSA membership: refer to the World Wide Web Site or contact the Congress Secretariat.

MODSIM 97 Congress Secretariat
Convenor: Dr A. David McDonald
c/- CSIRO Marine Laboratories
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Email: MODSIM97@ml.sciro.au
Web Site: http://www.ml.csiro.au/modsim97

Keynote Speakers

David Lam

National Water Research Institute, Canada
Decision support systems for water resource problems

Kenneth Lindsay

University of Glasgow, Scotland
Numerical methods for stochastic DEs

Kazuo Nishimura

Kyoto University, Japan, Japan
Non-linear dynamics and economic cycles

Adrian Pagan

Australian National University,
Uses of simulation-based econometrics

Neville Smith

Bureau of Meteorology Research Centre, Australia
Modelling and Simulation for the Global Ocean Observing system

Achim Sydow

National Research Centre for Computer Science, Germany
Simulation models for air quality management

International Workshop on Rangeland Desertification Iceland, 16 to 19 September 1997

Objectives

The workshop will be overview oriented and aims to bring together knowledge in several fields of science, including agronomy, geography, range ecology, soil science, and conservation policy. The goal is to put together a strong multidisciplinary workshop with an emphasis on:

- Critical review of rangeland degradation science;
- Desertification assessment methods;
- Rangeland conservation policy.

The discussion will not be limited to any particular climatic conditions, but will attempt to include broad perspective both from arid warm regions and more humid and colder parts of the world.

Structure

The workshop will be opened in Reykjavik on 16 September. A workshop excursion on 17 September will take participants through eroded areas and deserts to give an understanding of erosion processes and Iceland's geology, soils, glaciers and history. The last part of the workshop will be conducted at a rural centre (Klaustur). Participants will return to Reykjavik on 19 September.

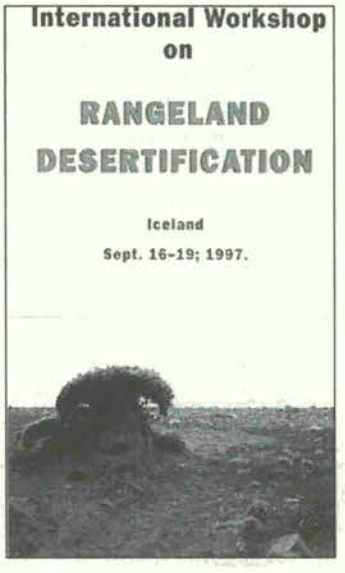
Workshop sessions will include:

- Rangeland degradation - an overview;
- Degradation and desertification assessment;
- Policy implications - a path to the future;
- Posters.

Post-conference excursion

A post-conference excursion will be offered. Participants will be taken to the central highlands of Iceland through areas of severe rangeland degradation and desertification, between Europe's largest glaciers, and to the erosion areas of the beautiful Lake Myvatn district.

For further information contact:
Olafur Arnalds Agricultural Research Institute
Keldnabolt
112 Reykjavic
Iceland
Email: ola@rara.is
phone: 354-577-1010
fax: 354-577-1020
Hope page:
http://www.RALA.IS/RADE



Desertification is land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities. This latest, internationally negotiated definition of **desertification** was adapted by the United Nations Conference on Environment and Development (UNCED), Rio de Janeiro, Brazil, in June 1992.

The United Nations Convention to Combat Desertification was formally adopted on 17 June 1994 and opened for signature in Paris on 14 October 1994. This Convention is notable for its innovative approach in recognizing the physical, biological and socio-economic aspects of desertification; the importance of redirecting technology transfer so that it is demand driven; and the involvement of local populations in the development of national action programmes. The Convention has 115 signatories and came into force on 26 December 1996.

Desertification Control Bulletin
United Nations Environment Programme