

# Agriculture, Livestock & Forestry: an Environmental Strategy for Semi-Arid Areas

Martin Adams

*A report to DANIDA*



**IIED**

INTERNATIONAL  
INSTITUTE FOR  
ENVIRONMENT AND  
DEVELOPMENT

Agriculture, Livestock & Forestry;  
an Environmental Strategy  
for Semi-Arid Areas

A report to DANIDA

by

Martin Adams

International Institute for Environment and Development  
3 Endsleigh Street, London WC1H 0DD, England

(June 1988)

## Introduction and Acknowledgements

This document has been prepared as part of a wider enquiry by Danida which is intended to lead to a plan of action, the purpose of which will be to ensure that ecological considerations and appraisals of environmental consequences are included in the overall planning and implementation of Danida's aid programme. In its annual report for 1986, Danida emphasizes that "the plan of action should neither be to impede economic development nor to convert development assistance into environmental assistance in a narrow sense" ..... "the focus should be on promoting sustainable economic growth and development" (Danida, 1987 - page 41). Thus, the objective of this paper is an ambitious one: to point to an aid strategy which would be consistent with the goal of sustainable development in semi-arid areas. Given the increasing population, the existing world economic order and possible secular climatic change, sustainable development in semi-arid areas is an extremely difficult goal to achieve, especially at the margins where the ecology is more fragile and where land use systems interlock and overlap with each other.

The section headings of this document were specified in Danida's instructions to IIED and they have been adhered to as closely as possible. The terms of reference to IIED initially required the report to be limited to 25 pages, but following an initial draft it was agreed to extend it in order to cover the wide range of subjects. In the circumstances, it was decided to include a summary with principal conclusions. A further addition is the bibliography with suggestions for further reading. To have attempted to substantiate the numerous statements in the text with supporting references would have extended the document enormously.

The terms of reference also required the Institute to work closely with a variety of specialists. This was achieved through the circulation of drafts as well as by a joint IIED/Danida workshop held in Denmark at the end of March 1988 in which many of those listed below were able to participate. I should like to specially thank Camilla Toulmin, my colleague in IIED and Gerda Adams who translated various Danish working papers and tried to ensure that my English was sufficiently clear to be expressed in Danish without too much difficulty.

### Danida:

Soeren Wium Andersen, Ecologist  
Ole Poul Hansen, Economist  
Kurt Moerck Jensen, Social Anthropologist  
Per Martin Larsen, Administrator  
Bo Jensen, Political Scientist (Deputy Head, Technical Advisory Division)  
Rud Larsen, Administrator  
Chresten Petersen, Agronomist  
Niels Richter, Anthropologist (Coordinator, Danida Environmental Action Plan)

Elsebeth Tarp, Social Anthropologist  
Erik Wandel, Administrator  
Henrik Hvidberg-Hansen, Forester

Danish State Forest Service:  
Bjerne Ditlevsen, Forester

IIED:

Camilla Toulmin, Economist (Director of the African Drylands  
Research and Networking Programme)  
Gerald Leach and Robin Mearns, Energy specialists

Overseas Development Institute:

Gill Shepherd, Anthropologist (Editor of ODI Social Forestry  
Network)  
John Farrington, Agricultural economist (Editor of ODI  
Agricultural Research and Extension Network)

Institute of Development Studies, University of Sussex:

Jeremy Swift, Economist (pastoral development)  
Charles Harvey, Economist (macro-economic policy)

African Studies Centre, University of Cambridge:

Maureen Fitzgerald, Geographer (environmental education)  
Bill Adams, Geographer (Chairman of the Committee on  
Environmental Issues in African Development Planning)

Renewable Resources Assessment Group, Imperial College:

Ruth Mace and Ian Scoones (ecological management)

Mokoro Limited:

Stephen Lister, Economist (national and sectoral planning)  
Andrew Bird, Economist (agricultural sector planning and policy)

Thus I have benefited from a wide range of expertise throughout  
and this assistance is gratefully acknowledged.

Martin Adams  
IIED, London  
27 May, 1988

CONTENTS

Introduction and Acknowledgements	i
Summary and Main Conclusions	1
Geographical Context	21
<b>PART I: PROBLEMS AND ISSUES</b>	
<b>1 Historic Development of the Present Land Use Systems</b>	
1.1 The Plains	25
1.2 The Highlands	27
<b>2. The Major Trends and Associated Constraints to Sustainable Utilization of the Natural Resources</b>	
2.1 Economic	28
2.2 Political	29
2.3 Cultural	29
2.4 Demographic Trends	30
2.5 Insecurity	31
<b>3. Problems and Issues Relating to Development Interventions</b>	
3.1 Management of Plant Biomass	32
3.1.1 Range Management and Improvement	32
3.1.2 The Improvement of Integrated Crop and Livestock Systems	34
3.1.3 Agroforestry Development	35
3.1.4 The Development of Arable Cropping	36
3.2 Management of Soils	37
3.2.1 Soil Fertility	37
3.2.2 Reclamation of Degraded Land	37
3.3 Management of Water Resources	38
3.3.1 Watershed Management	38
3.3.2 Irrigation	38
3.3.3 Water Harvesting	40
3.4 Occurrence and Management of Diseases and Pests	40
3.4.1 Crop Pests and Diseases	40
3.4.2 Livestock Pests and Diseases	41
3.5 Production and Use of Energy	42
3.5.1 Biomass Energy	42
3.5.2 Mechanical Energy	44
3.5.3 Renewable Sources of Energy other than Biomass	45
<b>4. Legislative Framework and Administrative and Financial Support</b>	
4.1 Constraints Related to Land Rights	46
4.1.1 Grazing Rights on the Plains	46
4.1.2 Cultivation Rights on the Plains	47
4.1.3 Agrarian Reform in the Ethiopian Highlands	47
4.2 Constraints Arising from Lack of Supporting Services	48
4.2.1 Agricultural Research	48

4.2.2 Extension	49
4.2.3 Input Supply and Credit	49
4.2.4 Veterinary Services	50
4.3 Constraints Arising from Inadequate Environmental Education	51
4.3.1 Formal Education	51
4.3.2 Non-formal Education	52
5. Infrastructure	53
5.1 Roads	53
5.2 Marketing	53
5.2.1 Livestock Marketing	54
5.2.2 Crop Marketing	54
6. Ecological, Demographic and Socio-Economic Trends to the Year 2010	
6.1 Ecological Trends	55
6.2 Demographic Trends	55
6.2.1. Factors Increasing Death Rates	56
6.2.2 Factors Reducing Birth Rates	57
6.3 Factors Affecting Resource Management	57

## PART II: LESSONS OF SUCCESS AND FAILURE

1. Introduction	59
2. Potential of Past Development Interventions	59
2.1 Transforming Traditional Systems	60
2.1.1 Irrigation	60
2.1.2 Mechanized Farming	61
2.1.3 Ranching	62
2.1.4 Land Settlement Schemes	62
2.2 Modernising Traditional Systems	63
2.3 Sustaining Traditional Systems	64
2.3.1 Tenurial conditions	65
2.3.2 Sustaining Pastoral Systems; Problems of Grazing Rights	66
2.3.3 Compatability with Farm Management Objectives	67
2.3.4 Food Security	68
3. Conservation of Species and Ecosystems	68
4. Five Major Lessons	69
4.1 A Learning Process Approach	69
4.2 Putting People's Priorities First	71
4.3 Secure Rights and Gains	71
4.4 Sustainability through Self-Help	71
4.5 Staff Calibre, Commitment and Continuity	72

5. Suiting Development Assistance to Actual Needs through Popular Participation	72
6. Ongoing Research	73
7. Research Required	74
8. Limitations Imposed by Conditions in Recipient Countries	75
9. Some Implications for Bilateral Donors	77
SELECTED BIBLIOGRAPHY	80

AGRICULTURE, LIVESTOCK & FORESTRY:  
AN ENVIRONMENTAL STRATEGY FOR SEMI-ARID AREAS.

SUMMARY AND CONCLUSIONS

Geographical Context

1. This strategy covers the arid and semi-arid zones of Africa and South Asia. In the former, it focuses on the Sudano-Sahelian zone and north-east Africa, including the Ethiopian highlands; areas where environmental degradation is associated with extreme poverty and famine.
2. Although the climatic conditions in the tropical drylands of Asia and Africa are similar, there are marked differences in human geography. Asia has a much higher population density; it is better endowed with soil and water resources and has a longer tradition of hydraulic engineering. The population is predominantly settled, systems of land use are more intense (higher inputs and outputs) and crop and livestock production are more closely integrated.

PART I: PROBLEMS AND ISSUES

Historic Development of the Land Use

3. The drylands have traditionally supported the herds and flocks of nomadic pastoralists who supplemented their living by hunting and gathering and rainfed agriculture. By maintaining mobility and keeping mixed herds and flocks (grazers and browsers), pastoralists in the semi-desert and dry savanna have been able to exploit low and uncertain rainfall more successfully than settled cultivators.
4. However, increased pressure of human population, cultivation and settlement, as well as the expansion of modern sector enterprises (i.e. irrigation schemes, mechanised farming, ranches and game parks) have reduced the viability of pastoralism. The situation has been exacerbated in Sudano-Sahelian Africa by the droughts of the 1970s and 1980s which caused the greatest loss and dislocation to pastoralists in the semi-desert and the greatest environmental damage in the savanna into which they retreated.
5. Although sustainable systems of dryland farming have been developed by settled farmers in favourable areas, the majority of cultivators in the Sudano-Sahelian zone have relied upon bush fallow to maintain soil fertility. Due to increasing population pressure and land scarcity, this is no longer possible and the clearing and continuous cultivation of large expanses of land are causing widespread erosion.



6. Nowhere is this more striking than in the Ethiopian highlands where many centuries of tree-clearing, grazing and plough cultivation on steep slopes, coupled with a stagnant food-production technology and severe population pressure, are causing irreversible environmental damage.

#### Major Trends and Associated Constraints

7. The semi-arid lands in north-east Africa and South Asia fall within the group of countries classified by the World Bank as the least developed. In turn, the dry marginal areas of these countries are the least endowed with physical and social infrastructure and have per capita incomes well below the national averages. Because of poverty, people are unable to make rational economic substitutions which would ameliorate degradation and diminishing return on capital, labour or land and total output.
8. People in marginal areas rarely carry any political weight. National governments fail to give priority to marginal areas as they are preoccupied with more immediate problems. International donors are usually the principal source of development support. Because much of the assistance is provided in response to drought-related emergencies, it is often ephemeral and inadequately planned.
9. Despite the weighty evidence collected by anthropologists about the subtlety of indigenous adaptations to marginal environments, popular misconceptions persist about the destructive behaviour of pastoralists. Governments tend to favour centrally controlled and administered solutions to the "nomad problem".
10. Reliable demographic data for the marginal areas are scarce. However, a substantial increase in population during the third quarter of the century is generally recognised, both as a result of immigration and natural increase. The impact of this trend was initially masked in the Sudano-Sahelian zone by a series of wetter-than-average years in the 1950s and mid '60s. The effect of the droughts of the '70s and '80s on human and animal numbers can only be estimated. Certainly, large numbers of pastoralists lost their animals and ended up in relief camps and shanty towns. The number which have returned to their pastoral way of life is not known, nor is the rate of expansion of those who were not displaced.
11. The high mortality and emigration which occurred during the most recent drought cycle will provide only temporary respite due to the propensity of animal and human populations to make rapid compensatory gains. In the northern highlands of Ethiopia where some half a million people died from starvation in 1984-5 and from where some 0.4 million have been resettled, there is still compelling environmental evidence of continuing over-population. Government attempts

to find alternative livelihoods outside the famine areas have been largely unsuccessful.

Problems and Issues Relating to Development Interventions

12. Range management and improvement: The main issue relates to whether traditional pastoralism can be improved by the introduction of American-style ranching systems, despite the very great differences between the two:

<u>item</u>	<u>ranches</u>	<u>traditional pastoralism</u>
labour	- labour-extensive	- labour-intensive
animals	- beef cattle - privately owned	- milk cattle, sheep, and goats - privately owned and shared among kin
land	- privately owned - subdivided and fenced	- communally owned - unenclosed range
grazing system	- animals rotated round paddocks	- closely herded on the open range
foreign exchange	- high cost	- negligible cost

Various improvements to the open range (e.g. bush control, aerial top-dressing) are technically feasible, but can be sustained only if it is possible to ensure that the costs can be recovered from the beneficiaries, which is difficult under conditions of open access.

13. Water supplies: In theory, access to the open range can be controlled by rotating the operation of modern stock-watering facilities. In practice, this leads to conflicts between different interest groups which are difficult for both government and communities to resolve. Maintenance of modern water supply technology is also frequently beyond the capability of local people (fuel, spare parts, etc.) and displaces artisans previously employed in operation and maintenance of traditional wells.

14. Land use planning: Interventions by outside agencies aimed at reducing pressure on soil and grazing resources in the savanna often involve the subdivision of the land into model farms which will accommodate arable crops, bush fallow and grazing. These rarely get beyond the drawing board because of the difficulties of accommodating local variations in land capability, differing household needs and capacities and population increase. Complex indigenous systems are difficult to model and reproduce.

15. Agroforestry aims to provide a substitute for traditional land rotation by incorporating the planting and maintenance of woody species into the farming system. Problems relate to the difficulty of matching ecological requirements with livelihood needs and farmers' preferences.
16. Arable cropping: The growth of population has stimulated the intensification of land use by shortening the fallow period. The ability of people to supply their expanding food needs has varied according to their capacity to make adjustments (e.g. mixed cropping, density of planting) and the inherent fertility of the land (soil and water resources). Many of the soil fertility and moisture conservation practices recommended by agronomists emerge from studies of traditional systems. Techniques (e.g. weed-free fallows) developed under rainfed conditions in rich countries are difficult to transfer because they are dependent on improved tools and machinery, beyond the reach of poor farmers. There are high risks attached to the use of chemical fertilizers in semi-arid areas; risks which low-income farmers cannot afford to take.
17. Soil fertility: For sustained cropping, high levels of soil organic matter must be maintained, otherwise soil structure breaks down rapidly and erosion occurs at an accelerated rate. If livestock are to provide the quantity of manure necessary to replenish the store of nutrients and organic matter removed by cropping, forage and fodder crops must be grown. The range of fodder crops well-suited to the dry areas is limited. Scarcity of land and labour may also preclude their inclusion in the farming system.
18. Watershed reservation is often difficult to justify to subsistence farmers who see reservation as a denial of their traditional rights to grazing and cultivation. Planning, implementation and follow-up need strong political commitment and popular support; payment of compensation may be required.
19. Irrigation: Both in Asia and Africa, the introduction of irrigation can result in dramatic increases in crop and livestock production. With a long history of irrigated agriculture, Asians have been more successful in coping with the attendant financial, technical and social problems. Among the most important are: excessively high costs, inadequate attention to the design and construction of water distribution and drainage, and over-optimism about the capability of farmers who are unfamiliar with irrigation and its extra requirements for labour and other inputs.
20. Water harvesting, long practised by pastoralists and farmers in semi-arid areas to trap rainfall run-off, has become a subject of interest in the search for worthwhile

labour-intensive work for people receiving food relief in drought periods. Many of the problems encountered relate to the organisation of food-for-work and the uncertain ownership of work sites and any crop they might subsequently carry. The high labour requirements of structures mean that voluntary (i.e. unpaid) work by pastoralists is discontinued when normal activities can be resumed.

21. Crop pests and diseases may be subdivided into migratory (e.g. locusts) and endemic. The former have been the subject of successful international research and control for decades and the spraying of toxic chemicals to kill them is tolerated as a necessary evil. Few farmers avoid losses from the diverse range of pests and diseases normally present in fields and grain stores. Due to acquired resistance and the dangers of poisoning the environment, methods of cultural and biological control are preferred. The most promising method is the breeding of resistant varieties of crops, but there is a long way to go before these are developed and can be supplied to poor farmers in remote areas.
22. Livestock pests and diseases are worst in Africa. Not only is a large area of the continent infested with tsetse fly, but there are many tick-borne diseases. Within the semi-arid areas, epizootics tend to occur when the animals are already under stress from drought. Problems lie mainly in the organisation and management of veterinary services, including the collection and analysis of information on disease outbreaks, which makes it difficult to plan and evaluate preventive measures.
23. Biomass Energy: The removal of plant biomass for combustion depletes the soil of nutrients and its capacity to store water and replenish the crop/vegetation cover, thus exposing the soil to erosion. Outside agencies have tried to introduce agroforestry, village woodlots and improved management of natural woodland without an adequate understanding of the place of firewood in the hierarchy of people's needs, the local farming system and rights to land and trees. People have been reluctant to adopt fuel-saving stoves because they have failed to prove as versatile as the three-stone fire-place. Among villagers, the low awareness of the firewood problem often contrasts with that of outsiders.
24. Farm power: In South Asia and the highlands of Ethiopia, draught animals are an essential part of the farming system, but in the Sudano-Sahelian zone people have been reluctant to harness their animals for tillage, despite the efforts of outsiders to persuade them to do so. This reluctance relates to the difficulty of getting animals into condition at the end of the long dry-season and, perhaps, to the ease with which sandy soils can be cultivated manually. Attempts by outsiders to introduce improved animal-drawn implements have also been disappointing. Although small farmers have been

willing to hire tractors from private entrepreneurs, tractor cooperatives have a high failure rate. Large-scale mechanization has rarely proved economic or environmentally sound, although mechanized crop production on clays (vertisols) may be an exception.

#### Constraints Relating to the Land Tenure and Supporting Services

25. Land Tenure: There are great differences between the semi-arid areas of South Asia and those of Africa where access to much of the land is relatively uncontrolled and where there is a strong tradition of moving-on once soil fertility is exhausted. Whilst this option remains, conservation measures and land registration are unlikely to be accepted by farmers.
26. Grazing rights: In colonial times, boundaries encompassed the grazing and dry-season water resources of pastoral groups. This system has now broken down due to lack of central government support for "tribal" institutions in the face of outside pressures. At the same time, attempts by governments to regulate grazing within much more narrow limits (ranches, grazing schemes, etc.) have proved both impracticable and unacceptable to the pastoralists. This has created conflict and hindered the emergence of sustainable management systems.
27. Supporting services: Marginal, semi-arid areas are typically remote from the capital and far from where most educated people wish to be. Government services are notoriously poorly staffed and underfinanced.
28. Agricultural research: Research scientists have been less successful in demonstrating technical innovations for the complex, diverse and risk prone semi-arid lands than for the more uniform humid tropics or irrigated areas. National research organizations are usually highly centralised and tend to focus on individual crops and commodities for the surplus producing areas. The improvement of soil and water conservation in marginal areas is very often neglected.
29. Agricultural extension: The problems normally encountered with extension programmes are multiplied in remote semi-arid areas: inappropriate and inadequate technical content, lack of practical skill, lack of a single direct line of technical support and administrative control for field staff. Parallel supporting services are very often weak or absent.
30. Livestock Marketing: In normal years, traditional producers are usually better served by their own marketing systems. In drought years, when large numbers of animals have to be sold because of reduced carrying capacity and relative increase in grain price, neither the traditional nor the government system serves them well.

31. Crop marketing: In areas with fluctuating rainfall, the size of the surplus marketed by small farmers differs widely from year to year. Market infrastructure has to be able to handle relatively large local surpluses in one year and imported supplies, including relief, in another. Government-controlled marketing systems can become extremely costly and inefficient with separate agencies responsible for: procuring local surpluses (at below market prices); distributing imported relief grain; and handling inputs for food-for-work. This increases the risks and prices and reduces returns to small farmers.
32. Veterinary services: Because mass vaccination programmes have to be free, there is an inevitable shortage of funds for vaccines and for the equipment necessary for the cold chain. Most of the budget is absorbed by salaries, allowances and transport. Government financial procedures are not geared to handling the purchase and sale of veterinary drugs and vets are reluctant to devolve responsibility for drug supply to the private sector.
33. Environmental education is sometimes a component of drought-rehabilitation programmes aimed at changing the attitudes of adults and children to environmental decline and persuading them to adopt conservation practices (tree planting, land forming, etc.). The main problem with such education programmes is that they are formal (i.e. top down), devised by outsiders and deal with the symptoms rather than the underlying causes of environmental degradation.
34. Infrastructure: Although roads can accelerate the removal of the tree cover for firewood and charcoal, there is also evidence that some areas without all-weather roads are also the most deprived and degraded. In these cases, the absence of roads is both a cause and an effect of economic underdevelopment. What applies to roads also applies to other communications' infrastructure.

#### Ecological, Demographic and Socio-Economic Trends

35. Factors influencing these macro trends over the next twenty years include rates of natural population growth, migration within and between countries, rates of death from famine and AIDS, climatic patterns and institutional changes such as agrarian reform. Populations in Sub-Saharan Africa are expected nearly to double, or more, over this period while growth in South Asia is unlikely to exceed 20-25 per cent.

## PART II: LESSONS OF SUCCESS AND FAILURE

### The Relationship between Development and Environment

36. Rising poverty both causes and results from environmental problems. It increases the pressure on natural resources as more people are forced to rely directly on them. Environmental degradation will not be halted by "environmental" projects on their own which merely treat the symptoms rather than the underlying disease, namely crushing poverty, caused by a stagnant food production technology, increasing population, a natural resource base, declining in both relative and real terms, and a world economic order which continues to reinforce these trends. In north east Africa, the boundaries between relief, environmental rehabilitation and development have become increasingly blurred.

### Lessons from Past Development Interventions

37. Interventions are classified according to the level of control which is sought by the development agency in transforming, modernising or sustaining the traditional production system.

#### Transforming farming systems

38. These include formal irrigation schemes, ranches and mechanised crop production projects. Land settlement projects for drought victims are another example.

39. Irrigation schemes: Although not without problems, irrigation in Asia has transformed crop and livestock production potential. The expansion in recent decades (e.g. the Mahaweli project in Sri Lanka) has been an extension of a centuries' old tradition. In Africa, south of the Sahara, the pace and scale of irrigation construction greatly increased in the 1970s, but with disappointing results. Reacting against large-scale projects, donors and governments have now turned to small-scale schemes, to an extent that far exceeds their potential contribution to the economy. The familiar problems created by top-down planning, implementation and scheme management have recurred. In Africa, the expansion of irrigation is unlikely to improve the lot of more than a tiny minority of people in the semi-arid areas. Here, as in Asia, the best returns from scarce capital will be from increasing the efficiency of existing schemes. A precondition for this is a better understanding of prevailing water management procedures.

40. Mechanized farming schemes: The financial losses of the mechanized groundnut schemes of the 1950s have been repeated on numerous occasions in semi-arid Africa. In those few cases where the clearing of large areas of grazing land for

mechanized crop production have resulted in increased overall productivity, the environmental and social costs have been high. The most appropriate type of mechanization generates rather than reduces unemployment, as for example on existing small farms in Punjab.

41. Ranches: Numerous ranching projects introduced to traditional pastoral areas of semi-arid Africa with the assistance of the World Bank and other donors have failed to take root. Local pastoralists have often suffered when they lost their traditional rights of access. Grazing pressure outside the fence was often intensified.
42. Land settlement schemes (land colonization in India), often associated with the extension of irrigation into arid lands, have a long history in Asia, the most recent being the Mahaweli Project in the dry zone of Sri Lanka. In north east Africa, they are a response to the need to accommodate drought victims (Somalia and Ethiopia) or refugees (Sudan). The social, managerial and financial costs (US\$ 5000 per household in Ethiopia for rainfed farming) of land settlement are extremely high considering the fact that only a small proportion of the total population can be accommodated. Further, without careful planning and skillful implementation, land settlement schemes extend the environmental crisis into previously unspoiled lands.

#### Modernising farming systems

43. In this type of intervention, input supply, marketing and credit (supported by research and extension) are the main points of entry into traditional production systems. Customary land rights and the raising of stock and the cultivating of crops remain in the hands of herders and farmers. Included in this category are the attempts to introduce multi-purpose agroforestry species, village woodlots and energy-saving stoves, all of which have proved much more difficult to introduce than originally anticipated.
44. Traditional pastoral systems evolved to exploit the highly seasonal and spatial variations in fodder and water availability in the semi-arid margins. Outside attempts to improve range and herd productivity have brought few benefits because the practices recommended were often developed under different circumstances. Aid projects involving the installation of stock-watering points (tubewells and diesel pumps) have frequently resulted in operational problems. The working life of equipment has been disappointingly brief. Rarely has it proved possible to use modern water supply technology to regulate access to grazing on the open range. Except in the field of epizootic control, there are few technical innovations which can significantly reduce the risks and uncertainties faced by pastoralists.



45. Recognising that alternative uses for semi-arid, marginal lands are very limited, it is reasonable to assume that these areas will remain pastoral for the foreseeable future. The emphasis must therefore be placed on sustaining traditional systems (see paragraph 52).
46. Crop farming: Interventions in the field of input supply and marketing by the public sector have had little beneficial impact on traditional crop farming in the marginal dryland areas. Apart from the fact that appropriate innovations are scarce, farmers are rarely able to afford even the most basic inputs to control crop pests and to improve fertility. It is now increasingly recognised that, in resource-poor agriculture, extension programmes must concentrate on minimum cash-cost improvements which provide high returns to land, labour and capital (e.g. farm forestry; land shaping; concentrating soil, water and fertility through water harvesting). Most if not all these improvements have been identified as a result of studying indigenous farming.
47. Farm management objectives: A recurring problem is the failure of outsiders to see that proposed innovations are incompatible with farmers' management objectives. In those parts of Africa where land is still abundant, extensive systems (shifting cultivation and pastoralism) yield a better return to labour than settled agriculture. While labour remains the scarce factor, farmers are reluctant to adopt practices which produce more food per unit of land if they involve more work.
48. Tenurial conditions: Another recurring difficulty is the failure of development workers to grasp the constraints imposed by existing tenurial conditions. Attempts to introduce, for example, tree planting or water harvesting are often based on the assumption that access to development sites can be controlled indefinitely in favour of an individual or group. If interventions are to be successful, they must be adapted to the customs and laws governing access to land and not vice versa.
49. Intermediate technology: The successful introduction of low cost innovations, which can be maintained and repaired with local materials and skills, requires the capacity to out-guess generations of indigenous craftsmen as well as a very detailed understanding of the local economy. The evidence suggests that the modification of existing equipment and manufacturing techniques is usually the most promising path to follow in cooperation with local craftsmen.

Sustaining farming systems

50. Drought Rehabilitation: This more modest approach accepts that wide departures from established systems are not

feasible in the foreseeable future and tries to sustain the customary way of life by reducing the impact of drought-related disasters. Measures include restocking with small stock and draught oxen, the distribution of agricultural inputs (seed and hand tools) and the provision of emergency food supplies to farmers. This type of assistance, often channelled through NGOs, aims to assist people to remain on their land in readiness for the next production cycle, especially in the more marginal, agropastoral areas.

51. Remote sensing and resource surveys: Donors have financed numerous surveys in the arid and semi-arid lands of north-eastern Africa, using both satellite imagery and low-level aerial census techniques. These could have led to a rationalisation of grazing and cultivation rights in the areas covered, but the tendency has been to shy away from the land tenure issues, especially in the absence of reliable "ground truth" from concurrent field surveys. Without detailed information on livestock and human populations, seasonal occupancy, political structure and functioning, etc. data from remote sensing are unlikely to be of any practical value. However, if migratory pastoralism is to remain viable, the territorial limits of pastoral groups need to be re-established and crossed only with mutual agreement. It will be necessary to place limits on the expansion of cultivation and wild-life parks which have steadily eroded the livelihood of nomads.
52. Future directions in the pastoral sector: While there is little prospect of dramatically improving traditional systems, there are a number of promising improvements and techniques which could help sustain traditional pastoralism, especially if combined:
- assistance with emergency destocking and accelerated restocking before and after drought; better local prices and market infrastructure;
  - improved access to basic animal health requisites;
  - reduction of animal mortality (especially young stock) by better disease control and nutrition;
  - better design, operation and maintenance of livestock water points;
  - better health and education services, especially non-formal education, for the pastoralists to help them better to deal with risks and uncertainties and to articulate their needs in the national political arena.

### Food Security

53. If the migration and starvation of the 1970s and 1980s are to be avoided in the 1990s, the necessary logistics (roads, transport and storage) and early warning systems must be established and linked to local, national and international food management policies and programmes. Without these measures, the drought-prone areas will be disrupted by recurrent emergencies and development efforts will be to no avail. Implementation of the required comprehensive measures requires close cooperation between governments and relief and development agencies.

### Conservation of Species and Ecosystems

54. Man's activities have modified the environment and reduced biological diversity and productivity and caused serious breakdowns in essential processes. Many plants and animals which supported people have been lost or have become rare and localized. These imbalances are most pronounced in the dry margins and have been accentuated by recent droughts. The importance of conserving ecosystems relatively intact, as a source of germplasm for future use hardly needs emphasis. However, efforts to set aside protected areas in the critically affected areas and to obtain the active support of local people and their governments have often been fruitless. IUCN, which has traditionally been concerned with the preservation of species and habitats and with protected areas, finds itself unable to stand aside from questions of drought and famine and now focuses on livelihood security as the only long-term basis for environmental rehabilitation.
55. As a safeguard against the irrevocable loss of genetic material, an international effort has been coordinated by the International Board of Plant Genetic Resources to store seed of potentially valuable plants. The Danish Forest Seed Centre and the Department of Economic Botany in Kew, England are examples of national seed banks from which seed is disseminated for the rehabilitation of semi-arid lands.

### Five Major Lessons

56. A study of a cross-section of small development projects (by Chambers, see bibliography) concludes that, for the achievement of sustainable livelihoods, five major lessons can be drawn. These concern:
- a learning process approach
  - people's priorities first
  - secure rights and gains
  - sustainability through self-help
  - calibre, commitment and continuity of staff.
57. A learning process approach: The first lesson recognises that development is a process of experimentation which should be

conducted so as to permit the project in hand to evolve at a pace suited to the human and environmental circumstances. Much of the failure to take proper account of land use, land rights and socio-economic conditions is due to the fact that projects are formulated in too much of a hurry by outsiders and in far too much detail at the outset. The resulting "blue print" may run into several volumes and be compiled with very little involvement of the local officials who have to implement the project, let alone the local farmers. While this is true of development planning in general, it is particularly the case in marginal areas where conditions are often uncongenial and inconvenient for visitors.

58. People's priorities are invariably closely linked with livelihoods; unless there is a direct pay back, for example in conservation, farmers are unlikely to show an interest. If development workers are to learn about people's priorities, provision must be made for regular face-to-face meetings, over a period of years rather than months in which there is a readiness to listen to farmers.
59. Secure rights and gains: Sustainable systems of crop and livestock production depend upon farmers feeling secure in their tenure and being able to take a long-term view. The willingness of poor people to invest time and effort for long-term gains depends on how secure they judge their future rights to be. Without secure rights to resources, it makes no sense for peasants to conserve soil, plant trees or protect forests. Where individual rights to property are not practicable (e.g. in the case of nomadic pastoralism), communal rights may be sustainable, provided territorial limits are clear and access is regulated by the joint owners.
60. Sustainability through self-help: Unless people are allowed to decide for themselves what they need and the steps that they are willing to take and to participate voluntarily in the conviction that an activity is in their own interest, action is unlikely to be sustained. Subsidies and food-for-work can diminish the relevance of a programme and induce people to undertake tasks in which they have no interest. Outsiders can be misled into believing that people see the long-term benefit when they see only the short term gain.
61. Staff calibre, commitment and continuity: The fifth lesson emerging from the case studies relates to the need for good staff with continuity in the field.

#### Suiting Development Assistance to Actual Needs through Popular Participation

62. A recurring problem in rural development work is how to involve the people in the planning and implementation of the

actions necessary to satisfy their needs. Planners may consult local leaders or a representative group of farmers, but if the purpose simply is to ask the people what they want from government, neither course is likely to be instructive. Farmers usually ask government for what they think it ought to provide (e.g. water supplies, feeder roads) and tend to overlook those things for which there is more immediate need, simply because no help of this kind has been provided by government in the past.

63. Before development workers can have a constructive dialogue with farmers, they need to have a reasonable grasp of the problems facing farmers and how they might be tackled. In the 1960s and 1970s, rural development programmes were often preceded by detailed resource surveys of physical and socio-economic phenomena conducted by a range of specialists, but, apart from being slow and costly, much of the information collected was often irrelevant and much of what was needed was overlooked.
64. Rapid rural appraisal (RRA) techniques were developed in response to the need to acquire quickly new information on, and new hypotheses about, rural development. RRA techniques are applicable to programme planning in resource-poor areas. They focus on diversity (biophysical and socio-economic), but aim to reduce complexity to a few key problems and opportunities. It encourages a participatory, "bottom up" approach by operating in the field (fields, gardens, villages, etc.) and combines semi-structured interviews by interdisciplinary teams and a systems perspective to make communication easy. RRA techniques for resource-poor farmers aim to emphasise not only productivity but stability, sustainability and equitability and the critical trade-offs between the two.
65. Similar techniques have long been used by extensionists. The "problem census", a structured enquiry aimed at defining problems, exploring differences in viewpoints between farmers and extension workers, redefining problems in terms which permit solutions and agreeing a course of joint action, can be used to encourage farmers to support the implementation of a programme once it has been formulated.

#### Ongoing Research

66. To attempt a review of relevant drylands research with environmental implications in this brief document would be unrealistic. A checklist of the main foci is attempted:
67. The International Union for the Conservation of Nature and natural resources (IUCN) is carrying out an annual review of the Sahelian environment (Sahel Environment Status Report). It operates several pilot schemes with the purpose of developing durable systems for the management of

representative ecosystems (natural resources, wildlife, people and domestic animals) with a view to contributing to the development planning process of Sahelian countries. It also aims to provide technical support to NGOs running small-scale "ecodevelopment" projects in the region. The Union's long-term strategy is set out in "The IUCN Sahel Report" (see bibliography), a key reference on environmental strategy.

68. Eleven years after the UN Conference on Desertification, the future of the UN Environmental Programme as the designated agency to follow up and coordinate the "Plan of Action to Combat Desertification" is being reviewed by UNEP members. Questions have been raised about the agency's technical capacity to monitor and evaluate environmental change on the desert margins and its ability to use effectively the bilateral resources placed at its disposal for desertification control. UNEP's problems in the field of "desertification control" relate to its apparent preoccupation with "rolling back the desert". Without a large number of complementary socio-economic and political actions, the physical task of revegetating the landscape on a significant scale is hopeless.
69. Despite the seemingly intractable problems, there is a strong interest in research in the drier regions. International centres (e.g. ICRISAT, ICARDA, ILCA) have been established with a farming systems emphasis and a number of national research programmes are being supported by the centres. Leaders of research programmes have expressed a strong interest in decentralising the organisation of research to bring scientists much closer to farmers and to working with their limited resources. It is widely accepted that many existing farming systems are well adapted to environmental and other constraints and that the knowledge of farmers must be an element in the search for improvements. The extent to which these undertakings to foster a "farmer-first" approach in agricultural research will be honoured by the international centres is an open question. It should be a continuing object for follow-up by donors

#### Research Required

70. Research breakthroughs of the green revolution variety are unlikely to emerge from the laboratories or experimental fields of research stations because of the complexity, diversity and risk-prone nature of the marginal, semi-arid areas. Research scientists working on a narrow range of crops, pests and diseases, cultivation practices, etc., can miss key linkages and potentials in traditional farming systems. The need for professional specialisation will continue, but in addition there is a need for a new breed of researchers who start with farmers' own analysis and priorities and support and strengthen farmers' own

experiments and adaptations. The strengthening of national agricultural research capability in this area will be vital.

71. Much of this applied research will need to be matched to specific agro-ecological zones and is impossible to specify in advance. However, the following areas will be central to the need to increase the stability and sustainability of rural livelihoods in semi-arid areas:
- \* soil, water and fertility conservation techniques which are integrated at farm level;
  - \* measures to increase the reliability of yield as well as the yield per unit area of crop varieties with the minimum of imported inputs;
  - \* an increase in the range of crops available to farmers, especially multi-purpose agroforestry species, which are the subject of considerable knowledge and optimism but slow to be incorporated in farming systems in the dry zone;
72. In view of the large number of agencies involved in ecodevelopment initiatives and applied research, there will be a continuing need for effective information and communication networks.

#### Limitations Imposed by Conditions in Recipient Countries

73. When compounded by economic mismanagement, the poverty of the countries Sub-Saharan countries imposes severe constraints over the type and amount of foreign aid which can be effectively absorbed, whether for environmental or any other purposes. Against this background, the World Bank and the IMF in the early 1980s pressed for domestic economic and institutional reforms. As the causes of economic distress have varied, so has the response to treatment. Much has depended on the political will and commitment of the governments involved and the domestic support they have received in implementing the reforms.
74. Structural adjustment should result in a shift of resources to the countryside, improve income distribution and growth and therefore deserve support. The implications for bilateral donors might be as follows:
- while sub-Saharan African governments are in a state of permanent debt crisis, environment and conservation are unlikely to receive priority; debt forgiveness and substantially improved inflows of aid may be a precondition for changing attitudes;
  - a relevant mix of programme and project aid is necessary;

- as far as project aid is concerned, there are likely to be a number of items on the agenda which require project finance (e.g. feeder roads, market infrastructure);

- in helping to create capital assets, it may be necessary to avoid overloading the government budget with running costs;

75. Macro-economic policy is not the only issue with environmental implications. Amelioration of fiscal policy can have an immediate impact on rural livelihoods while land tenure and local government reforms will have an effect only in the medium term. Education and population control policies can bring about improvements in the long term

#### Some Implications for Bilateral Donors

76. The 1973-4 famine in the countries of the Sahel and in Ethiopia caused intense concern about environmental degradation in Africa, but, fifteen years later and ten years after the Nairobi conference on desertification and the creation of UNEP, there is little evidence that the underlying causes of degradation are being tackled on the scale and in the manner necessary. Donors are aware that environmental and development issues are inter-related; only when poor people obtain secure livelihoods will sustained environmental improvement be possible. Donors are sympathetic to the lessons emerging from the case studies (paras. 56-61), but the problem is translate them into practical actions.
77. The potential for intervention by donors is necessarily limited - both in geographical area and content. Influence over the overall policy framework of host governments is also likely to be small. Donors also knows that rural development has proved a major stumbling block, especially in the marginal areas of Africa.
78. However, the experience of the last two decades leads to the conclusion that rural development is not necessarily achieved through massive inputs of resources within a few years; on the contrary. Appropriate solutions are invariably location specific and need persistent effort over many years. However, a bilateral agency with reliable funding should be in a strong position to do things modestly but well. The main opportunity lies in operating in a limited area (i.e. concentrating on both content and area) and, by working with local people, demonstrating sustainable systems with a wider application.
79. Agencies would do well to keep in mind that rural development is a process of experimentation which does not lend itself to the highly structured approach adopted by the larger agencies, the bureaucratic procedures of which have proved an unwelcome strait-jacket. Bilateral agencies will need to



exercise ingenuity and patience in their efforts to involve both officials, local leaders and the people (women as well as men) in the planning and the implementation of the actions necessary to satisfy local needs. In the last 25 years, development planning has been an urban, male, bureaucratic and technocratic activity by those who do not depend immediately on the environment for their security. The results have been short-term objectives, neglect of ecological imperatives and local environmental knowledge in project planning and a growth of the absolute poor and environmental refugees.

80. If donors are to pursue a genuinely participative and consultative approach, they must be prepared to allocate the necessary time, effort and manpower to understanding socio-economic and socio-political phenomena. Participative planning and implementation take time and considerable persistence. This should not lead to the neglect of the required surveys of physical factors (soils, hydrology, etc.) nor to delays in disbursement for basic infrastructure (e.g. roads). Indeed, assistance with essential capital works will make it easier to insist upon a more gradualist and measured approach to rural development in degraded and marginal areas.
81. There are real difficulties in working through government bureaucracies in the Third World especially in remote marginal areas, but it is essential for a bilateral agency to do so. By working closely with local officials, differences in viewpoints can be explored and attitudinal changes based on mutual respect can be fostered. The bilateral status of donors should not prevent close cooperation with NGOs, which have clear advantages in local, community-development programmes. It can be helpful to combine the two types of technical assistance within one sector; for example by providing direct support in a ministry's HQ and indirect support through NGOs in the field.
82. It is apparent that many of the problems associated with the implementation of development projects in remote areas relate to difficulties in staffing, particularly with expatriates. The problems of recruiting competent staff on contract and maintaining them in the field in remote, inhospitable areas are not necessarily made easier by delegating the task to commercial firms, whose high overheads are difficult to justify to recipient governments and whose relationship with contract staff are unlikely to be close.
83. It is also apparent that the commitment of field workers is not directly related to financial and other inducements. Costly accommodation and over-generous provision for expatriates in the field is a frequent cause of friction with local staff. The recruitment, conditions of service and management of expatriate technical assistance on rural

development projects in remote areas and the opportunities for replacing them with local staff need to be carefully considered. Aid workers, like their counterparts, can become institutionalised. There are positive lessons to be learnt from the NGOs.

84. The devolvement of responsibility for development projects, as opposed to studies and monitoring of physical and socio-economic trends, to specialised UN organizations (e.g. UNEP and UNSO) also requires careful consideration. The channelling of funds through these agencies for project planning and implementation can result in an unnecessary addition of bureaucratic layers and a reduction of the funds available for the people who most need them.

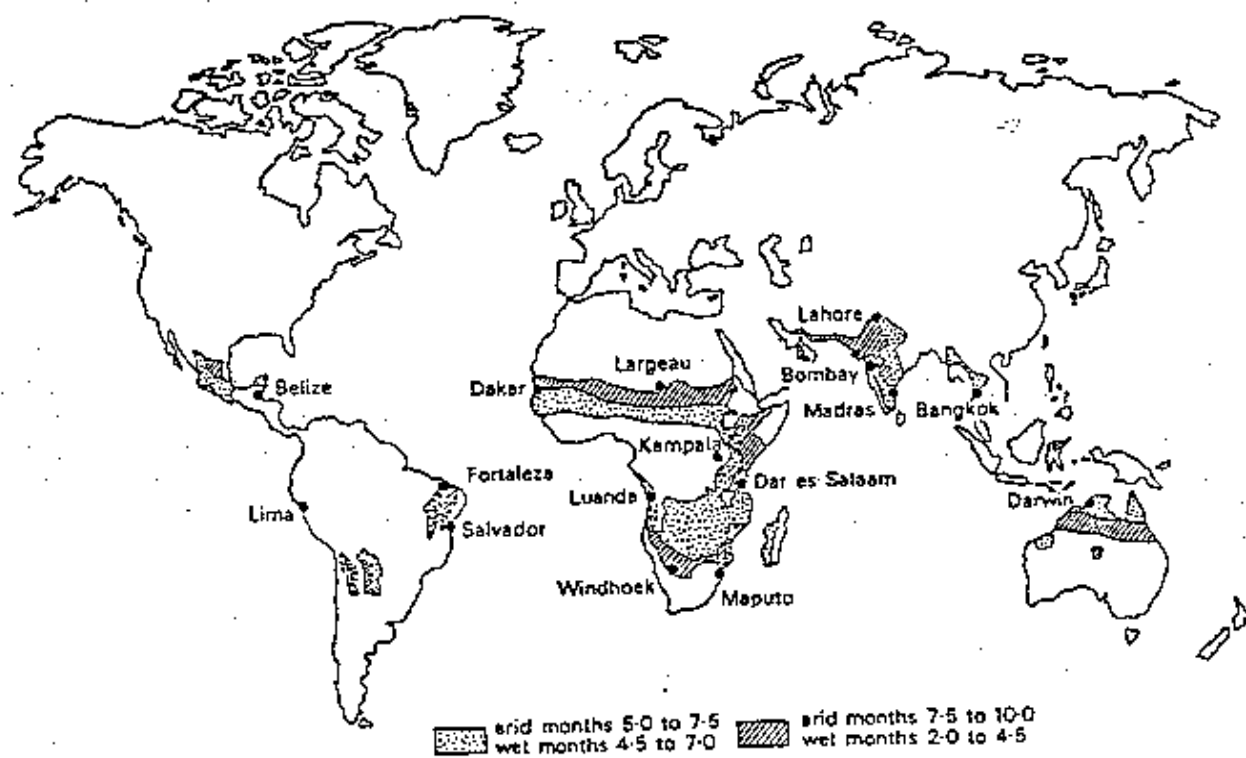


Fig. 1. Semi-arid tropical climates: world distribution (Source: Troll, C. (1965). Seasonal climates of the earth in: Lindsberg, M.E. et al (eds.) *World maps of climatology*. Springer-Verlag: Berlin, Heidelberg, New York.)

## Geographical Context

This strategy embraces the arid and semi-arid zones of Africa and South Asia. In the former, it focuses upon the Sudano-Sahelian zone, the Horn of Africa and the semi-arid parts of East Africa and, in the latter, the drier parts of India, Pakistan and Sri Lanka.

In arid and semi-arid lands, the evaporative demand of the atmosphere exceeds the income of moisture over most of the year. Semi-arid areas (see map) normally have more than two wet months, a mean annual rainfall ranging between 300 and 1500 mm and permit at least one arable crop per year. The variability of this rainfall increases with decreasing mean annual precipitation. Arid areas have less than two humid months and are generally unsuitable for crop production without some form of irrigation. The arid areas are subdivided into semi-desert and desert. The former provides seasonal grazing for transhumants.

In the dry areas of Africa and South Asia, rainfall patterns and soil types are crucial factors influencing the distribution of cultivation and grazing. In both continents, the increasing pressure of land use on natural resources is diminishing the human and livestock carrying capacity of the land. In the last two decades, the environmental and socio-economic conditions have further deteriorated as the result of a sequence of years with below-average rainfall, both in eastern Africa and South Asia.

Asia: South and south-east Asia have a significant area of land (2.2 million square kilometres) which comes within the semi-arid classification. India has 54 per cent semi-arid, Pakistan and Sri Lanka, 45 per cent. Population density is much higher than in Africa (1.3 persons per ha in India, 0.1 in Sahelian Africa) and half of the land holdings are less than 1.0 ha. Semi-arid areas in India are predominantly settled and have only small nomadic populations. Compared with Africa, there is little community-owned land with any natural vegetation remaining.

Africa: Semi-arid lands south of the Sahara total 11.5 million square kilometres, about 60 per cent of the semi-arid tropics (see map). Soils are very often sandy and infertile and there are considerably fewer sources of irrigation water than in Asia. The river Nile which supplies the Gezira is an important exception.

For the purpose of presenting the principal environmental issues, it is necessary broadly to classify the climatic and related production systems of the arid and semi-arid areas. This classification, which inevitably involves a high degree of generalization, has two main components, the plains and the highlands. The plains are again subdivided into the savanna, the semi-desert and the desert, but in reality they form a continuum, land use in one frequently having far-reaching consequences in the other.

The African plains include the Sudano-Sahelian belt with mean annual rainfall between 200 and 1000 mm occurring mainly in the months of June to September. It is a vast area of acacia bush, woodland and open grassland, traditionally used for grazing by nomadic and transhumant cattle herders. It is increasingly cleared for the semi-permanent cultivation of sorghum, millet and groundnuts by sedentary cultivators with small herds and flocks and exploited by charcoal burners for the rapidly expanding urban market. Also included is the single-wet-season savanna of central Tanzania where 500 to 1000 mm of rain falls during a single rainy season (December to April), followed by a severe dry season of six or seven months. Large areas of miombo woodland are uninhabited and infested with tsetse fly. In Kenya, the semi-arid twin-rainy-season savanna consists of acacia bushland populated by Maasai and largely allocated to national parks.

In Asia, a large part of the area is under rainfed crops: sorghum, millet and pulses (chick pea, lentils, grams and pigeon pea). Over much of the area, there are two monsoons: the kharif which gives rise to the main cultivation and the rabi to a minor cropping period. However, the total area irrigated or partly irrigated in the semi-arid lands of south and south-east Asia is 55 million hectares or 25 per cent of the total area. Unique to India and Sri Lanka has been the irrigation of rice from tanks or earth-bunded reservoirs used to catch and retain the monsoon rainfall and run off. The use of bullocks and buffaloes as draught power is an essential part of the farming system as is the use of organic manure, although inorganic fertilizer use averages 39 kg per hectare (in India), which is ten times that in sub-saharan Africa (excluding Kenya, 38 kg).

Under the category semi-desert, with 100-300 mm of rain annually, are included the Horn of Africa (i.e. Somalia, north and north-eastern Kenya, and east and south-eastern Ethiopia) and the desert fringes of the northern Sudan; in South Asia, the dry plains of north-west India and Pakistan. The semi-desert provides wet-season grazing for the nomadic and transhumant pastoralists who subsist mainly on their camels, goats and sheep.

Except where they are traversed by perennial rivers or where groundwater is accessible for irrigation (e.g. Baluchistan), deserts (less than 100 mm of rain per annum) fall outside the scope of this strategy statement. They are of interest, perhaps, where sand dunes encroach upon riverine land (for example on the pump schemes of the Nile in Northern Region of Sudan).

The highlands include the deeply dissected escarpment and plateaux of north-east Ethiopia, between 1400 and 3500 m above sea level. These areas are on the leeward side of the main monsoonal circulation and receive less rain than the western side of the highlands. The reliability of rainfall on the north-east escarpment is extremely low with most rain falling as heavy showers. Low temperatures and frost occur on cloudless nights in

the dry season (November to February) above 2200 m. Temperate crops (wheat, barley, faba beans) are grown at these altitudes. Sorghum, maize and teff are found at intermediate altitudes (1400 to 2200 m). Livestock (oxen, donkeys, mules) are kept primarily for work.



## PART I: PROBLEMS AND ISSUES

### 1 Historic Development of the Present Land Use Systems

#### 1.1 The Plains

In recent times, the semi-desert and savanna traditionally supported the herds and flocks of nomadic and seasonally transhumant pastoralists\*, who, to a greater or lesser degree, supplemented their living by hunting and gathering and extensive dryland agriculture.

The pastoralists adjusted to highly seasonal and spatially variable rainfall by:

- maintaining a high degree of mobility to take advantage of changes in the availability and nutritive value of forage;
- conserving fodder by postponing the use of dry season pastures as long as possible;
- diversifying their holdings with grazing and browsing species; adding goats and camels to cattle and sheep when conditions become more marginal;
- maintaining a ratio of males and females which optimises milk production and ensures rapid herd recovery after a bad year.
- maintaining high stocking rates in relation to available forage (which leads to a higher level of production per unit area than per animal in contrast to modern systems where land is private rather than commonly owned).

Thus, nomadic pastoralists have been able by such strategies to support a higher population than would otherwise have been possible by sedentary systems in the semi-desert and dry savanna. However, they have come up against a number of problems, some of which appear to be inherent and others externally induced.

In Baluchistan, for example, goats and sheep have, over centuries, been responsible for overgrazing, that is the reduction of palatable species in the plant association to the extent that recovery is not possible in the short term. Degradation of pastures in Kordofan and Darfur, Sudan, is more recent and has taken place over the past ninety years. Here native plant species have had less than 100 years to adjust by genetic modification to the present levels of defoliation. On the other hand, the animals (short-horned Zebu cattle, goats, sheep, donkeys, horses and camels) have worked their way down from the Middle East in the last five thousand years, gradually adapting

---

\* It is convenient to categorise groups as pastoralists or cultivators, but in reality the distinction is usually blurred.



to drier conditions. The outcome of the interactions between the biomasses involved is only beginning to emerge. Preferred species in the herb layer are becoming scarce, unpalatable species common and extensive areas of ground are bare throughout the year. In turn, high intensity of utilization has favoured goats, which can reproduce and survive under conditions of low fodder production.

Overgrazing has been further exacerbated by a number of factors:

- the expansion of cultivation around dry-season water points by indigenous, sedentary cultivators as well as pastoralists no longer able to subsist on their reduced herds;

- the expansion of modern-sector enterprises (irrigation schemes, mechanised rainfed crop production, ranches, game parks) either in the dry-season grazing areas or across migration routes;

- the breakdown of civil order and arming of hostile neighbours with automatic weapons; and

- an overall decline in rainfall since the mid 1960s with severe droughts in 1968-73 and 1983-85 in Africa and in the last four years in South Asia.

In Africa, the droughts of the 1970s and 80s have caused the greatest loss and dislocation to pastoralists in the semi-desert, but damage to soil and vegetation resources has been most marked in the savanna into which they retreated. Here destruction has been taking place around settlements for decades, forming islands of degradation beyond the desert margin, rather than desert advance on a broad front. Although there is a common belief that the Sahara (and its easterly parts, the Libyan and Nubian deserts) and the Rajasthan deserts are on the march, scientific evidence does not conclusively support or refute the popular theory of the spread of the desert. However, local dune encroachment undoubtedly takes place.

Settlement near dry-season wells has meant that pastures could not be rested during the rains when annual grasses set seed, increasing the stress upon the system. This has increased the marginal position of those herds that have remained nomadic and which relied on the water sources and surrounding pastures for part of the year. Since the herds of the nomads are more productive per animal than those of the sedentaries, settlement in arid savannas has inevitably meant a lower offtake of milk and meat per animal and per unit area and the impoverishment of the pastoralists. Such losses in productivity generally are not made good by rainfed farming because of the high risks in growing crops in areas of low and uncertain rainfall and infertile soils.

Not all cultivators have pastoral ancestors. Some farming communities in the more fertile and humid, higher-altitude areas have long practised dryland agriculture without reliance on land rotation or bush fallow systems. However, over the greater part of the Sudano-Sahelian zone, bush fallow has been the logical way of maintaining fertility and reducing weed encroachment.

In Africa, the switch from shifting or fallow systems to semi-permanent or permanent farming due to population pressure and land scarcity is one of the most important changes that has been taking place in the semi-arid lands this century. This process has evolved further in the centre and south of the continent where permanent farming systems are now more common. In the Sudano-Sahelian zones, many types of semi-permanent farming have replaced shifting cultivation, but only in the areas of more fertile soils and higher rainfall.

For the pastoralists of Africa, the expansion of irrigated farming in former dry-season grazing areas (e.g. on the Awash in Ethiopia, on the Juba and the Shebelle in Somalia, on the Nile, Blue Nile and Atbara in Sudan, on the Turkwell and Tana in Kenya) has had mixed results. Much depended on the extent to which they were able to retain access to water and grazing and were allocated land within the schemes. In most cases, even where pastoralists have settled on an irrigation scheme, they have preferred to retain their livestock.

With the advent of irrigation in Sudan's Gezira, the human and livestock carrying capacity of the clay plains has been immensely increased. Prior to canalization, the semi-desert and dry savanna supported no more than one household per square kilometre. Today the Gezira and adjacent schemes sustain 20 to 30 times that number, many of them former pastoralists. Nowhere has irrigation allowed the intensification of land use more than in India where the irrigated area has more than doubled from 17 million hectares to 38 million since the beginning of the century.

There are other cases, however, where the impact of modern-sector development has been entirely negative and led to the eventual impoverishment and demise of pastoral communities. Such developments remove from the system the very land which is most crucial, that is the better watered areas which usually are central to the survival of livestock during the dry season.

## 1.2 The Highlands

In north-east Ethiopia, there is not the complex gradation of mixed herding and cultivating found in the Sahel, where latitude rather than altitude is the significant factor. In the highlands, the transition between cultivators and pastoralists is mostly abrupt and spectacular.

Tigray and Weio are the most intensively farmed of all Ethiopia's regions with a tradition of settled agriculture that dates back

at least three thousand years. Family holdings now average less than one hectare and grain production provides only about 50 per cent of human energy requirements on average. Chronic hunger is only partially ameliorated by the free distribution of relief grain. The capacity of the land to sustain the population is decreasing at an alarming rate, especially in the drier parts. The scene of two major drought-related famines in twelve years with over a million deaths from starvation.

Repeated ploughing of steep hillsides for cereals, the exposure of bare soil to intense rainstorms and the removal of crop residues and dung for fuel combine to cause soil erosion on a massive scale. Since the mid 1970s, silting of reservoirs downstream has become a major problem, especially on the Blue Nile and Atbara rivers on which power supplies and the irrigated agriculture in Sudan mostly depend. The environmental crisis in the highlands is far more serious than elsewhere in semi-arid Africa because of its scale and clearly irreversible nature. While the Sahelian vegetation would recover given a sequence of wet years and protection from grazing, the same would not occur in the highlands because of the disastrous loss of soil cover.

In this brief historical review, we see the close inter-relation between economic development and environmental issues. Some forms of intervention directly or indirectly cause ecological imbalance and accelerated erosion. At the same time, environmental degradation usually has an immediate impact on economic prospects. Rising poverty is thus a major cause and effect of environmental problems and increases the pressure on natural resources as more people are forced to rely directly upon them.

## 2. The Major Trends and Associated Constraints to Sustainable Utilization of the Natural Resources

### 2.1 Economic

Without exception, the countries covered by the strategy statement fall within the "least developed" classification of the World Bank, with GNP per capita less than US\$ 400. In turn, the dry marginal areas of these countries are the least endowed with modern physical and social infrastructure and have per capita incomes well below the national average. Thus the inhabitants of the arid and semi-arid areas are the poorest of the poor.

Because of poverty, isolation and the primitiveness of communications, inter-regional trade is relatively insignificant. People are unable to make economic substitutions (e.g. kerosene for firewood, fertilizer for fallow) which would ameliorate or even forestall environmental degradation and diminishing per unit production and total output.

Over the major part of semi-arid Africa, where labour rather than land has been in short supply, farmers have been reluctant to adopt innovations which would produce more food but would involve more work. However, the shrinking availability of land in relation to labour is generating a demand for innovations intended to raise yields per unit area. This pattern has been noted where changing factor combinations have contributed to the acceptance of soil conservation measures, formerly rejected by farmers when there still remained vacant land to move to.

## 2.2 Political

The inhabitants of marginal areas rarely carry any political weight and their traditional rights are frequently disregarded by those at the centre who seek to expropriate resources for the benefit of the urban community on whom they depend for political support. This places further pressure on the environment.

National governments are too preoccupied with immediate crises to be concerned about environmental issues in marginal areas. For example, Ethiopia's government, threatened on all sides by civil rebellion, gives priority to military expenditure. The scarce funds remaining for development work are absorbed by the areas most likely to produce a surplus. The dry highlands rely on international assistance for their development budget. A similar pattern occurs in Kenya and Sudan. This can create regional distortions in the distribution of resources. Much of the help is in the form of ephemeral, inadequately planned projects, hurriedly put together following a drought-related emergency.

## 2.3 Cultural

Anthropological research among pastoralists has revealed a variety of social and cultural adaptations to the problem of group survival in ecologically marginal environments. These adaptations used to control access to valued resources at certain seasons and limited the expansion of individual wealth as well as the rate of growth of pastoral populations. Colonial conquest and organization and post-colonial economic processes have often caused the breakdown of these adaptations, directly or indirectly.

Popular ideas about the environmentally destructive behaviour of pastoralists, unconcerned about their animals and pastures, have been largely discredited by the evidence of recent research. However, such myths are not easily disposed of, especially when those perpetrating them have a vested interest in doing so. Nomads are not easy to control and administer and the cultural and political preference of the ruling elite is invariably for the settlement of nomads, whatever the long-term consequences for the environment.

Group awareness of the importance of soil and water conservation among African cultivators in the dry savanna is less well documented, although it certainly existed in the past, especially where groups took refuge in mountain regions to escape their enemies. For example, there is ample evidence of ancient land terracing in northern Welo, Ethiopia and in Jebel Marra, western Sudan. Accounts exist of a tribe in south-west Tanzania which, hemmed in and condemned to increasing land shortage with no option but to cultivate the steepest slopes or starve and with no cattle to provide manure, evolved a system of agriculture which included crop rotation, composting, grass fallow and terracing. In South Asia, husbandry skills would appear to be more highly developed and widespread. In the dry zone of Sri Lanka an agricultural elite of north Indian ancestry executed feats of irrigation which excite wonder two thousand years later.

#### 2.4 Demographic Trends

Sub-Saharan population growth rates are the highest in the world. Growth rates have increased from 2.3 per cent in 1960 to 3.1 per cent today, despite (and because of) still high infant mortality rates. Birth rates and fertility rates are also extremely high and in some countries are increasing. See Part 1, Section 6.1. Information about demographic changes within the Sudan-Sahelian zone is not easily obtained. A number of changes are taking place resulting in a convergence of people and increasing settlement in the dry savanna, especially around towns, and accelerating rates of natural increase.

Traditionally, nomadic pastoralism not only supported relatively large numbers of people on the land (in contrast to modern ranching systems), but also maintained social controls over human fertility. Comparative sample surveys of nomadic and settled populations have revealed a significantly higher natural increase among the latter. Of course, total population counts of nomads are notoriously difficult, not only because they are on the move, but also because of the difficulties of defining nomadic and non-nomadic census categories.

On their return to their dry-season grazing, pastoralists have increasingly found that vital, dry-season pastures have been taken over by cultivators. With a rising population in the wetter savanna, there has been a rapid expansion of arable farming into what had been rangelands. Animal populations also expanded as the result of water provision from deep wells. The long-run impact of this trend was masked initially because the 1950s and 1960s saw a run of wetter-than-average years.

The impact of the droughts of the 70s and 80s on human and animal populations will never be precisely known. When drought threatens, pastoralists normally move their animals promptly to less stressed pastures rather than sell them at throwaway prices, or allow them to die of starvation. However, during the most recent droughts in the Sahel, Sudan and the Horn of Africa,

hundreds of thousands of pastoral families have lost their animals and have been forced to seek their livelihood elsewhere.

The number of pastoralists who have been able to return to their former livelihood when conditions recovered is not known, nor is the rate of expansion of those who manage to remain in the system. It is, however, well established that nomadic herds have demonstrated a remarkable capacity for compensatory gain and rapidly recover to take up the slack created after vegetation recovers from drought. Annual growth rates as high as 26 per cent per year, leading to a doubling of cattle numbers in three years, are possible for a few years after the end of a drought given plentiful food supply. Higher rates are possible for sheep and goats.

Reliable demographic data for the dry highlands of Ethiopia are also lacking. No census has been undertaken due to the protracted civil war. However, it is well recognised that the northern highlands have been the principal source of migrants for the agricultural colonization of the south and west for at least a hundred years. Government-planned resettlement of famine victims started in the 1950s. This reached a peak in 1985 when some 590 000 people were resettled in Western Ethiopia, 370 000 from Welo Region. At the same time, half a million are believed to have died from starvation within the drought area, at least 250 000 from Welo, the population of which probably declined from 3.6 million to 3.0 million between 1984-85. Even with this dramatic decrease, Welo is unable to sustain its population and is expected to import one third of its grain requirements in 1988. Without an improvement in farming methods, soil erosion will continue apace and environmental degradation will be rapidly extended to western Ethiopia by the settlers.

## 2.5 Insecurity

Secessionist wars in the Horn of Africa and insecurity in the frontier regions of Sudan periodically interrupt the traditional migrations of pastoralists and can lead to undesirable concentrations of stock in the more secure areas with consequent over-grazing and settlement around water points. Although these events, which imply a return to the situation which prevailed in the last century, may allow the recovery of vegetation in insecure areas, irreversible damage can be caused around refugee settlements. An extreme example of this type of destruction can be observed on the Baluchistan frontier with Afghanistan which has received over a million refugees since the Russian invasion in 1979.

In addition to diverting hard currency (and able-bodied men) to support military operations, continuing instability prevents any progress being made with rehabilitation and development in most of Ethiopia's northern highlands.

### 3. Problems and Issues Relating to Development Interventions

#### 3.1 Management of Plant Biomass

In this section, we examine the ecological problems and issues associated with the management of plant biomass in the semi-arid tropics. The treatment follows an evolutionary path, from extensive to intensive systems, that is from range management and improvement to arable cropping.

##### 3.1.1 Range Management and Improvement

The main issue relates to whether or not range management, as normally understood, is relevant to the pastures of the traditionally managed herds and flocks. Most modern knowledge aimed at improving traditional pastures has come from the USA where labour-extensive ranching systems are employed in the raising of privately owned animals on private land. Modern systems invariably require the subdivision of land into fenced paddocks and its allocation to individuals or small groups. Supporters of ranches (at the national level or in aid agencies) usually justify intervention on ecological grounds (e.g. that rangelands are suffering severe and rapid deterioration as a result of overgrazing), and/or on economic grounds (e.g. higher offtake and financial returns).

##### (a) Rotation of Pastures

Both range scientists and pastoralists recommend rotation: i.e. altering the timing, length, and succession of use of a particular area of range. Whereas scientists emphasise the beneficial effects of rotation on the vegetation, pastoralists put much more stress on the benefits to livestock or on negative environmental (e.g. mud and tsetse flies) or on political factors (tribal raiding or conflicts with cultivators) or on equitable distribution of grazing (e.g. around permanent water supplies). Further, pastoralists closely herd their stock, making the best use of available labour and grazing.

##### (b) Other Range Improvement Activities

One or several of the following activities can improve range condition in semi-arid conditions:

##### Vegetation improvement:

- \* bush clearing; hay making;
- \* planting, seeding with selected species or varieties;
- \* burning to reduce bush infestation;
- \* burning to replace rank hay with flush of nutritious grass;
- \* application of herbicides.

**Soil improvement:**

- \* levelling, contouring, to reduce runoff;
- \* scarifying to reduce run off;
- \* application of chemicals (macro and micro nutrients)

Their technical relevance will depend on the extent to which they improve (directly or indirectly) the use of water, the scarcest resource. Their economic relevance will depend on the extent to which those who make the investments are in a position to reap the benefits.

**(c) Water Supplies as an Instrument in Range Management**

The development of water supplies should be closely connected with range management because access to water is a key factor in controlling access to pasture. Water engineers stress the following:

- \* New watering points (boreholes, dams, ponds) can permit the use of fodder that would have otherwise been unused.
- \* It is possible to close down pumps to relieve grazing pressure during a particular season.
- \* New facilities can be designed to supply a limited number of animals in keeping with the estimated range carrying capacity.
- \* Water from deep boreholes (e.g. the vast Nubian aquifer in Sudan) is not subject to annual or even secular variations in rainfall.

But the reality is somewhat different.

The environmental problems associated with water provision are well known. The semi-desert areas of short annual grassland, are suitable for wet season grazing only and will not sustain animals during the dry season, however much water is provided. When the wet-season grazing is exhausted, they move to more humid areas where grazing (perennial grasses) and water are more plentiful, either from wadi beds or drilled or dug wells. At this time of the year, it is normal for pastoralists to suspend migrations and concentrate around one point. This inevitably results in a zone of destruction ("sacrifice area") within a radius of about one kilometre. In times of acute drought, it will extend much further. Provided the area is rested during the subsequent dry season, longer if necessary, the vegetation will recover. In practice, however, it is difficult for watering points to be rotated in this way. Both pastoral groups and people who settle around the well inevitably press for the watering point to be kept open.

Social problems arise due to a failure to involve the pastoral community in the planning of the water development programme and



through choice of inappropriate technology. Because of economies of scale associated with construction, the water supply capacity of installations is often too large. This attracts large concentrations from many different groups and creates insurmountable difficulties for the operation of the supply by the community. The technology is also frequently dependent on trained mechanics and imported spare parts, beyond the capacity of local people. In consequence the operation and maintenance depends on government employees or contractors who find it difficult to discriminate between local groups and outsiders or to resist public pressure to keep the well open when it should be closed. Whereas traditional labour-intensive watering methods served to restrict herd size, motor-driven pumps encourage individuals to accumulate large herds. Thus traditional income redistribution mechanisms break down.

#### (d) Drought Reserves

Traditional pastoralists invariably have a number of drought-avoiding strategies which have been evolved to increase their chances of survival. These include: building up herds during good years for sale during bad; reciprocal arrangements for the temporary transfer of certain types of stock to kin outside the neighbourhood; prior agreement with other groups to move into their rangelands and have access to their water points; etc. From time to time, range scientists have proposed range reservations for holding animals during drought, outside the affected area. Again, such schemes are likely to involve an investment (e.g. in water supplies, fencing, staff) which would be hard to recoup. There is also the issue of opportunity cost: grazing and useful output foregone in years when the holding area is not used.

In the Kaduna area of Nigeria, ILCA have been working on the introduction of "fodder banks" which are reported to give milk yield and fertility gains comparable to those previously obtained by using expensive concentrates. Fodder banks consist of small, densely sown stands of legumes (*Stylosanthes*) grazed during the long dry season when fodder is not only scarce but of poor quality. Animals are concentrated on the land before planting to break up the soil, weaken the existing grasses and provide manure needed for good establishment and vigorous early growth. Some superphosphate is used to start the legumes. It is not yet clear how the system will fit into the sedentary and transhumant grazing systems and whose animals will benefit.

#### 3.1.2 The Improvement of Integrated Crop and Livestock Systems

In the semi-desert and dry savanna, traditional crop and livestock management systems are both complex and closely integrated and poised in delicate balance with the environment. Cropping yields a lower return to labour than herding and carries a higher risk, but when carried out in conjunction, the two modes are mutually re-inforcing.

For example, in Bay Region, Somalia, pastoralists grow a dual purpose (forage and grain) sorghum variety within a bush fallow system. Livestock are retained mainly for milk and fed on crop by-products and range plants. The feed supply from crops is more sensitive than range to the amount and distribution of rainfall. In good seasons when the crop is heavy and the water in ponds remains longer, the animals are retained close to the homestead. In dry years, they may remain in distant range areas. By cultivating cereals, the household can minimise the sale of milk and breeding stock and maximise the growth of the pastoral enterprise, an important consideration following a bad year with stock losses due to drought or disease.

Adverse factors leading to breakdown of the system:

- expropriation of land for mechanised crop production;
- autonomous growth in population leading to land scarcity;
- in-migration of cultivators from sub-humid areas.

Problems and issues: Most proposals from outside agencies, which aim to overcome the above factors, usually involve some way of arbitrating between the cultivators and the stock keepers on the basis of land use planning. Implementation invariably requires a level of planning and management which is beyond the capacity of the local administration. In an attempt to produce replicable models, arbitrary assumptions are made about crop:fallow ratios which fail to accommodate variations in land capability and the different capacities of individual households. Complex indigenous systems are difficult to model and reproduce.

### 3.1.3 Agroforestry Development

Agroforestry has been defined by Gunnar Poulsen as "an integrated land-use system which combines crop farming and/or animal husbandry with the growing of woody perennials. It aims at satisfying the basic production needs of the user of the land while ensuring sustainability through the upkeep of an ecologically well balanced structure". In other words, it aims to provide a substitute for traditional land rotation systems which are no longer possible due to changes in people:land ratios and the consequent breakdown of the bush fallow system. Agroforestry options include: alley cropping with multi-purpose (soil enriching and conserving, forage, fuel) species; enriched fallows (fast-growing legumes); live fences.

The above definition starts with the essential components of the land-use system and how they should fit together to produce the ideal crop/tree interactions. It has been criticised as being too theoretical, not enough attention being given to the real life situation of farmers, particularly the scarcity of labour and land and individual household requirements. It describes a land use system which is quite different from that actually found on farms. A less ambitious definition would be simply "the planting

of trees on farms", starting, not with the ideal, but with what farmers can do, bearing in mind their problems and constraints.

### 3.1.4 The Development of Arable Cropping

The growth of population is a major factor stimulating the intensification of land use by shortening the fallow period, but the capacity of the modified farming systems to supply the food needs of a much higher population has greatly varied. Indigenous adjustments include the mixed cropping of cereals and legumes, supplementary irrigation, manures, "in and out" field systems and changes in land tenure from uncontrolled to controlled access. These developments have enabled cropping to continue longer than previously, but not all soils, least of all low-nutrient sands, can sustain intensification of the cropping system.

Specific problems confronting rainfall-dependent arable farming in dry tropical environments are:

- \* the inherent uncertainty of tropical rainfall patterns;
- \* the bulk of rain falls as heavy showers and much may be lost due to run off; the remainder falls as light showers which add nothing to ground water storage;
- \* moisture deficits at critical stages of growth can seriously reduce grain yield;
- \* weeds at early stages of plant growth compete for scarce reserves of moisture and nutrients;
- \* only the earliest planted crops benefit from the flush of nitrogen which accompanies the first planting-rains thus accentuating the competition between food and cash crops for labour;
- \* organic matter levels are always low, except for short periods after harvesting or manure application;
- \* responses to fertilizer are highly variable, often minimal and not reliably economic;
- \* severe labour bottlenecks occur at planting and first weeding especially at the drier margins where planting may only be possible for 2 to 3 days after a suitable rain.

There are a number of management practices which can reduce the risks associated with the above problems. Many of the practices recommended by agronomists emerge from a study of indigenous responses (e.g. planting in water-receiving sites, appropriate choice of indigenous crop and variety, timing of planting in relation to moisture availability, adjusting planting population to amount of moisture available, mixed cropping).

More recently, dryland farming techniques from Australia have received attention: bare, weed-free fallows, mulching with crop residues for soil and water conservation and to reduce soil temperature, contour and tied ridging on clays. However, many of the techniques are dependent on improved tools and machinery, beyond the reach of small farmers.

### 3.2 Management of Soils

#### 3.2.1 Soil Fertility

Whatever systems may have been evolved by cultivators in the past to maintain fertility, they frequently breakdown under continuous cropping in a semi-arid climate. The exposure of the soil to intense rainstorms, tillage and harvesting remove the organic matter faster than it can be replenished by decomposing plant material. Organic matter is essential for binding soil particles into aggregates, the arrangement of which determines soil structure, allows root aeration, water infiltration and protection of soil particles and nutrients from erosion.

Loss of structure is reported to be taking place even on the vertisols (black cotton soils) of the Sudan clay plains, previously classified as "permanent cultivation" soils. At the other extreme, over much of the Sahel and in the Horn of Africa, there are weak, windblown soils derived from granite which, under a climatic regime of short rain and long dry season, may require 25 years to regain a brief fertility for two or three years of cultivation. If livestock are to provide the quantity of manure necessary to replenish the store of nutrients and organic matter removed by cropping, forage and fodder crops (including leguminous shrubs) must be grown. Agronomists have yet to discover fodder crops well-suited to the dry areas.

Of the major plant nutrients required for growth, potassium is commonly found in most soils of the dry tropics, but phosphorus is very often deficient and a major limiting factor for crop production. The quantity of nitrogen in dry tropical soils varies enormously and is highly mobile. It shows large seasonal fluctuations in availability to plants. There is usually a "flush" of nitrogen with the first rains. For many decades, African farmers have been told by agronomists what they already know, namely that early planting outyields late planting, but there is a limit to the amount of land that can be planted in the brief time they have available, especially if cash crops are competing with food crops.

#### 3.2.2 Reclamation of Degraded Land

The reclamation of stock routes, severely degraded village and town perimeters, etc. is often necessary to prevent further damage to both public and private land. Exclosure and soil conservation works (cut off drains, terracing, planting, etc.) may be necessary. Technical solutions are usually not the major

constraint, but rather the cost and availability of materials and labour. For such projects on public land, community involvement and participation are essential. This has been forthcoming for tree planting to control dune encroachment where it threatens high-value irrigated land and settlements. In these circumstances, communities have found a common purpose (e.g. along the Nile in Northern Region, Sudan). Such projects are usually dependent on strong local leadership and initiative. Rarely can they be replicated on a large scale.

### 3.3 Management of Water Resources

#### 3.3.1 Watershed Management

The principles are well known. Mountains, hill ranges, escarpments of plateaux serve to force up approaching airstreams to cooler altitudes at which their water vapour condenses as rain. These features of the landscape are commonly source areas for stream flow. To ensure that streams discharge as long into the dry season as possible; that lowlands are not flooded by torrents from bare mountains; that hydraulic structures are not filled by deposits of soil and gravel washed down from the hills, it is necessary to protect watercatchment soils from tree clearing, grazing and cultivation. This problem occurs on a vast scale in the catchment of the Ganges in the Himalayas, with disastrous consequence for those downstream in Bangladesh. The dilemma is repeated on a lesser scale throughout east Africa and Ethiopia.

It is difficult to explain to subsistence farmers who see reservation as a denial of their traditional rights to grazing and cultivation. Their marginal economic situation does not incline them to show interest in the fate of others living downstream; they do not know or care about the importance of regulated flows of clean water. Planning, implementation and follow-up needs a strong technical capability, political commitment and popular support. The last-mentioned will often require the payment of compensation to those upstream.

#### 3.3.2 Irrigation

Irrigation allows both crop nutrient and moisture to be provided in a controlled and measured way, enabling cropping to continue on the same land for many years without reduction in yield or soil fertility. With the growing sophistication of water supply technology (drip, overhead sprinklers, etc.) and the adoption of new crops and production techniques, increasing numbers of people can be supported from limited areas of land. In theory, a well designed and maintained system can offer sustainable rural livelihoods and the greatest opportunities for producing food. In practice, however, there has often been a large gap between predicted and realized returns, particularly in Africa.

The very recent history of irrigation in tropical Africa contrasts with over three thousand years of experience in Asia where some 25 per cent (55 million ha) is fully or partly irrigated. According to one estimate, it could reach 50 per cent of the area in the long term. On the other hand, only very limited areas of tropical Africa are irrigated. Of an estimated potential of 60 million ha, only 8 million ha have been developed so far, 1.5 m ha in Sudan.

In the 60s and 70s irrigation development dominated the planning perspective of national governments and aid agencies, both in South Asia and East Africa. Official investment was channelled into ambitious and expensive projects. Development costs per hectare averaged US\$20,000 (current prices) and escalated out of all proportion to the returns possible from irrigated crop production. The indirect costs have also been high as a result of:

- \* the exclusion of nomads from dry-season grazing;
- \* the need to resettle farmers from reservoir areas upstream;
- \* the clearing of valuable riverine forest;
- \* the diversion of water from users downstream;
- \* and the neglect of the rainfed areas.

Problems with irrigation schemes arise from::

- \* inadequate feasibility surveys of physical resources (soils, topography, hydrology);
- \* over-optimism about the rate of development, crop yields and intensities, cropped area, prices and economic rate of return;
- \* delays in construction (design problems, shortages of equipment and materials, local opposition);
- \* shortages of trained staff and excessive dependence on expatriates for design and implementation;
- \* inadequate attention to downstream (farm level) works, inequitable distribution and low system efficiency, inadequate drainage leading to waterlogging and salinity;
- \* resistance by farmers to central authority and control;
- \* the false assumption that farmers will be able to move rapidly from extensive rainfed farming to intensive irrigated farming often with unfamiliar crops, inputs and machinery;
- \* lack of resources for operation and maintenance.

### 3.3.3 Water Harvesting

This technique is traditionally used by a number of farming groups in Sub-Saharan Africa including the Turkana in Kenya where the annual rainfall averages about 200 mm. The pastoralists plant sorghum on small water-receiving sites, often surrounded by a heavy thorn barrier which helps to trap surface flows and increase infiltration. The planting is speculative and involves little labour, which is principally used for tending animals. Since the 1960s, both government authorities and missionaries have attempted to improve local water-harvesting techniques with methods developed in the Negev Desert. Labour is provided by destitute pastoralists paid in food grain. Two basic structures have been tried: level basins and semi-circular bunds on slopes not exceeding 3 per cent.

Many of the problems encountered relate to the system of food-for-work and the uncertain ownership of the site and any crop it might carry. Others relate to problems of design and location; many were swept away within the first season. Simpler techniques, involving the ranging of stones along the contour, have been promoted by Oxfam in Burkina Faso.

In both cases, the role of the donor has been to build on local knowledge, to train personnel and help to develop the technique with experiences gained elsewhere. The contribution lies in technical advice and training and, in the case of Turkana, food logistics. Like soil conservation work and tree planting, water-harvesting is a common component of FFW programmes aimed at rehabilitating people and land impoverished by drought and over-use. They can be justified in the long term if they help the population towards regaining their independence from food relief. However, unless the pastoralists begin to copy and build the structures themselves spontaneously, as has happened with farmers and the permeable rock bunds in Burkina Faso, rainwater harvesting cannot be counted a success or a useful innovation.

## 3.4 Occurrence and Management of Diseases and Pests

### 3.4.1 Crop Pests and Diseases

The semi-arid areas of India and Africa suffer from migratory pests (e.g. desert locust, African army worm, quelea bird) capable of devastating crops over a wide area. The desert locust has been the subject of international research and control measures for several decades. Similar advances have recently been made with the control of African army worm which causes losses of pasture and cereal crops. The control of migratory pests consists of prediction and monitoring of outbreaks so that prompt control measures can be aimed at breeding areas and used only when necessary. In these circumstances, the spraying of toxic chemicals (organochlorines) is tolerated in view of the historical association between locust swarms and famines.

Few crops escape from the diverse range of pests and diseases normally present in fields and grain stores. Attacks can be severe seasonally with a virulence that can result in almost complete crop loss. Of great importance are downy mildew of millet, the ergot and smuts of millet and sorghum, the stemborers of sorghum and maize, the viruses and blights of legumes, the rosette disease of groundnuts and the bacterial blight and wilt of cotton. Together they may result in 25 to 75 per cent losses depending on location and season. Losses do not end at harvest. Their incidence depends on the storage techniques employed by farmers. Weeds competing for water, light and nutrients reduce yields and some parasitic weeds (e.g. Striga) cause stunting of host plants with severe loss of grain.

However, farmers are not totally defenceless as they have evolved a number of techniques to reduce crop losses, especially in storage. Furthermore, indigenous varieties of crop plants have a broad genetic base and therefore a wide spectrum of resistance to endemic pests and diseases.

The initial enthusiasm with which the first modern insecticides (the chlorinated hydrocarbons) were greeted in the 1940s and 50s has long since begun to wane, due to the resistance developed by so many pests and the dangers of poisoning the whole environment. The aim is now to control pests by cultural and biological means. The most promising aspect of cultural control is the development of resistant varieties of crops, but there is a long way to go before these will become available to subsistence farmers in remote areas.

For the foreseeable future, it would be unrealistic to assume that chemicals, environmentally acceptable or not, will provide solutions to crop protection problems of subsistence farmers; they are unlikely to have the money to buy them. In any case the infrastructure does not exist to distribute them or to instruct farmers in their use. In these circumstances, the work of plant breeders will be crucial.

### 3.4.2 Livestock Pests and Diseases

Disease and parasite constraints on the productivity of livestock are worst in Africa. Not only is a large area of the continent infested with tsetse flies, but there are a larger number of tick borne diseases than elsewhere, including East Coast Fever which only occurs in Africa.

On the drier margins of the savanna, the incidence of pests and diseases is lessened (a) by the acquired resistance of stock to enzootics (e.g. foot and mouth disease, ECF) and epizootics (rinderpest and contagious bovine pleuro pneumonia), (b) by the traditional herding systems which help to reduce the spread of infection, and (c) by the dry conditions which are unfavourable for some important disease vectors. Camels, which occupy the desert fringe, are noted for being relatively free of diseases.



goats are more hardy than sheep whilst cattle are the most prone.

Within the drier margins, disease outbreaks tend to occur when the herds and flocks are already under stress through lack of food and when crowding around the remaining waterpoints. Although nomads are better able to escape when disease threatens than sedentary stockkeepers, they are more vulnerable when disease does strike. Outbreaks can result in the complete decimation of their herds and in starvation among the people who depend upon them, as happened in Africa during the rinderpest outbreaks in the late 19th and early 20th Centuries. A more recent example of the impact of disease was the outbreak of contagious caprine pleuro pneumonia among the Turkana small stock in 1980 which hastened the movement of the nomads into relief camps. Equally exposed to the ravages of disease are the cultivators who depend on draught animals. The great Ethiopian famine of 1888-92 is believed to have been triggered by an outbreak of rinderpest carried by animals imported from India by Italian merchants.

In view of the threat of epizootics, in particular, government authorities have long favoured the vaccination of cattle against rinderpest. Despite the JP 15 campaign of the 1970s, the disease appears to be on the increase and outbreaks have been recorded in the 1980s in the Sudan, Ethiopia and Somalia. Some would argue that epizootics are nature's way of coping with overstocking; similarly, that the tsetse fly serves to preserve range for wildlife. However, this is not an argument which finds favour amongst stockkeepers or their governments. Somalia which has few alternatives to stockkeeping is currently mounting a campaign of aerial spraying against tsetse in the southern part of the country. A major incentive for the governments to control diseases are the import controls on diseased stock imposed by the rich countries, e.g. Saudi Arabia, the Gulf states and the EEC countries. Veterinary services are further discussed in Section 4.2.4.

It is worth noting that, both in relation to crop and animal diseases, no data are available for economic losses because the information on which such assessments can be made is not being adequately collected. This makes it difficult to plan and evaluate preventive measures.

### 3.5 Production and Use of Energy

#### 3.5.1 Biomass Energy

There are many variables affecting the supply of and demand for biomass energy (firewood, charcoal, dung, crop by-products) and hence the cost and per capita consumption. Important factors include the following:

- \* per capita income and use of "modern" fuels;
- \* density of settlement (urban or rural);

- \* climatic conditions (e.g. need for space heating in the highlands; growth and replenishment rate of vegetation);
- \* duration and history of settlement and the degree to which the natural vegetation has been cleared;
- \* standing reserves on common land (much less important in South Asia than Africa);
- \* thermal efficiency of cooking/heating technology;
- \* dietary/cooking patterns.

The removal of biomass from the ecosystem for combustion depletes the soil of nutrients and its capacity to store water (for plants and to prevent leaching) and to replenish the crop/vegetation cover, thus exposing the soil to erosion by the physical elements.

The first step is the removal of timber, either for firewood or conversion into charcoal. In Africa, fuelwood and charcoal is a by-product of the clearing of communal land for cultivation. The clearing of forest solely for charcoal by urban contractors, however, is an accelerating problem wherever feeder roads provide access to the savanna woodland. In South Asia, firewood and charcoal are produced mostly from private or from Forest Department land, in India.

The next phase down the energy ladder is the use of agricultural residues (dung and crop by-products). The environmental consequences will vary according to the chemical and physical properties of the soils, the climatic conditions and the type of biomass removed. In hot dry climates, the breakdown and incorporation of organic matter (e.g. millet straw, dung) in the soil has to await the rainy season. In the meantime, residues can be carried away by the wind or washed away with the first storm. Thus, the use of residues for fuel may not necessarily be at the cost of the next harvest, especially if these harbour crop pests, and if the ashes, rich in potash and phosphate, are returned to the soil. The main threat to the soil is in situations where residues which were previously recycled are being used as fuel instead and where the dangers of soil erosion are great due to steep slopes and high rainfall intensity (e.g. in the Ethiopian Highlands and the hills of northern India and Pakistan).

As the costs of fuel sources increase, people are obliged to adapt their heating/cooking techniques to increase the efficiency of fuel use. The economies achieved can be quite surprising; efficiency can be increased by a factor of four or five.

The successful planning of external interventions to increase the supply of fuel, either directly:

- \* agroforestry,
- \* village woodlots,
- \* improved management of natural forest for sustained yield.

or indirectly:

- \* fuel-saving education.
- \* fuel-saving stoves.
- \* biogas digesters

requires a detailed understanding of the domestic fuel economy and its linkages with subsistence production, gender variation in rights of access to land, agricultural residues and forest and other socio-economic factors, such as the division of labour within the household. A good technical understanding of the potential impact of new technology on nutrient cycles and organic matter levels in the farming system is also needed. Awareness of this necessity has invariably been inadequate and usually gained by donors only after the event.

To the multivariate nature of the biomass problem must be added one further difficulty, namely that of "simultaneity of end use". For example, the traditional three-stone fireplace can be managed to simmer or boil a pot of water, provide space heating, keep down insects, dry grain in the rafters, provide a social focus and light. Against the benefits from an "improved" energy-saving, smokeless stove, must be measured the costs of cooking in the dark in a cloud of mosquitoes. Similarly, trees provide poles for house construction, fodder, fruit, shade as well as off-cuts of brushwood for firewood, once these other needs are satisfied. A planting programme aimed solely at the supply of firewood is unlikely to receive popular support.

Villagers' low awareness of the firewood problem contrasts with that of townspeople. Many would argue that the firewood crisis relates to the area which is accessible to towns and that the best way to resolve the deforestation problem would be to concentrate on finding alternative energy sources for urban dwellers

### 3.5.2 Mechanical Energy

#### (a) Animal Draught

In South Asia, the use of bullocks and draught power is an essential part of the farming system, but in the Sahel, despite a long tradition of using oxen, camels and donkeys for riding and for pack, people have been slow to harness their animals for tillage. Cultivation is done manually with a hoe. Numerous attempts to introduce animal draught to overcome the labour bottleneck at weeding time have met with limited success. This reluctance no doubt relates to the difficulty of maintaining working animals over the long dry season and getting them into good condition at the beginning of the rains when forage has been scarce for several months. In this respect, camels are less vulnerable than cattle.

In the dry highlands of northern Ethiopia, draught oxen are essential for preparation of the heavy soils of the plateaux and peasants without their own pair are obliged to borrow against their crop. Lack of draught animals is the most persistent problem affecting a vast number of farmers. During drought, when both grain and forage are exhausted, oxen may have to be sold in order to purchase grain. Restocking of work oxen is an essential component of any drought-recovery programme.

Many unsuccessful attempts have been made by researchers to improve the efficiency of the traditional two-ox wooden plough, the centuries old maresha, a simple tine instrument constructed of wood. An attempt to develop an alternative one-ox traction system has recently been abandoned by ILCA. It was accepted that, if single-ox traction had advantages over a pair, it would have emerged as the preferred system over the 3000 years that animals had been used for tillage in the highlands.

#### (b) Mechanization

Farmers have been quick to change from manual to animal power or from animals to engines when they have seen a clear advantage in doing so. An example is provided by the rapid substitution of diesel-powered pumps for the ox-powered saquias on the irrigation schemes of northern Sudan in the late 1960s. Mechanical pumps for drinking water supplies have proved much less successful where the responsibility for maintenance has remained with government.

In the dry savanna where the timing of cultivation to suit soil moisture conditions is crucial, governments and donors have been strongly drawn to the idea of large-scale mechanized schemes for oilseed and cereal production. The ill-fated British groundnut schemes of central Tanganyika were an early example and there have been many since. In few instances has it proved possible to establish an economically viable and sustainable farming system.

One possible exception are the mechanized crop production schemes on the clay plains of east-central Sudan, which extend into the more humid savanna. These soils have proved exceptionally durable, both under irrigation and rainfed agriculture, despite the worst fears of the environmentalists. Nonetheless, mechanized farming has become a favourite target for critics of Sudanese agriculture.

#### 3.5.3 Renewable Sources of Energy other than Biomass

Of the renewable sources, hydropower for electric turbines is by far the most important in north and east Africa. However, electric power lines usually by-pass rural communities on their way to the urban centres.

Although solar power for limited demand (about 1/2 kilowatt) provides energy to remote places more cheaply than building power lines, its application is limited by technical complexity. Solar

power is confined to powering batteries for radio telephones, refrigerators, etc. issued to a few institutional users (hospitals, veterinary clinics, etc). Despite early optimism, solar powered pumps have yet to obtain widespread acceptance due to cost and complexity.

Wind pumps must be adequately maintained for long service and reliable performance. They are frequently used by institutions for water supply and irrigation, but they are too expensive for the small farmer and tend to suffer from the usual problems of mechanical equipment dependent on imported materials and components.

#### 4. Legislative Framework and Administrative and Financial Support

##### 4.1 Constraints Related to Land Rights

The customs and laws regulating rights of access for hunting and gathering, grazing and cultivation greatly influence the method and intensity of land use. Any environmental strategy has to be worked out within the framework provided by these customs and laws. Ideally, they should foster the prudent use of land resources.

There are great differences between the semi-arid areas of South Asia and those in Africa where access to much of the land is relatively uncontrolled and where there is a strong tradition of moving on once the fertility of the land is exhausted. Whilst this option remains open, land registration is unlikely to be accepted. Where registration has occurred, it has invariably resulted in landlessness for some and has frequently ignored women's rights.

##### 4.1.1 Grazing Rights on the Plains

The semi-desert and dry savanna of the Sahel, Sudan, Kenya and the Horn of Africa, occupy frontier zones. They lie beyond effective national territory and are far removed from the centres of national government and law enforcement. Pastoralists move across national frontiers, mostly unhindered. The situation today is undoubtedly more chaotic than it was in the colonial period, when administrations took tribal boundaries as given and left lineage and clan groups to police them and maintain them. Boundaries encompassed the grazing and dry-season water resources of the group, though reciprocal rights to access between neighbouring groups were a standard part of risk-spreading strategies.

In the post-Colonial period, this system has fallen apart as a result of a deliberate policy to break "tribalism" and the power of tribal leaders, pressure on resources created by the expansion of cultivation in the grazing areas and the scarcity of grazings

and water during the droughts of the '70s and '80s.

#### 4.1.2 Cultivation Rights on the Plains

In semi-arid Africa, just as the grazing regulations have broken down so has the administration of cultivation rights. In Sudan, for example: until 1971, usufructuary rights to land away from the Nile and the towns were recognised and administered by sheikhs and omdas (the native administration). In that year, following a leftist coup, all unregistered land was declared government property. Its administration was placed in the hands of town-based rural councils mostly made up of government officials with little knowledge of the rural areas. There were no effective means of resolving land disputes and there was a free-for-all in which the rich and powerful triumphed. In 1983, an Islamic law readmitted usufructuary rights. However, since the fall of the Nimeiry government, it is not clear if the 1983 law has been repealed nor who is responsible for land administration.

#### 4.1.3 Agrarian Reform in the Ethiopian Highlands

In total contrast is the land tenure situation in those parts of the Ethiopian highlands controlled by Addis Ababa, the seat of a highly centralised, revolutionary socialist government. Prior to the 1974 Ethiopian Revolution, the most frequently cited problems contributing to Ethiopia's agricultural underdevelopment were structural in nature. In the south, these mainly included the feudal land tenure system characterized by the absentee landlord and insecurity of tenure. After 1974, agrarian reform distributed the land to the tillers. Peasant associations were established and recognized as the focal point of development and local organization. This led to the expectation that the development potential of the peasants would be unleashed.

However, in the absence of capital, farm inputs and other supporting services, the first effect of the agrarian reform was to reduce the amount of grain going into the towns; the abolition of landlords dramatically reduced rural-urban trade. Therefore, in 1978-79 further directives were given for the establishment of service and producer cooperatives, for channelling inputs and outputs and for collectivising small farms. The rationale for this was that little could be achieved by the half-starved and impoverished peasant working on one hectare.

These changes had a number of effects. They re-introduced insecurity of tenure for the peasant who could be swept up into a collective at any moment. It led government and party officials to believe that family farms could be transformed into large-scale mechanized collectives and it frightened off western donors who believe that small farmers with access to inputs and fair prices have higher levels of productivity per unit area than large collective farms. Thus the agrarian reform which promised so much has run into the sand.

## 4.2 Constraints Arising from Lack of Supporting Services

Semi-arid areas are characteristically remote from the capital and from where most educated people wish to be. Government services are notoriously poorly staffed and underfinanced. Officials are invariably marooned in their offices without transport and fuel. When they do venture out, they are confronted with a host of insoluble problems by poorly paid junior staff who are expected to operate without even the most basic facilities and equipment. Nevertheless, multilateral and bilateral donors have been known to pour in resources for soil conservation (e.g. hand tools and polythene tubes, mobile cinemas) or for veterinary services (e.g. mobile clinics) when there are no local staff trained to handle them and no recurrent budget to cover operating costs.

A prerequisite for most bilateral and multilateral programmes is a government bureaucracy with the necessary staff and financial and administrative procedures. Even if an NGO, with its own staff and budget, is charged with the implementation of a specific programme (on behalf of a bilateral donor), it may have little long-term impact unless it works closely with the government agency to which it must eventually hand-over.

### 4.2.1 Agricultural Research

Research scientists have been more successful in demonstrating technical innovations in the humid tropics and in irrigated areas where large increases in yields have been achieved with a limited number of crops grown under a specific set of favourable conditions, i.e. adequate moisture, nutrients and protection. Apart from experiments being more manageable under these conditions, this is where research has concentrated. National agricultural research organizations are usually highly centralized.

Setting aside all the methodological issues (e.g. farming systems research, on-farm trials, research extension linkages, etc.) and focussing on priorities specific to semi-arid environments and sustainable yield, important needs are:

- \* to devise, test and demonstrate new approaches to soil, water, crop and vegetation conservation which are integrated at farm level;
- \* to increase the reliability of yield as well as the yield per unit area of crop varieties with the minimum of imported inputs;
- \* to increase the range of crops available to farmers, especially multi-purpose agroforestry species, which are the subject of considerable knowledge and optimism but difficult to incorporate in farming systems in the dry zone;

Of the above, a debatable area has been the effort expended on the breeding of improved varieties. In the case of sorghum, for example, it has proved extremely difficult to breed varieties with yield stability comparable to local material. It is far easier to select from the available cultivars and to minimise losses from pests and diseases by breeding for resistance. Even then, a 20 per cent increase in sorghum yield in the dry zone amounts to very little compared with an equivalent rate of increase in humid zones, the most fruitful area for crop improvement. Much greater yield increments can be obtained in zones of higher rainfall where inputs are less likely to be wasted as a result of drought.

#### 4.2.2 Extension

The problems normally encountered with extension programmes are multiplied in remote semi-arid areas: inappropriate and inadequate technical content, lack of practical skill, lack of a single direct line of technical support and administrative control for field-level staff. Parallel supporting services (e.g. input supply, marketing, credit, research) are often very weak or absent and very little can be achieved by the lone extension worker who may be given various non-agricultural tasks as well. Very little time is left for working with farmers.

In the late 1970s and early 80s, the standard response to these problems was the introduction of the Training and Visit system which involves the adoption of a number of management reforms and greatly improved on-the-job training for staff. This gave encouraging results with the diffusion of the Green Revolution technology in south and south-east Asia. But the T&V system which emphasises the package deal approach and the mechanical organization of a large number of village-level staff, who are told what to do every day, has proved suitable only for homogeneous conditions and a narrow range of crops. Extension work in more marginal environments usually needs a more flexible approach, with concern for the needs of crops and livestock as well as for the needs of people growing them.

#### 4.2.3 Input Supply and Credit

The physical inputs required by the mass of poor subsistence farmers in semi-arid areas are limited to hand tools and seed, plus oxen and wooden ploughs in the highlands. For these items the household must be self sufficient or obtain them from the local market. While chemical fertilizers will increase yields in good rainfall years, the risks of failure are often too high for the small farmer. Thus, in the absence of the other supporting services (research, extension, marketing, etc.), the general absence of commercial input suppliers and credit for farmers in semi-arid areas cannot be considered a major constraint. Put another way, the branch offices of parastatal agricultural banks will remain unused by the mass of producers until progress is made on other fronts.



Following the droughts of the 70s and 80s, donors have become aware of the need for seed banks containing strategic reserves of locally adapted seed for distribution to farmers after a drought. The absence of suitable seed on these occasions may have added to farmers' problems. Much of the seed distributed by NGOs in Ethiopia following the 1984 emergency was seed of unknown genetic quality from state farms. In some cases, farmers used seed taken from consignments of relief grain from North America and Europe (i.e. winter wheat) which failed to flower. Similar difficulties occurred in Turkana in 1984 when maize was distributed in the absence of sorghum.

#### 4.2.4 Veterinary Services

The range of services provided varies greatly, depending on the resources of staff (veterinarians) and finance. In the semi-arid areas of India (e.g. Rajasthan and Andhra Pradesh) where veterinarians are plentiful, the government provides curative and preventive treatment and artificial insemination services from stationary veterinary hospitals and dispensaries at the rate of one facility to 180-1600 square kilometres and 6000 to 30 000 bovines. In Sahelian Africa (e.g. Niger and Chad), a far less comprehensive service is provided by one facility to 13 000 to 17 000 square kilometres and over 100 000 bovines.

Ecologists have criticised government veterinary services because they are not coordinated with measures to increase off-take and sales. Vets respond that disease cannot be accepted as a means of controlling stocking rates, a point of view no doubt shared by the pastoralists. The ecologists' criticism is not based on systematic evaluation of the impact of preventive vaccination programmes on livestock mortality. The few studies which have been conducted conclude that the increase in domestic herbivore numbers over the last fifty years in semi-arid areas of Africa is due to factors unrelated to curative and preventive treatment by vets.

Veterinarians argue that the willingness of pastoralists to participate in mass vaccination programmes is evidence of the efficacy of the services offered. However, pastoralists are not as cooperative as is often claimed. In Africa, at least, owners continue to be reluctant, partly due to mishaps and partly to the vaccines which are rendered ineffective by mishandling.

Difficulties are caused by the remoteness of the areas in which vets are expected to operate. However, nomadic populations usually concentrate at certain times of the year or pass along known migration routes where they can be intercepted by mobile teams. Mass preventive programmes (vaccination, dipping) have to be free and there is the inevitable shortage of funds. Most of the budget is absorbed by salaries and allowances. If there is money left over, it is usually spent on fuel and transport. As a result, vaccines and drugs are not provided, refrigerators have

no fuel or are not repaired. When the cold chain is broken, the vaccine is rendered useless.

Government financial procedures are not set up to handle the purchase and sale of drugs. Revolving funds provided by donors are invariably mismanaged and diverted to cover other operating expenses. The time of government-employed veterinarians is frequently swallowed up by bureaucratic tasks, yet they are usually reluctant to devolve responsibility for drugs to the private sector or to train pastoralists to handle routine vaccinations. Because of the non-pastoral, urban background of government staff, there is usually a profound lack of trust between them and the pastoralists they are meant to serve. There is a general tendency among vets to maintain their own monopoly.

Despite the above problems, veterinary services have been a common component of many rural development programmes and have largely gone unquestioned. The reasons for this are not entirely clear, but are probably linked to the strong camaraderie between vets in donor and recipient countries and the international drug firms. Investment in veterinary services, like any other activity, requires careful planning and follow up. Above all it should be accompanied by appropriate investigation and recording of the incidence of disease, and an economic as well as technical evaluation of the measures to control it.

#### 4.3 Constraints Arising from Inadequate Environmental Education

Aid agencies, and to a lesser extent host governments, are beginning to recognize the importance of environmental education as a vital component of programmes aimed at rehabilitating an economy following a drought-related emergency. But, rather like social surveys in feasibility studies, they can be extraneous to the planning process, rather than used as a tool in programme design.

##### 4.3.1 Formal Education

"Normal professional thinking about environment and development starts with things and treats people as a residual, with poor people coming last of all." (Robert Chambers, see bibliography)

Thus a caricature of the "normal" way for aid agencies and governments to tackle environmental education would be as follows:

- \* starting with perceived solutions (soil conservation, reforestation, energy saving stoves, etc) and proceeding to inform rural people about what they need and the benefits to be obtained;

- \* conceiving and formulating programmes in the HQs of aid agencies, agreeing them with the directors of the government departments in the host countries;

\* delivering the message through the formal education system (schools and colleges), adult education centres, farmers' training centres, etc. and the mass media;

\* clientele: teachers, students, extension agents, leaders of "mass organizations"; mostly urban, mostly male;

\* teaching methods: formal, prescriptive, classroom-bound, non-participatory;

\* motivating with overseas visits and scholarships for the local professionals and the normal shopping list: buses and field vehicles, audio visual equipment ("video mania"), radio sets, studios; cash for per diems, publications and other loosely specified budgetary support.

This is a somewhat one-sided description of an environmental education programme currently being implemented in Ethiopia. The limitations of the approach are, to some extent, recognised by the donor, but attempts to infiltrate the system, extend/change the national curriculum, develop and adapt teaching methods inevitably run into a number of problems. The teaching methods used in Ethiopia are monotonous, prescriptive and strictly traditional and seemingly devoid of initiative and creative thinking. Before it is possible to reach the rural people, it is necessary to change the approach of teachers. Even the formal education system will probably by-pass the poorest and the weakest since their children, especially girls, do not go to school. Any bilateral or multilateral agency choosing this route, aiming to "put the people first", must face up to this problem. NGOs may have more flexibility, but less access to policy makers and less opportunity to influence the system.

#### 4.3.2 Non-formal Education

An example of another approach which starts with a "problem census" could be drawn from any one of dozens of NGO programmes. The techniques, originally developed by educational psychologists, are particularly useful in marginal environments when it is necessary to explore differences in viewpoints between the rural people and development workers drawn from outside the region. A problem census can be adapted to solve particular problems and to suit local culture, ecology and the occupation of participants.

In the context of a marginal environment, the aim would be to help people to draw on their own experience and culture, and to demonstrate that by their own efforts, they can do much to reduce the risks and uncertainties of life. The techniques require dialogue (not monologue) between local groups and development agents, under trees rather than in classrooms. The outcome of a problem census should be a plan of action within which problems have been redefined in terms which permit solutions (i.e. what

the people can do; what the external agency can do). The technique can be repeated at various stages to strengthen the commitment of the people and the change agent and to modify the plan as required.

Clearly, both formal and non-formal methods are applicable, depending on the circumstances and it is not a case of adopting one or the other. Governments have very few educational psychologists capable of developing the informal approach, whereas they have large numbers of formal education sector teachers. Environmental studies within the formal education system do require a more creative approach if they are not to become too stultified and if they are to harness the knowledge and wisdom of local people.

## 5. Infrastructure

### 5.1 Roads

In semi-arid north-east Africa, there is strong evidence that the areas with poor access are also the most deprived and degraded. The absence of roads is both a cause and an effect of economic underdevelopment.

It could be expected that the construction of all-weather roads would increase the radius of exploitation by the metropolis in search of firewood, charcoal supplies and cash crops. While this may be the case in the savanna, it does not apply in the northern highlands of Ethiopia from where surpluses have been moved along deeply eroded trails by mule for several thousand years. Since 1980, major strides have been made within Welo with hillside closure and soil conservation, but only along the main road to Asmara. Roads provide access, not only for food supplies in an emergency, but also for development workers, tree seedlings and other inputs. While this would be possible by mule, by the nature of things it does not happen.

What applies to roads also applies to transport: trucks, field vehicles and the means to operate and maintain them (mechanical workshops, spare parts, mechanics, fuel and so on).

### 5.2 Marketing

In Sahelian Africa and along the diffuse boundary between the semi-desert and the savanna, important towns have grown up on the traditionally flourishing trade between the "desert and the sown". In centres like Tombouctou, Abeche, Nyala and El Obeid, trade has a marked seasonality, peaking in October when the outcome of the rains is known. The transhumants sell animals surplus to breeding requirements and purchase grain for the household. In turn, cultivators empty their grain stores from the previous harvest and invest in some capital "on the hoof". The main factor determining the pattern of sales is the effect of the

weather on the amount of surplus produced.

### 5.2.1 Livestock Marketing

Additional to this thriving local trade, middlemen purchase stock for trekking out of the area. Trade stock (mostly 3-4 year old male cattle) are passed through a complex network of traders, agents and merchants to the great urban centres (e.g. Khartoum, Ibadan). Depending on prevailing quarantine regulations, stock from Sudan, Ethiopia and Somalia are shipped across the Red Sea to Saudi Arabia. A similar pattern occurs in Kenya. This trade in livestock is well established and, between Sudan and Egypt, goes back 200 years.

Various attempts by governments to intervene in the trade, with the purpose of destocking, increasing market efficiency and earning export revenue, have achieved very little. Government initiatives include the purchase of special railway rolling stock, large-scale fattening schemes and canning factories. These schemes have been defeated by the resistance of the traditional traders and by the failure of parastatals to procure sufficient animals. Contrary to popular belief, there has proved to be no large reservoir of untapped animals awaiting a market.

The normal pattern of livestock trade can be seriously disrupted in times of drought when pastoralists are obliged to unload large numbers of stock. On these occasions prices fall dramatically. In countries with diverse ecologies or a substantial irrigation sector, many animals are moved out of the drought zone for purchase by households with other sources of income. Following the drought of 1984-85 in Ethiopia and Sudan, NGOs helped a relatively small number of pastoralists to rebuild their herds and flocks by helping with the repurchase of animals. Restocking does not as such contribute to overstocking since the animals are already present. The aim is to obtain their redistribution into smaller herds to support the people who formerly owned and managed them.

Governments and aid agencies have attempted to formulate larger-scale projects for the purpose of emergency destocking and accelerated restocking. It is unlikely, however, that any government organization would have the flexibility to respond when a drought struck or the capacity to hold the animals until recovery of the range and then resell them. Restocking is probably best managed by the traditional system with NGOs oiling the wheels where possible.

### 5.2.2 Crop Marketing

Subject to sufficient land and labour being available subsistence farmers tend to cultivate an area large enough to ensure the food supply in a season of poor yields. Otherwise the community would be frequently exposed to hunger, especially in regions of uncertain and fluctuating rainfall. Thus in normal years, there

is a surplus, which is sold to local consumers or to traders from the towns and/or state marketing boards. The size of the surplus fluctuates much more than that from commercial farms. Marketing infrastructure has to be able to cope with these very wide variations. Even in the last two decades, there have been years in which farmers have produced relatively large surpluses. Usually, however, they have been close to, or below, the margin and increasingly dependent on relief supplies.

Thus in semi-arid areas, the marketing infrastructure takes the form of strategically placed grain stores and trucking fleets, partly or wholly in the hands of government or parastatals responsible for both the collection and distribution of grain. However, the system can become immensely complicated with three different agencies responsible for collecting surpluses, distributing relief and distributing inputs for food-for-work, each with its own system of transport and storage. Such is the situation in Ethiopia.

## 6. Ecological, Demographic and Socio-Economic Trends to the Year 2010\*

### 6.1 Ecological Trends

Factors influencing these three trends over the next 20 years include rates of natural population growth, migration within and between countries, rates of death from famine and AIDS, climatic patterns and institutional changes such as from land tenure reform. The factors responsible for climatic events, such as the droughts of the past 20 years, have still to be properly understood. However, it is increasingly accepted that there has been a significant shift towards lower annual rainfall in many parts of dry Africa, and future planning should take this as its starting point.

### 6.2 Demographic Trends

Annual population growth in sub-Saharan Africa is projected to continue at rates close to 3 per cent in the next 20 years, showing only a slight slackening from a little over 3 per cent over the last 20 years. Tanzania and Kenya are expected to exhibit even higher rates, ranging from 3.7 per cent to over 4 per cent per annum, respectively. Taking expected rates of growth over the next 20 years would bring the following national population totals for selected countries:

Table 6.1 Estimated Population Growth to the Year 2010 ('000)

	1987	2010
Ethiopia	45997	87200
Kenya	22397	56561
Somalia	4862	9176
Sudan	22828	42604
Tanzania	24186	55903
India	786300	948123
Sri Lanka	16725	19291

(Source: IIED and World Resources Institute, 1987)

Populations in Sub-Saharan Africa are expected nearly to double, or more, over this period while growth in South Asia is unlikely to exceed 20-25 per cent. Within this increase in Africa there are important movements of population between areas to consider. Urban growth rates averaging between 5 and 8 per cent per annum are typically 2-3 times those of the rural sector. Population growth in arid and semi-arid areas will be lower than this rural average where, as frequently happens, these areas provide a high proportion of urban migrants. However, as population densities continue to increase in other parts of the country, people are likely to spill into the more marginal arid zones. There are thus important consequences for resource management and pressure on land in arid areas that stem from how far industry and agriculture in other parts of the country can absorb both their own population increase and migrants from arid lands.

Continued urban growth will have adverse consequences for the marginal drylands where this growth further pressures governments into placing high priority on the needs of urban dwellers as opposed to those in more distant, poorer environments. The political and economic weight of urban consumers will remain an important factor in the competition for resources in all areas.

#### 6.2.1. Factors Increasing Death Rates

Famine-induced deaths have, in some regions, been high enough to offset significantly a natural population growth rate of 3.0 per cent per annum, or more. Such high rates of death may strike other famine-prone regions where aggravating conditions of civil unrest and transport difficulties severely impede the large-scale transport of relief grain. Likely rates of death from AIDS are highly speculative at the moment. Currently, arid and semi-arid areas seem less severely at risk than more humid parts of east Africa, such as southern Uganda, but given the high levels of internal migration for men and women within these countries, the infection is likely to spread to all areas.

### 6.2.2 Factors Reducing Birth Rates

Rates of contraceptive use remain very low in sub-Saharan Africa, though there are encouraging signs of change, in Kenya for example. Here the number of married women currently using contraception more than doubled from 7 per cent to 17 per cent over the period 1977-84, with the largest increase in the 25-29 age group. However, rates of use in dryland areas are likely to be much lower than national averages, due to poor access to information and facilities.

### 6.3 Factors Affecting Resource Management

There is currently, in a number of countries, a move away from state control over land towards allocation of greater control to local communities and to private land-holders. This is based on the assumption that appropriation and control of resources by communities or individuals allow for longer-term considerations to predominate over immediate need. Such a shift in tenure policy should have beneficial consequences for resource use and management in arid and semi-arid lands in those circumstances where there is equitable distribution of access to resources to local communities and where governments fully support the rights of often politically marginal communities.





## PART II: LESSONS OF SUCCESS AND FAILURE

### 1. Introduction

Concern for the environment - like that for the advancement of women - should not be the subject of separate consideration, but should be an integral part of the development planning process throughout (Danida, 1987). This policy is based on an appreciation of the close relation between development and environmental issues.

The Brundtland Report describes the nature of this relationship. It emphasises that the removal of vegetation, the degradation of soils, etc., arise from the lack of development which has an *immediate impact on future economic prospects* of the population. Like so many problems of underdevelopment, it is cyclical. Rising poverty both causes and results from environmental problems; it increases the pressure on natural resources as more people are forced to rely directly upon them. Thus, environmental degradation will not be halted by miscellaneous "environmental" projects involving, for example, tree planting, fixing dunes, terracing of fields or closing the range to animals. This would be merely treating the symptoms rather than the underlying disease, namely poverty caused by a stagnant food production technology, increasing population, a resource base which is declining in both relative and real terms, and a world economic order which continues to reinforce these trends.

The contribution of previous development initiatives in semi-arid areas, briefly reviewed in Part I, has been negligible in so far as they have done little to improve the lot of the poor. The reasons for this lack of success are, at least, now better understood. It has become absolutely clear that, unless local people can be actively involved in the planning and implementation of the actions necessary to satisfy their needs, development assistance in resource-poor areas will fall on barren ground.

### 2. Potential of Past Development Interventions

Attempts at planned change can be usefully grouped according to the extent to which implementation requires an outside agency (normally the government or some parastatal) to obtain control of the agricultural system to achieve its purpose.

The early development projects frequently involved transforming or replacing indigenous systems of production, including the rearrangement of holdings and land rights. This was based on the assumption that a radical change was essential in order to break the bad habits of the past. An intermediate approach, modernising, leaves existing production systems intact, but aims at facilitating the introduction of modern inputs and marketing. A yet more modest approach, also planned and initiated from

outside, falls into a third category, that of sustaining traditional systems. For example, assisting traditional herders with rebuilding their herds after drought would fall into this general category\*.

## 2.1 Transforming Traditional Systems

In the period up to about 1970, three development models dominated the planning perspective of western-trained engineers and agronomists - irrigation (often associated with land settlement), mechanized farming and ranching. They represented an attempt to transplant a system of production from one continent to another and from one socio-economic and political system to another, very often under the aegis of a colonial government.

### 2.1.1 Irrigation

In South Asia, irrigation systems have very greatly increased production potential in the drylands. The irrigated area has increased from 30 to 55 million hectares since the beginning of the century. Rivers rising in the Himalayas have been harnessed by peoples with several thousands of years of hydraulic achievements behind them (but whose efforts are now being threatened by widespread tree-clearing in the upper catchments). In many ways the large irrigation schemes constructed in northern India since independence were a logical extension of a centuries' old tradition.

In Africa, there is neither the tradition nor the hydraulic potential. Apart from a few celebrated early schemes, notably the Gezira in Sudan which was started in 1913, and some relatively smaller colonial and post colonial irrigation schemes, for example in Nigeria, Sudan and Kenya, formal irrigation development has come late to the continent. In the 1970s, however, the pace and scale of construction increased over much of semi-arid Africa. Unfortunately, the problems listed in Part I (section 3.3.2) have been more or less replicated throughout. The main rivers have now been largely tapped and there is a scarcity of good water storage sites. Further, there are economic and environmental factors combining against the use of large dams.

In recent years, engineers have been recommending the expansion of supplementary, small-scale irrigation and, where possible, the diversion of small surface flows and the use of shallow groundwater. As a result, the attention of governments and donors has been drawn to small-scale irrigation to an extent which far exceeds its contribution to the economy. Following the drought of 1984-85, donors have been encouraged to supply pumps and construction equipment on the understanding that irrigation would provide security against future droughts, despite the fact that

---

\* suggested by Ruth Mace when commenting on the draft report

irrigation supplies (small rivers and shallow groundwater) also depend on rainfall. The "discovery" of small-scale irrigation has frequently resulted in the government taking over existing, informal schemes and imposing bureaucratic controls.

Small schemes, that is less than about 200 hectares, supplied from small river diversions or pumps can suffer from the same problems as large schemes, especially if they are imposed from above. As with large projects, the main issues are not engineering, but social, financial and economic. However, in small schemes adverse environmental and social impact are reduced to a more manageable scale.

There is a growing body of evidence that the improvement of existing irrigation infrastructure and its management offers the most economic means of increasing agricultural production in the water-scarce countries. A pre-condition for this is an understanding of farmers' management practices at field and water course levels as well as the operation of the main water distribution system. Investment in improved operation and maintenance is likely to be more cost-effective than investment in major civil engineering works such as the Jonglei Canal on the White Nile or large-scale reclamation and settlement projects in sandy deserts using sophisticated irrigation equipment. The latter are highly dependent on factors beyond the control of individual farmers (pumps, distribution systems, spare parts, energy supplies, and other farm inputs controlled by officials) the failure of which can result in rapid desiccation of the crop. Such equipment is better suited to small-scale irrigation of high value cash crops by entrepreneurs who retain control over their own water and energy supply.

There can be little hope that an expansion of irrigation will very significantly improve the lot of more than a tiny minority of people in the semi-arid areas in Africa. Here, as in Asia, the best returns from scarce capital will be from increasing the efficiency of existing irrigation schemes, large and small.

### 2.1.2 Mechanized Farming

Whereas the inspiration for the Sudan Gezira irrigation scheme came from India, the idea behind the early mechanised schemes in Africa (e.g. Tanganyika and Nigeria) came from Russian collective farms which had been noticed by the British colonial government. During the war (1939-45), the results achieved by mass-production methods and large-scale projects had impressed the public mind. However, the organizational model of, for example, the Niger Agricultural Project in northern Nigeria, came from the Gezira. The epitaph for the Niger Project (part of the notorious "groundnut scheme") was written as early as 1957, but, since then, the advice has often gone unheeded:

"The administrative organization of a scheme such as the Project, or indeed the Gezira Scheme, must inevitably be

very expensive. This can be afforded where productivity can be raised significantly in comparison with the achievements of existing local methods..... There may not be very many conditions in which such a complicated, expensive organization can be justified as a method of development. Wide departures from established systems of agriculture, whether African or any other, are seldom immediately practicable." Baldwin (see bibliography).

In a few cases, the clearing of large areas and subsequent mechanized cultivation have been a qualified success in that overall system productivity has been raised and the production of both cash and food crops increased. However, this has often been achieved at a high social and environmental cost. With the possible exception of the Sudan clay plains, semi-arid tropical soils are rarely amenable to such cultivation systems and the effect on long-term soil stability can be serious. Further, most mechanization of temperate origin has had the effect of displacing labour, whereas one of the important objectives in many developing countries is to maximise the utilization of labour. Therefore, the type of mechanization that is most likely to be appropriate is one that generates rather than reduces employment. This may occur if a servicing industry grows up to support mechanization on existing peasant farms as, for example, in the Punjab in India.

### 2.1.3 Ranching

This development model, when introduced to Africa from North and South America or Australia, has failed to take root in areas occupied by traditional pastoralists. Ranches tend to employ a much smaller labour force in relation to the size of their herds than traditional systems, which induces them to invest in imported labour-saving devices (fencing, vehicles, pumps) and to specialise in the production of animals for meat rather than more labour-intensive dairy products on which the pastoralists subsist. Centralized management of commercial ranches is ill adapted to exploit the grazing of the savanna and semi-desert. And, even in their areas of origin, ranches have not induced people to keep numbers down to the estimated carrying capacity.

Where modern systems of range management involving rotation have been introduced to traditional pastoralists in semi-arid Africa, very few improvements in range or herd productivity have been obtained. On the other hand, traditional users have suffered because they have lost their rights of access to land.

### 2.1.4 Land Settlement Schemes

Land settlement or land colonization in India, often associated with the extension of irrigation into arid lands, has a long history in Asia, the most recent scheme being the Mahaweli Project in the dry zone of Sri Lanka. In north east Africa, the most recent land settlement schemes have been a response to the

need to accommodate drought victims (Somalia and Ethiopia) or refugees (Sudan) The social, managerial and financial costs (US\$ 5000 per household in Ethiopia for rainfed farming) of land settlement are extremely high considering the fact that only a small proportion of the total population can be accommodated. Further, without careful planning and skillful implementation, land settlement schemes extend the environmental crisis into previously unspoiled lands.

## 2.2 Modernising Traditional Systems

In this type of intervention, input supply, marketing and credit (supported by research and extension) are the main points of entry into traditional production systems. Customary land rights and the raising of stock and the cultivating of crops remain in the hands of herders and farmers. Included in this category are the attempts to introduce multi-purpose agroforestry species, village woodlots and energy-saving stoves, all of which have proved much more difficult to introduce than originally anticipated.

An example is provided by the vigorous promotion of *Wojoba* (*Simmondsia chinensis*), a shrub which bears a liquid wax, suggested as a substitute for sperm-whale oil. In the late 1970s, the universities in California and Arizona, together with Israeli institutions, promoted the shrub as the "miracle bean" which could be used to "revegetate the Sahel". The whole subject of plant introduction to the semi-arid zones is one of considerable complexity and requires consideration of the whole ecological, social and economic situation, not only the technical and agronomic characteristics of individual crop plants.

Water supply projects for pastoralists, which are attractive to bilateral agencies with a national expertise in water supply technology, are another example. Spending money on new supplies is the easiest form of pastoral development, but the outcome is rarely beneficial. Paradoxically however, while this is a waste of money, it has less serious environmental and social effects than one might fear, since few water points remain operational for more than a few years.

Traditional systems of crop and livestock production were well adapted to fragile conditions and very hard to improve from outside. Awareness of this fact has come about both from unsuccessful attempts to introduce improvements as well as from the detailed study of traditional systems themselves. Much of this awareness has developed only during the last decade, following the Sahelian drought of the mid 1970s. At that stage, there was a fairly widespread belief that technology held the answer to recurring disasters and that by pouring money, scientific expertise and new techniques (e.g. solar pumps, drip irrigation, miracle seeds and new crops) into the fray, the relief operation could be transformed into a long-term development programme. In the last decade, few innovations have

taken root and meanwhile the technology of the pre-1960s (e.g. diesel pumps, conventional irrigation systems, railways, telephones, mass vaccinations) has been increasingly difficult to operate and maintain.

The successful introduction of low-cost innovations (e.g. pumps, stoves, tools and equipment) which can be maintained and repaired with local materials and skills, requires the capacity to outguess generations of indigenous craftsmen as well as a very detailed understanding of the relevant local economy. The challenge is not impossible, but should not be entered into lightly. The evidence from numerous such attempts is that the simple modification of existing equipment and manufacturing techniques is usually the most promising path to follow, preferably in close cooperation with local craftsmen. Examples are provided by the improved charcoal jiko of Kenya and the broad-bed maker based on the maresha plough in Ethiopia.

An obvious but nonetheless daunting obstacle to the adoption of production improvements by farmers in semi-arid areas - the home of the extremely poor - is their inability to afford the purchase of even small amounts of superphosphate, pesticides to control stalk borer, hybrid seeds, sacks and tools. Although not impossible to overcome with farm savings and credit schemes, poverty slows the pace of change enormously because it increases the element of risk: when farmers' livelihoods are at stake, they cannot afford mistakes.

The most promising environment for innovations derived from industrialised countries are the irrigated and high rainfall, high potential areas in the Third World, not the semi-arid areas where the farming systems are complex, diverse and high risk. Very different types of technology are appropriate for improving the productivity of the farming and resource environments of the drier tropics.

### 2.3 Sustaining Traditional Systems

It is perhaps ironic that after so many decades of development we should now be emphasising the importance of sustaining traditional systems rather than transforming or modernising them. In the last decade, agronomists working in semi-arid areas have learned to be more cautious about forecasting breakthroughs. Having accumulated more knowledge of indigenous systems, we now recognize the importance of understanding these before coming forward with alternative proposals. Baldwin's warning, now over thirty years old, should continue to ring in our ears:

"Wide departures from established systems of agriculture, whether African or any other, are seldom immediately practicable". (see Section 2.1.2)

Similarly in the field of range management and animal production, there are few innovations, except in the area of epizootic

control, which can significantly reduce the risks and uncertainties faced by pastoralists. Anthropological studies have greatly increased our respect for the complexity of their adaptations.

It is now increasingly recognised that, in resource-poor agriculture, extension programmes must concentrate on minimum cash-cost improvements which provide high returns to land, labour and capital (e.g. farm forestry; land shaping; concentrating soil, water and fertility through such traditional techniques as water harvesting). Most if not all these improvements have been identified as a result of studying indigenous farming. Once a small surplus has been generated, low-cost techniques requiring small cash outlays may be possible.

Despite the recent changes in emphasis from large-scale to small-scale and the attention being paid to people's participation, there is a danger of perpetuating the old paternalism associated with the aid programmes of the past. From the review of past interventions, it is evident that there are a number of recurring problems (sections 2.3.1-2.3.3) which continue to frustrate even the more modest efforts of NGOs.

### 2.3.1 Tenurial conditions

Tenurial conditions are constantly evolving under pressure of population, but outside attempts to force the pace will not bear fruit. If interventions are to be successful, they must be adapted to local customs and laws governing access to land and not vice versa.

The inability of development workers to grasp the constraints imposed by existing tenurial conditions are frequently exhibited. Attempts to introduce, for example, tree planting or water harvesting, are often based on the assumption that access to development sites can be controlled indefinitely in favour of an individual or group. However, in much of semi-arid Africa, the foundation of the land tenure system is equity and subsistence, usufruct being determined by subsistence needs and not by ability to use land profitably or dedication to good husbandry. Prevailing customs often require that access be kept open for different users at different seasons (e.g. for grazing stubble, collection of dung, etc.) and that cultivation rights revert to the group after the harvest.

Farmers have shown themselves willing to grow trees only on permanently-owned land. In many parts of Africa this means the compound and/or the home garden. Where shifting or fallow systems still operate, tree growing has not been accepted, however much outsiders have recommended it. Tree growing has caught on only in more densely populated areas where farms are all contiguous on permanently-farmed land and where there is need for boundary hedges to protect crops from animals and timber for poles and firewood (e.g. the Ghana Burkina Faso frontier, the slopes of



Mount Kenya, Kakamega in western Kenya, etc.). In the Ethiopian highlands where agroforestry could meet vital needs, individual farmers are reluctant to plant trees because under the agrarian reform law they no longer enjoy permanent rights to trees or land. Farm forestry is not being held back for lack of research. If the trouble is taken to consult farmers, it will be possible to find plenty of things to get on with in most places. The problem is that planners want farmers to plant species for fuelwood or soil protection, and farmers want to plant for diversification of diet (fruit), shade and poles.\*

### 2.3.2 Sustaining Pastoral Systems; Problems of Grazing Rights

Past attempts to introduce range improvements within traditional systems on the open range frequently came to nothing because the responsibility for maintenance had not been agreed. It was unclear who would bear the cost and there were difficulties of excluding those who did not contribute.

In the past two decades, national governments and donors have financed numerous resource inventories using both satellite imagery and low-level aerial census techniques in the arid and semi-arid lands of north-eastern Africa which could have led to a rationalisation of grazing and cultivation rights in the areas covered. The tendency has been, however, to shy away from the land tenure issues, especially in the absence of reliable "ground truth", and adopt only the recommendations relating to the procurement of materials and equipment for water supplies and veterinary drugs, etc.

If a peaceful solution leading to sustainable land use is to be achieved, the territorial limits of pastoral groups need to be re-established and crossed only with mutual agreement. It will be necessary to place limits on the expansion of cultivation and wild-life parks which have steadily eroded the pastoral resource.

Simply registering land to individuals and rangelands to tribes is no panacea. Laws will be effective only in so far as they are accepted by local people, supported by the police and judiciary and complemented by other supporting services to help the producer. Unless land use can be intensified, population growth will defeat whatever benefits land registration might bring.

While there is little prospect of dramatically improving traditional systems, there are a number of promising improvements and techniques which could help sustain traditional pastoralism, especially if combined:

- assistance with emergency destocking and accelerated restocking before and after drought; better local prices and market infrastructure;

\* I am indebted to Gill Shepherd of ODI for these insights.

- improved access to basic animal health requisites;
- reduction of animal mortality (especially young stock) by better disease control and nutrition;
- better design, operation and maintenance of livestock water points;
- better health and education services, especially non-formal education, for the pastoralists to help them better to deal with risks and uncertainties and to articulate their needs in the national political arena.

### 2.3.3 Compatability with Farm Management Objectives

Another recurring problem encountered by outsiders is the failure to perceive that proposed innovations are incompatible with farmers' management objectives. For example, in parts of Africa where land is still abundant, shifting cultivation yields a better return in kg grain per man hour of labour than does settled agriculture. While labour remains the scarce factor, farmers are reluctant to adopt practices which produce more food, if they involve more work. This principle can be illustrated with an example from Sudan where research workers developed a method of increasing rainfed cotton yields six times per ha than those obtained by local farmers. It involved digging trenches across fields and filling them with grass collected from a wide area. This system, which gave a sustained yield from the same piece of land received much praise from the experts, but little interest from the farmers who stuck to their traditional methods of planting new ground each season. It was found that the new method required 40 per cent more labour per unit of cotton produced than the traditional method. The local farmers preferred to carry cotton seeds to fertility than to carry fertility to their cotton.

It is only when farm boundaries become contiguous and farmers no longer have the option of moving on that they will be prepared to invest in fertility conservation measures such as tree planting and terracing on their land. Only at this stage does land registration become attractive.

The improvement of indigenous rainfed arable farming in the dry tropics is a slow and difficult process. Many problems are evident, particularly the adaptation of new knowledge or techniques to suit local conditions. Recent work at international agricultural research centres has indicated that the order of improvement achieved on small farms in more humid areas or under irrigation cannot be reproduced in the dry tropics in the foreseeable future. This is not a reason for giving up but a warning to those who are inclined to base their optimism for improved conditions in semi-arid areas on the achievements of the "Green Revolution" in more favourable environments.

#### 2.3.4 Food Security

In the last two decades there have been two major drought-related famines in the Sudano-Sahelian zone and in northern Ethiopia. The most recent drought seriously set back development initiatives mounted after the drought of the mid 1970s. If farmers in drought-prone areas are to be helped to build sustainable systems, then security from famine will be needed, at least in the short term; indefinitely, if we fail to help them.

An integrated food management system should be an integral component of any long-term rehabilitation programme in the drought-prone areas. The management of such a system by governments is difficult and, at times, extremely controversial. State grain monopolies tend to be very inefficient, which is reflected in high price differentials between the buying and the selling price which farmers are unable to afford. Thus, they fall back on relief grain provided by aid organizations drawn from rich-country surpluses. The problem is to obtain a balance between incentives for farmers in good rainfall years and security when the rains fail. Ideally, farmers' groups should be helped to manage their own strategic reserves and food-for-work activities.

An essential component of food security programmes is the provision of adequate roads, in the absence of which timely response to hunger is extremely costly if not impossible. Examples are provided by the provinces of Darfur and Kordofan in Western Sudan and the western districts of Welo Region in the northern highlands of Ethiopia. Both regions experienced drought-related famines in 1984-85, the relief of which was delayed and at great financial cost due to the absence of all-weather roads.

In contrast the construction of the asphalt road into north Turkana, Kenya, in the early 1980s, greatly simplified the transport of relief supplies and probably saved the district from a repeat of the 1979-80 famine following another drought in 1984. In fact, the drought went largely unnoticed mainly because food supplies for food-for-work and related interventions were uninterrupted. If sustained development means anything at all, it must include the capacity to respond in a controlled and measured way to forestall starvation which forces people to abandon their homes, sell their livestock and possessions and walk to the nearest road to obtain relief.

### 3 Conservation of Species and Ecosystems

Man's activities have modified the environment and reduced biological diversity and productivity and caused serious breakdowns in essential processes. Many plants and animals which supported people have been lost or have become rare and localized. These imbalances are most pronounced in the dry

margins and have been accentuated by recent droughts. The importance of conserving ecosystems relatively intact as a source of germplasm for future use hardly needs emphasis. However, efforts to set aside protected areas in the critically affected areas and to obtain the active support of local people and their governments have often been fruitless. IUCN, which has traditionally been concerned with the preservation of species and habitats and with protected areas, finds itself unable to stand aside from questions of drought and famine and now focuses on livelihood security as the only long-term basis for environmental rehabilitation.

As a safeguard against the irrevocable loss of genetic material, International Board for Plant Genetic Resources coordinates the effort to store seed of potentially valuable plants. The Danish Forest Seed Centre and the Department of Economic Botany in Kew, England are examples of national seed banks from which material is disseminated for the rehabilitation of semi-arid lands.

#### 4. Five Major Lessons

Based on a series of case studies for IIED's conference on sustainable development, April 1987, Robert Chambers (see Bibliography) concluded that, for the achievement of sustainable livelihoods, five major lessons could be drawn. These concern:

- a learning process approach
- people's priorities first
- secure rights and gains
- sustainability through self-help
- calibre, commitment and continuity of staff.

##### 4.1 A Learning Process Approach

The first lesson recognises that development is a process of experimentation which should be conducted so as to permit the project in hand to evolve at a pace suited to the human and environmental circumstances, establishing by trial and error new patterns of economic and social endeavour.

Much of the failure to take proper account of local systems of land use, land rights and socio-economic conditions is that projects are formulated in too much of a hurry, by outsiders, and in far too much detail at the outset. Decisions are made in the respective capitals; people likely to be affected - farmers, community leaders and officials - are rarely kept informed or even consulted. This is especially the case with bilateral or multilateral aid which must go through official government channels. NGOs, however, normally have more flexibility.

In the 1970s and early 80s, external aid to agriculture consisted almost exclusively of project grants or lending, that is assistance to specific and discrete projects. Bilateral agencies

have followed the lead of the IBRD and recognize a number of steps in the project cycle, such as identifying, preparing and appraising the project. Consultants are usually recruited to assist with preparation, carrying out studies based on terms of reference agreed between donor agency and government. In some cases (e.g. EDF), standard instructions on the preparation of project dossiers are extremely detailed and leave no scope for adaptation. This may work well with infrastructural projects (e.g. roads, dams, buildings, etc.), but not with more complex rural development projects which tend to be "over planned" by consultants. The resulting "blue print" may run into several volumes and be compiled with very little involvement of the local officials who have to implement the project, let alone the local farmers.

Pre-project studies of multivariate socio-economic phenomena spanning a few weeks or months can never anticipate all the information needed to implement a three- to five-year rural development programme. Detailed information of the kind needed can be built up only after several years of working in close cooperation with the people for whose benefit the programme is intended. In any case, circumstances will change over the years, sometimes rapidly, due to a drought, for example.

This should not prevent initial disbursement of funds on the basis of a tentative plan (e.g. involving the construction of some clearly needed item: feeder road, water supply, store, etc.) on the understanding that further disbursements will be based on annual programmes and budgets within a financial frame agreed at the outset. Within a multisectoral project, the option can be retained to reallocate funds across sectoral boundaries on the basis of progress achieved the previous year, along the lines of Kenya's district development projects in arid and semi-arid areas (ASAL projects).

For the learning process (as opposed to the blue print approach) to be successful, socio-economic studies have to be taken seriously by both parties, geared to the annual financial cycle and carried out jointly by staff recruited from recognised institutions in both the recipient and the donor countries.

If, in the past, socio-economic studies were neglected in favour of surveys of physical resources, our heightened awareness of the importance of socio-economic phenomena should not now lead to a corresponding neglect of the physical supply factors, e.g. climate, soils, hydrology. Hydrogeological investigations are an essential prelude to groundwater development; regional plans to control dune encroachment need to be founded on a thorough understanding of the scale of sand movement in space and time. Information gathered in previous surveys needs to be thoroughly researched.

#### 4.2 Putting People's Priorities First

People's priorities are invariably closely linked with livelihoods; unless there is a direct pay back from, for example, building soil conservation structures or planting trees, farmers are unlikely to show much interest.

The method used by development workers to learn about people's priorities is also important. No single formula will work - much depends on the political structure and functioning of the society involved. Whatever system is adopted, provision must be made for regular face-to-face meetings, over a period of years rather than months, in which there is a readiness among development workers to listen to farmers. Brief encounters prior to the initiation of a project are unlikely to be enough.

#### 4.3 Secure Rights and Gains

Sustainable resource use requires that the users can take a long-term view. Once their very basic livelihood is assured, the willingness of poor people to invest time and effort for long-term gains depends on how secure they judge their future rights to be. This aspect of peasants' rationality has been persistently overlooked. Without secure rights to resources, it makes no sense for peasants to conserve soil, plant trees or protect forests. Hence the Ethiopian peasants, about to be moved into government-planned villages, rapidly cut down the trees around their houses for fear of losing the timber. They are correspondingly reluctant to plant and protect trees around their new homesteads for fear of being moved before they can reap the benefits. Evidence from elsewhere confirms that when peasants are secure in their ownership of land and their rights to trees, they are likely to plant these in considerable numbers.

Where individual rights to property are not practicable (e.g. in the case of nomadic pastoralism), communal rights may be sustainable, provided territorial limits are clear and access is regulated by the joint owners.

#### 4.4 Sustainability through Self-Help

Self-help involves the voluntary participation of people who provide labour (sometimes materials or cash) in the conviction that an activity is in their own interest. If people are allowed to decide for themselves what they need and the steps they are willing to take, self-help schemes can be an important means of changing attitudes and generating interest and sustainable development. Self-help can cover a wide range of activities from conservation work to small-scale experiments by farmers on their fields.

Subsidies in the form of food for work may sometimes be necessary when food energy intake is below subsistence needs, but should be avoided as far as possible because they can diminish the

relevance of a programme and induce people to undertake tasks in which they have no interest or faith. In projects where importance is attached to FFW, outsiders can be fooled into believing that people see the long-term benefit when they see only the short-term gain. One way of overcoming this difficulty within deeply impoverished communities may be to let them decide who should receive the food and for what tasks. Encourage them to manage their communal allocations.

#### 4.5 Staff Calibre, Commitment and Continuity

The fifth lesson emerging from the case studies by Robert Chambers relates to the need for good staff with continuity in the field. In the case of rural development programmes, continuity refers to the requirement for staff to work consistently over three or four years. Those responsible for the detailed planning ("preparation" in IBRD parlance) should be on hand to train the management team and transfer "ownership" of the project from the planners to the implementers.

Calibre refers to sensitivity, insight and competence. It reinforces the ability to implement the other lessons: the learning process approach, putting people's priorities first and especially those of the poorer, securing rights and gains, and enabling self-help for sustainability. Commitment refers to determination, self-sacrifice and dedication to working with the poor.

It is usually impossible for government field staff to have the combination of assured continuity and freedom of action needed - although there are exceptions. NGO staff are more often in a better position to see problems through the eyes of the rural poor and to put themselves in their shoes (if they have any!)

#### 5. Suiting Development Assistance to Actual Needs through Popular Participation

A recurring problem in rural development work is how to involve the people in the planning and implementation of the actions necessary to satisfy their needs. Planners may consult local leaders or a representative group of farmers, but if the purpose simply is to ask the people what they want from government, neither course is likely to be instructive. Farmers usually ask government for what they think it ought to provide (e.g. water supplies, feeder roads) and tend to overlook those things for which there is more immediate need, simply because no help of this kind has been provided by government in the past.

Before development workers can have a constructive dialogue with farmers, they need to have a reasonable grasp of the problems facing farmers and how they might be tackled. In the 1960s and 1970s, rural development programmes were often preceded by detailed resource surveys of physical and socio-economic phenomena conducted by a range of specialists, but, apart from

being slow and costly, much of the information collected was often irrelevant and much of what was needed was overlooked.

Rapid rural appraisal (RRA) techniques were developed in response to the need to acquire quickly new information on, and new hypotheses about, rural development. RRA techniques are applicable to programme planning in resource-poor areas. They focus on diversity (biophysical and socio-economic), but aim to reduce complexity to a few key problems and opportunities. It encourages a participatory, "bottom up" approach by operating in the field (fields, gardens, villages, etc.) and combines semi-structured interviews by interdisciplinary teams and a systems perspective to make communication easy. RRA techniques for resource-poor farmers aim to emphasise not only productivity but stability, sustainability and equitability and the critical trade-offs between the two.

Similar techniques have long been used by extensionists. The "problem census", a structured enquiry aimed at defining problems, exploring differences in viewpoints between farmers and extension workers, redefining problems in terms which permit solutions and agreeing a course of joint action, can be used to encourage farmers to support the implementation of a programme once it has been formulated.

## 6. Ongoing Research

To attempt a review of relevant drylands research with environmental implications in this brief document would be unrealistic. A checklist of the main foci is attempted:

The International Union for the Conservation of Nature and natural resources (IUCN) is carrying out an annual review of the Sahelian environment (Sahel Environment Status Report). It operates several pilot schemes with the purpose of developing durable systems for the management of representative ecosystems (natural resources, wildlife, people and domestic animals) with a view to contributing to the development planning process of Sahelian countries. It also aims to provide technical support to NGOs running small-scale "ecodevelopment" projects in the region. The Union's long-term strategy is set out in "The IUCN Sahel Report" (see bibliography), a key reference on environmental strategy.

Eleven years after the UN Conference on Desertification, the future of the UN Environmental Programme as the designated agency to follow up and coordinate the "Plan of Action to Combat Desertification" is being reviewed by UNEP members. Questions have been raised about the agency's technical capacity to monitor and evaluate environmental change on the desert margins and its ability to use effectively the bilateral resources placed at its disposal for desertification control. UNEP's problems in the field of "desertification control" relate to its apparent preoccupation with "rolling back the desert". Without a large



number of complementary socio-economic and political actions, the task of revegetating the landscape on a significant scale is hopeless.

Despite the seemingly intractable problems, there is a strong interest in research in the drier regions. International centres (e.g. ICRISAT, ICARDA, ILCA) have been established with a farming systems emphasis and a number of national research programmes are being supported by the centres. Leaders of research programmes have expressed a strong interest in decentralising the organisation of research to bring scientists much closer to farmers and to working with their limited resources. It is widely accepted that many existing farming systems are well adapted to environmental and other constraints and that the knowledge of farmers must be an element in the search for improvements. The extent to which these undertakings to foster a "farmer-first" approach in agricultural research will be honoured by the international centres is an open question. It should be a continuing object for follow-up by donors

## 7. Research Required

Research breakthroughs of the green revolution variety are unlikely to emerge from the laboratories or experimental fields of research stations because of the complexity, diversity and risk-prone nature of the marginal, semi-arid areas. Research scientists working on a narrow range of crops, pests and diseases, cultivation practices, etc., can miss key linkages and potentials in traditional farming systems. The need for professional specialisation will continue, but in addition there is a need for a new breed of researchers who start with farmers' own analysis and priorities and support and strengthen farmers' own experiments and adaptations. The strengthening of national agricultural research capability in this area will be vital.

Much of this applied research will need to be matched to specific agro-ecological zones and is impossible to specify in advance. However, the following areas will be central to the need to increase the stability and sustainability of rural livelihoods in semi-arid areas:

- \* soil, water and fertility conservation techniques which are integrated at farm level;
- \* measures to increase the reliability of yield as well as the yield per unit area of crop varieties with the minimum of imported inputs;
- \* an increase in the range of crops available to farmers, especially multi-purpose agroforestry species, which are the subject of considerable knowledge and optimism but slow to be incorporated in farming systems in the dry zone;

In view of the large number of agencies involved in ecodevelopment initiatives and applied research, there will be a continuing need for effective information and communication networks.

#### 8. Limitations Imposed by Conditions in Recipient Countries

The countries covered by the strategy statement fall within the least developed classification of the World Bank. When compounded by economic mismanagement, their poverty imposes severe constraints over the type and amount of foreign aid which can be effectively absorbed, whether for environmental or any other purposes. Causes may differ from country to country, but the symptoms are much the same, especially in sub-Saharan Africa. Infrastructure, health and education services are severely run down. The public sector is under-financed, over-manned and poorly managed. Foreign exchange is greatly undervalued. Farm prices both for food and export crops are unattractive for producers. Foreign debt service ratios are impossibly high. In this situation, putting money into agricultural development projects can be a waste of time.

Against this background, the World Bank and the IMF in the early 1980s pressed for domestic economic and institutional reforms. The elements of the structural adjustment recipe were:

- increasing the price of foreign exchange by 100 per cent or more;
- price incentives to farmers: emphasis on agriculture and export;
- greater reliance on market mechanisms: removal of subsidies, less direct control by government and parastatal organisations;
- institutional reforms to reduce over-manning, etc.;
- public expenditure strategy, e.g. more focus on agriculture, rehabilitating roads, marketing infrastructure.

As the causes of economic distress have varied, so has the response to treatment. Much has depended on the political will and commitment of the governments involved and the domestic support they have received in implementing the reforms. After several years of structural adjustment in sub-Saharan Africa, a number of lessons are beginning to emerge:

- urban people lose because the costs of both imports and food shoot up as the purchasing power of wages goes down; governments need sufficient support in the countryside to stand up to the urban interests;

- farmers may gain quickly from improved farm prices, but if they are to invest in conservation measures and tree crops, etc., they must be convinced that prices will hold up in the long term;

- stabilisation requires simultaneous actions in a number of areas (e.g. higher farm prices will be inflationary while consumer goods remain scarce), which is difficult to achieve in a distorted economy; the more distortions, the more the difficulty in predicting the impact of removing controls;

- it is better to proceed step by step and unwise suddenly to float exchange rates and remove price controls, or to devalue without first reducing the budget deficit;

- institutional reforms and infrastructural rehabilitation take time; the deadweight of the civil service is difficult to shift;

- structural adjustment needs to be financed more generously by debt forgiveness and greater inflows of both programme and relevant project aid.

Structural adjustment should result in a shift of resources to the countryside, improve income distribution and growth and therefore deserve support. The implications for bilateral donors might be as follows:

- while sub-Saharan African governments are in a state of permanent debt crisis, environment and conservation are unlikely to receive priority; debt forgiveness and substantially improved inflows of aid may be a precondition for changing attitudes;

- a relevant mix of programme and project aid is necessary and the details are best arrived at in discussions with other donors and the government involved; pressurising governments to adopt the standard IMF package before they have mobilised domestic support for it can be counterproductive;

- as far as project aid is concerned, there are likely to be a number of items on the agenda which require project finance (e.g. feeder roads, market infrastructure);

- in helping to create capital assets, it may be necessary to avoid overloading the government budget with running costs; it may be advisable to look for ways of supporting the recurrent budget, e.g. meeting vehicle running costs for the extension service. (Donors, understandably, are reluctant to provide support to weak administrations as there is a tendency for the requirement to become

indefinite. The problem donors are faced with is how to support useful projects where the administration is weak and likely to remain so. The art of project design is to identify the level of administrative support necessary for the project in hand.)

Macro-economic policy is not the only issue with environmental implications. At the IIED/Danida workshop (Copenhagen, March 1988) on incorporating environmental aspects into development assistance, one group came up with the format shown in Figure 2. Amelioration of fiscal policy can have an immediate impact on rural livelihoods while land tenure and local government reforms will have an effect only in the medium term. Education and population control policies can bring about improvements in the long term.

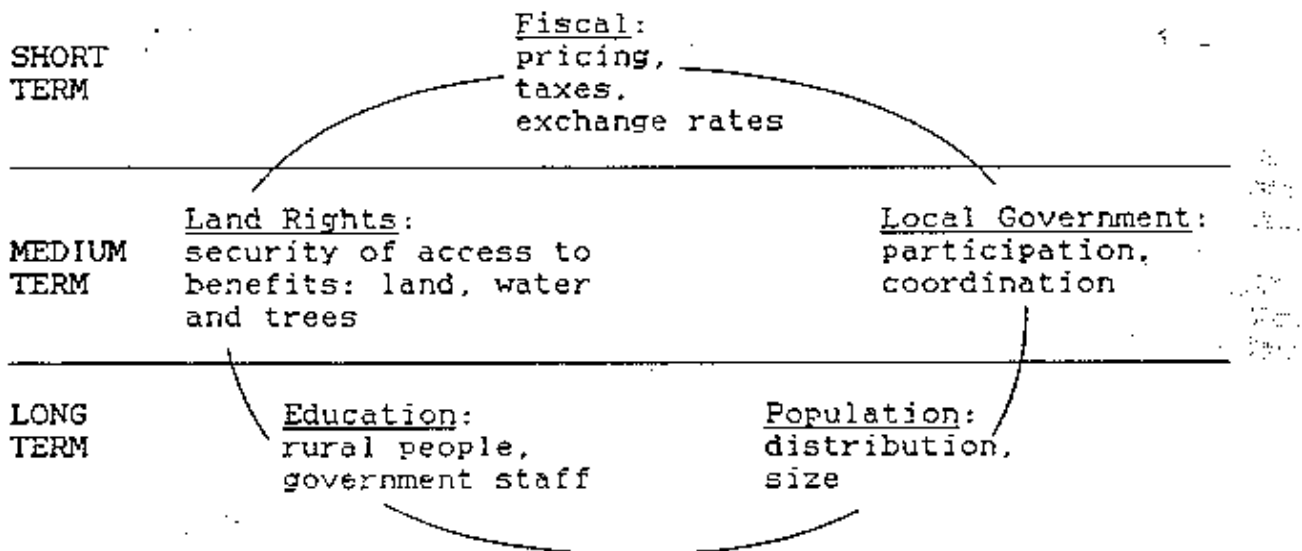


Figure 2. Macropolicy Issues Affecting the Environment

## 9 Some Implications for Bilateral Donors

The 1973-4 famine in the countries of the Sahel and in Ethiopia caused intense concern about environmental degradation in Africa, but, fifteen years later and ten years after the Nairobi conference on desertification and the creation of UNEP, there is little evidence that the underlying causes of degradation are being tackled on the scale and in the manner necessary. Donors are aware that environmental and development issues are inter-related; only when poor people obtain secure livelihoods will sustained environmental improvement be possible. Donors are sympathetic to the lessons emerging from the case studies (paras. 56-61), but the problem is to translate them into practical actions.

The potential for intervention by donors is necessarily

limited, both in geographical area and content. Influence over the overall policy framework of host governments is also likely to be small. Donors also know that rural development has proved a major stumbling block, especially in the marginal areas of Africa.

However, the experience of the last two decades leads to the conclusion that rural development is not necessarily achieved through massive inputs of resources within a few years; on the contrary. Appropriate solutions are invariably location specific and need persistent effort over many years. However, a bilateral agency with reliable funding should be in a strong position to do things modestly but well. The main opportunity lies in operating in a limited area (i.e. concentrating on both content and area) and, by working with local people, demonstrating sustainable systems with a wider application.

Agencies would do well to keep in mind that rural development is a process of experimentation which does not lend itself to the highly structured approach adopted by the larger agencies, the bureaucratic procedures of which have proved an unwelcome strait-jacket. Bilateral agencies will need to exercise ingenuity and patience in their efforts to involve both officials, local leaders and the people (women as well as men) in the planning and the implementation of the actions necessary to satisfy local needs. In the last 25 years, development planning has been an urban, male, bureaucratic and technocratic activity by those who do not depend immediately on the environment for their security. The results have been short-term objectives, neglect of ecological imperatives and local environmental knowledge in project planning and a growth of the absolute poor and environmental refugees.

If donors are to pursue a genuinely participative and consultative approach, they must be prepared to allocate the necessary time, effort and manpower to understanding socio-economic and socio-political phenomena. Participative planning and implementation take time and considerable persistence. This should not lead to the neglect of the required surveys of physical factors (soils, hydrology, etc.) nor to delays in disbursement for basic infrastructure (e.g. roads). Indeed, assistance with essential capital works will make it easier to insist upon a more gradualist and measured approach to rural development in degraded and marginal areas.

There are real difficulties in working through government bureaucracies in the Third World especially in remote marginal areas, but it is essential for a bilateral agency to do so. By working closely with local officials, differences in viewpoints can be explored and attitudinal changes based on mutual respect can be fostered. The bilateral status of donors should not prevent close cooperation with NGOs, which have clear advantages in local, community-development programmes. It can be helpful to combine the two types of technical assistance within one sector:

for example by providing direct support in a ministry's HQ and indirect support through NGOs in the field.

It is apparent that many of the problems associated with the implementation of development projects in remote areas relate to difficulties in staffing, particularly with expatriates. The problems of recruiting competent staff on contract and maintaining them in the field in remote, inhospitable areas are not necessarily made easier by delegating the task to commercial firms, whose high overheads are difficult to justify to recipient governments and whose relationship with contract staff are unlikely to be close.

It is also apparent that the commitment of field workers is not directly related to financial and other inducements. Costly accommodation and over-generous provision for expatriates in the field is a frequent cause of friction with local staff. The recruitment, conditions of service and management of expatriate technical assistance on rural development projects in remote areas and the opportunities for replacing them with local staff need to be carefully considered. Aid workers, like their counterparts, can become institutionalised. There are positive lessons to be learnt from the NGOs.

The devolvement of responsibility for development projects, as opposed to studies and monitoring of physical and socio-economic trends, to specialised UN organizations (e.g. UNEP and UNSO) also requires careful consideration. The channelling of funds through these agencies for project planning and implementation can result in an unnecessary addition of bureaucratic layers and a reduction of the funds available for the people who most need them.

SELECTED BIBLIOGRAPHY

- Adams, M.E. (1982): Agricultural Extension in Developing Countries. Longman, London.
- Adams, M.E. (1982): The Baggara Problem: Attempts at Modern Change in Southern Darfur and Southern Kordofan, Sudan, Development and Change, 13, 2, 259-289. Sage, London.
- Adams, M.E. (1986): Merging Relief and Development: The Case of Turkana. Development Policy Review, 4, 4, 314-324.
- Adams, W.M. and Grove, A.T. eds. (1983): Irrigation in Tropical Africa: Problems and Problem Solving. African Studies Centre, Cambridge, England.
- Agricultural Administration (1981): Vol 8 (6) (Issue devoted to papers on Rapid Rural Appraisal, selected from those presented at IDS Conference, December 1979).
- Allan, W. (1965): The African Husbandman. Oliver and Boyd, Edinburgh and London.
- Asher, M. (1986): A Desert Dies. Penguin, London.
- Baldwin, K.D.S. (1957): The Niger Agricultural Project. Blackwell, Oxford.
- Barnard, G. and Kristoferson, L. (1985): Agricultural Residues in the Third World. Earthscan, IIED, London.
- Behnke, R.H. (1982): Production Rationales: The Commercialisation of Subsistence Pastoralism. Ministry of Agriculture, Botswana.
- Chambers, R. (1987): Sustainable Rural Livelihoods: A Key Strategy for People, Environment and Development. IIED Conference on Sustainable Development, IIED, London.
- Conway, G.R. et al (1987): Rapid Rural Appraisal for Sustainable Development: Experiences from the Northern Areas of Pakistan. IIED Conference on Sustainable Development, IIED, London.
- Curtis, D., Hubbard, M. & Shepherd, A. (1988): Preventing Famine, Policies and Prospects for Africa. Routledge, London and New York.
- Danida (1987): Denmark's Development Assistance, 1986. Danida, Copenhagen.
- Dejene, A. (1987): Peasants, Agrarian Socialism, and Rural Development in Ethiopia. Westview Press, Boulder and London.
- FAO (1986): Ethiopian Highlands Reclamation Study (2 volumes). (AG: UIF/ETH/037/ETH), Rome.
- Farmer, B.H. (1974): Agricultural Colonization in India since Independence. Oxford University Press, London.
- Farrington, J. (1988): A Review of Developments in Agricultural Biotechnology and Potential Implications for the Third World. ODI, London.
- Fitzgerald, M. et al (1987): An Evaluation of Environmental Education in Welo Region, Ethiopia. SIDA, Stockholm.
- Gibbon, D and Pain, A. (1985): Crops of the Drier Regions in the Tropics. Longman, London.
- Gill, P. (1986): A Year in the Death of Africa, Politics Bureaucracy and the Famine. Paladin, London.
- Harrison, P. (1987): The Greening of Africa, Breaking Through in the Battle for Land and Food. Paladin, London.

- Harvey, C. (1988): Non-marginal Price Changes: Conditions for the Success of Floating Exchange Rate Systems in Sub-Saharan Africa. IDS Bulletin, 19, 1.
- Harvey, J. et al (1987): Rapid Rural Appraisal of Small Irrigation Schemes in Zimbabwe. Agric. Admin. & Extension, 27.
- IIED and World Resources Institute (1987): World Resources 1987. Basic Books, New York.
- IUCN (1986): The IUCN Sahel Report: A Long-Term Strategy for Environmental Rehabilitation. International Union for the Conservation of Nature and Natural Resources, Gland, Switzerland.
- Jackson, J.K. ed. (1984): Social, Economic and Institutional Aspects of Agroforestry. United Nations University.
- Johnson, D. and Anderson, D. (1988): The Ecology of Survival. Case Studies from Northeast African History. Lester Crook Academic Publishing, London.
- Leach, G. and Mearns, R. (1988): Bioenergy Issues and Options for Africa. IIED, London.
- Nye, P.H. and Greenland, D.J. (1960): The Soil under Shifting Cultivation. Commonwealth Agricultural Bureau, England.
- Overseas Development Institute (1987): Coping with African Drought. Briefing Paper, ODI, London.
- Plucknett, D.L. et al (1987): Gene Banks and the World's Food. Princeton University Press.
- Richards, P. (1985): Indigenous Agricultural Revolution. Hutchinson, London.
- Ruthenberg, H. (1980): Farming Systems in the Tropics. Clarendon Press, Oxford.
- Sandford, S. (1983): Management of Pastoral Development in the Third World. Wiley, ODI, London.
- Shepherd, G. (1985): Social Forestry, 1985. ODI Social Forestry Network Paper No.1A. ODI, London.
- Spear, J. (1982): Kenya's Past. Longman, London;
- Swift, J. (1982): African hunter-gatherer and pastoral peoples. Development and Change, 13, 2, 159-181.
- Troll, C. (1966): Seasonal climates of the earth in Lindsberg, M.E. et al (eds.) (1966). World Maps of Climatology. Springer-Verlag: Berlin, New York.
- Walters, P.R. et al (1979): Jojoba: an Assessment of Prospects. Tropical Products Institute, Min. of Overseas Development, London.
- Wickens, G.E. (1986): Breadfruit to Computers; Economic Botany at Kew. Span, 29, 2.
- Wilson, R.T. (1979): The incidence and control of livestock diseases in Darfur (Sudan). The International Journal of African Historical Studies, 12, 1, 62-81.
- World Bank (1987): World Development Report 1987 Oxford University Press.
- World Commission on Environment and Development ("The Brundtland Report") (1987): Our Common Future. Oxford University Press, London.