

Executive Summary and Extracts from

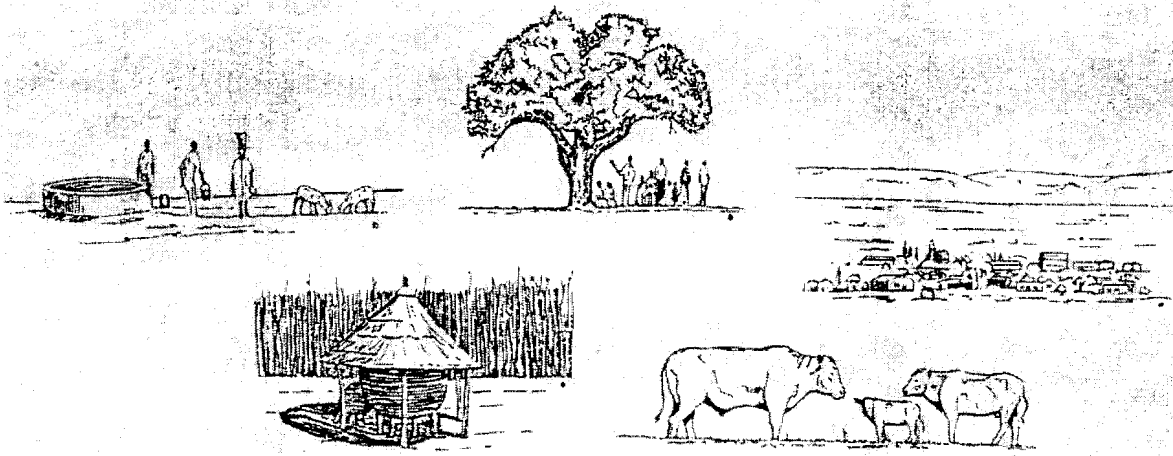
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A PRELIMINARY ASSESSMENT OF THE ECONOMIC IMPACT OF DESERTIFICATION IN NAMIBIA

by

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A Report prepared for
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This series of Research Discussion Papers is intended to present preliminary, new, or topical information and ideas for

Foreword

Everyone knows that environmental degradation affects soil, grass, trees, and animals. But not everyone realises how much it affects people's livelihoods and living standards: the sustenance farmers get from the land, their wealth and health, and the strength of the Namibian economy. This report was commissioned to examine the links between the economy and environmental change.

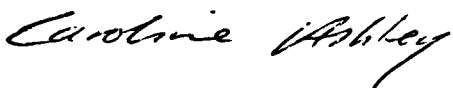
This report identifies ways in which long term environmental change -- rather than short term fluctuations in rainfall -- affect output and living standards. It shows that in communal areas, where the majority of Namibians depend on the land, the impacts of desertification are complex and inter-related, affecting the subsistence and cash income they get from livestock, the time and effort needed for fuelwood and fencing, and family food security. Costs faced by communal farmers from lost output and increased expenditure can be estimated at around N\$100 million per year. The particular impact on those with least cash, livestock, transport, and power in the growing competition for natural resources is highlighted.

In commercial areas, the nature and impacts of desertification are shown to be very different -- with bush encroachment affecting grazing areas and hence stock numbers, off-take and sales -- though the total financial costs per year are of a similar order of magnitude: lost beef output worth over N\$100 million per year.

Just as desertification affects the economy, the reverse is true too. The report highlights that a vast array of economic policies and practices affect how people manage resources, and hence the extent of over-use and degradation. The farmers and fuel-collectors are at the end of a long chain of cause, incentive, constraint and effect. Decision-makers defining international trade rules, meat prices, drought-relief strategies, land tenure systems, water supply, marketing and transport infrastructure ... all affect the sustainability of resource use. Further research on these causes of desertification, and how to alleviate them, is just one of the many recommendations contained in the last section on policy, research, and training needs.

This report is the first in Namibia to look at the costs imposed, not by short-term drought, but by the long-term effect of environmental change, from decade to decade and generation to generation. It was commissioned in order to supply information and recommendations to the first National Workshop on Desertification, organised by the Desert Ecological Research Unit in July 1994, under a joint project of the Ministry of Environment and Tourism and Ministry of Agriculture, Water and Rural Development, funded by GTZ.

The research was necessarily preliminary, intended to show directions for future work rather than provide conclusive answers. Our understanding of the nature and extent of desertification is too limited for an economic assessment to be based on anything other than assumed and reported, rather than scientifically documented, change. This initial study was conducted in less than two months by a team with strong environmental, agricultural, and economic skills -- though not familiar with Namibia -- under the guidance of the Namibian government and non-governmental organisations. The inevitable oversights or inaccuracies in the detail should not detract from the overall purpose of the report: to provide a broad indication of the type and scale of economic impacts, key economic causes, and the priorities for future action; to highlight that desertification is not just a result of cattle numbers and a concern of environmentalists, but it affects, and is affected by, people and policies in all sectors.



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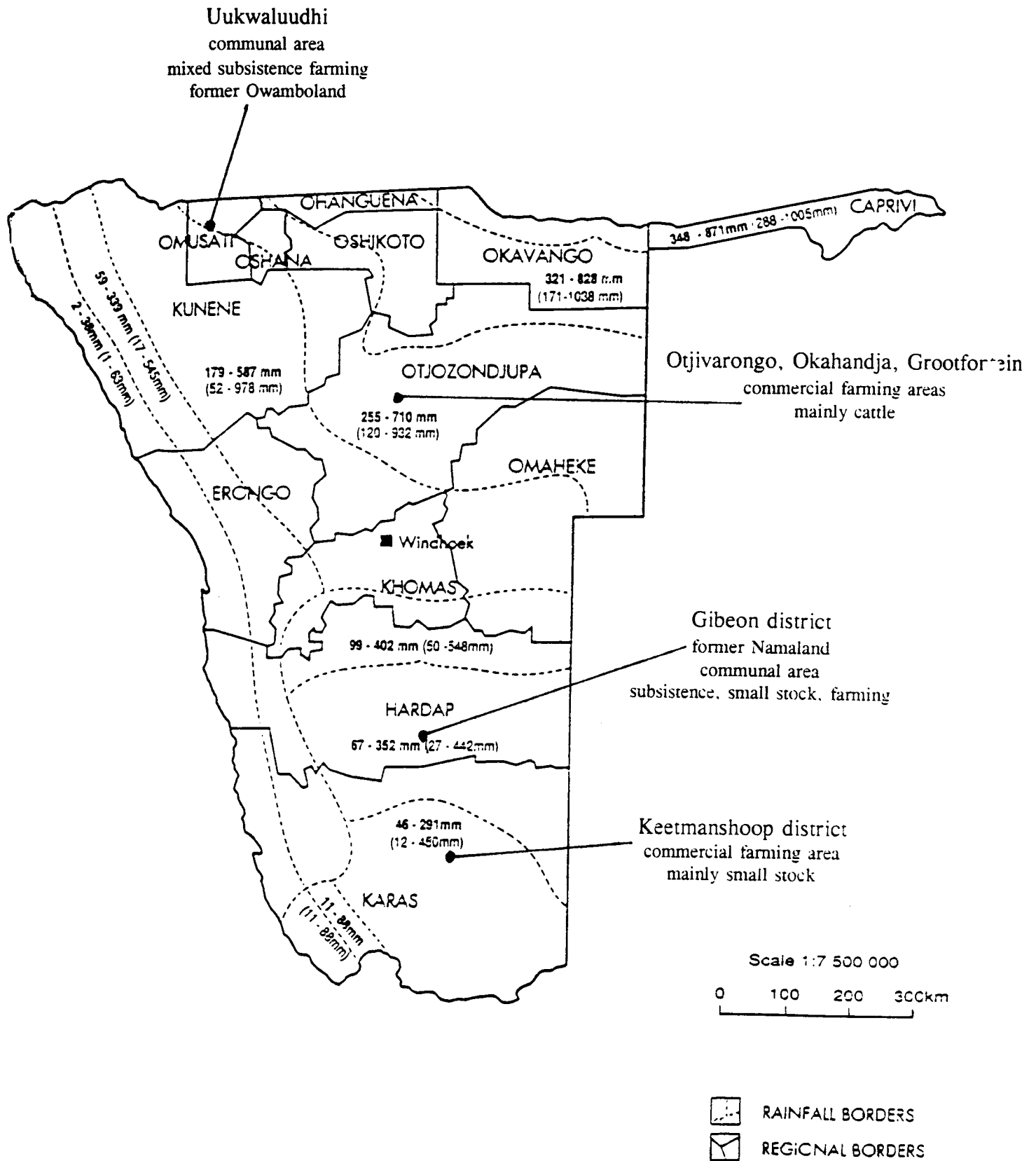
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Regions of Namibia, rainfall patterns, and case study sites

The rainfall numbers in bold indicate the average rainfall that can be expected 90% of the time. The thinner numbers in brackets indicate the minimum and maximum rainfall expected 90% of the time.

Reproduced from Yaron et al, 1993.

A PRELIMINARY ASSESSMENT OF THE ECONOMIC COSTS OF DESERTIFICATION IN NAMIBIA

EXECUTIVE SUMMARY

Introduction

The present report is the result of a study commissioned by the Desert Ecological Research Unit of Namibia in conjunction with the Ministries of Environment and Agriculture, as part of the preparation for a National Workshop on Desertification held from 4th-7th July 1994. The object of the study was to assist in the development of a framework for understanding and assessing the economic costs and factors involved in desertification, as a basis for further research and action to be undertaken in the context of a national programme to combat desertification. The study is based on the findings of a number of regional case studies and data available at national level about the socio-economic and biophysical aspects of land degradation. A short paper summarising the results and conclusions of the study was presented at the National Workshop; this summary serves to provide a record of that paper and an overview of the main report.

Background

1. Desertification is understood as a combination of processes of land degradation occurring in arid and semi-arid environments, whereby the productive potential of the land and its ability to support populations is severely impaired or destroyed. Although various factors including climatic variations and drought are involved in desertification processes, the impact of human land use is considered to be of primary importance.
2. The natural environment and economy of Namibia is defined as arid and semi-arid, with low and variable rainfall. There is severe inequality in land distribution and wealth resulting from the colonial administration of the country until 1990, and the territory and the agricultural sector remains divided into a commercial sector, responsible for commercial livestock production, and a communal sector, which produces subsistence goods and incomes for the majority of the indigenous population. Poverty and a history of underdevelopment in these areas contribute to continuing land degradation and deforestation.

The role of environmental economics

3. The importance of an economic analysis of land degradation is that it enables an assessment of the type and scale of the costs involved, an identification of the different stakeholders who face these costs, and the implications for the national economy. This in turn enables some comparison of the costs and benefits which may be involved in projects and programmes to combat degradation, and assists in decision making and the prioritisation of investments and policy measures.
4. There are four key steps involved in assessing the economic costs:

- firstly to identify the degradation processes at work: in Namibia these are primarily deforestation; rangeland degradation due to overgrazing; soil erosion; the decline in the fertility of arable land; and the salinisation of soil and water sources;
- secondly to identify the main types of economic costs involved, such as damage to natural resource stocks and losses of cash or subsistence income; damage to natural environments and loss of species; to identify who bears these costs; and to establish whether or not they can be expressed in monetary terms;
- thirdly to assess the extent of degradation and the environmental changes which have taken place, gathering data which allows measurement of the resources and the productivity lost;
- finally it is necessary to assess the level of costs involved by using economic techniques to value the changes which have taken place.

5. A number of techniques are available to place economic values on environmental changes. The principal technique used is the *effect on production approach*, which costs the losses in yield or in income which result from degradation, by using market prices for the goods involved or their nearest available substitutes which are traded on the market. This approach may also be used to value the additional time which may be expended because of degradation and growing scarcity of resources: for instance extra time spent gathering firewood is said to have an *opportunity cost* because the time could otherwise have been used in more productive, income earning activities. The cost is then measured in terms of the income lost or the value of the production foregone.

6. A second technique is to assess the value of capital assets or natural resources lost as a result of degradation by establishing their *replacement costs*; i.e. what it would cost to replace them at market prices. Where markets do not exist for natural resource goods or services the market price for commercially available substitutes can be used, or the costs of rehabilitating or restoring a damaged environment can be assessed. A related approach is the *preventive expenditure* method which estimates economic value of environmental resources by assessing what it would cost to prevent damage to them.

7. It should be remembered that in addition to the *use value* of resources, their *total economic value* has other components. It can be very difficult to place monetary values on many environmental goods, such as the cultural or spiritual importance of natural environments, the possible future *option value* of natural resources to future generations and the unique *existence value* of living species and habitats. Economists have attempted to develop methods of measuring such values, generally based on the principle of *willingness to pay*, but these are of only limited applicability to most developing country situations. This does not mean however that they do not have economic values, or that they should be discounted in decision making.

8. Attention to economic valuation of environmental costs and benefits enables a fuller assessment of the *divergence between the financial and the economic* costs and benefits of natural resource use. This occurs because environmental resources are treated as free goods, and changes in their availability as a result of degradation are not reflected in the financial costs which users bear. For instance, an individual farmer may reap

financial gains from intensive use of a grazing resource, but he may not be making good use of the resource from an economic point of view, if it becomes irreversibly degraded and unavailable for other or for future use. In this case, resource degradation by one user imposes *external costs*, by penalising others, for whom the productivity and utility of the resource is undermined.

Application to the case studies

9. Case studies were carried out in two communal areas, Uukwaluudhi in the north and Gibeon in the south, and two commercial farming areas, Otjivarongo/Grootfontein (north), and Keetmanshoop (south). As far as possible the case studies applied these techniques to data collected from secondary sources, field observation, interviews and discussions held with Local farmers and community members.

10. Difficulties encountered included the lack of available data on changes in the environment and in production and incomes over time, i.e. to actually measure the extent of degradation and its impact; and also the problem of attributing changes and losses which were observed to human land use-induced degradation rather than to drought. In practice the impacts of drought and degradation are very much tied up together imposing combined costs and losses on people and on local economies. They thus need to be addressed together, although arbitrary assumptions may need to be made in deciding what degree of change or loss to attribute to each factor.

11. There are further difficulties involved in assessing the value of livestock to local people, and in understanding the relationship between numbers of livestock and rangeland degradation. Here, a number of aspects of recent debate are considered. Firstly, it is difficult to establish the nature and extent of vegetation change, since we are dealing with complex ecological dynamics over time. Secondly, pastoral people tend to manage livestock as mobile, flexible assets which can provide *multiple benefits* for them, including their socio-cultural value, rather than for solely commercial objectives such as offtake of meat from the herd. Thirdly, because traditional production systems rely on flexibility and mobility to utilise grazing and water resources over wide areas and long periods, more livestock may be supported per unit area than by farming animals within a fixed location, and so it is difficult to define a "carrying capacity" for an area or attribute environmental degradation to an excess of animals above this level.

Economic costs in the communal areas

12. In the communal areas, because of the lack of comprehensive data, it is necessary to focus on the economic costs of degradation in terms of the impact on the livelihoods of individual households, which may be more or less representative of what happens in the region as a whole. In Uukwaluudhi the research team were able to assess some typical costs of the growing scarcity of wood because of deforestation for example, by assessing the costs involved in substituting gathered firewood by firewood gathered at market prices (\$60/month minimum) or local timber for fence building, with commercially available poles and wire (\$400 - \$640 for a 3 Ha farm).

13. The impact of rangeland and pasture degradation is more complex because there are costs involved in both the lowered productivity of livestock and livestock products and the limited access to those products experienced because of changes in the seasonal

mobility of cattle in search of grazing and water, and their prolonged absence from the homestead. Costs were identified for a number of interrelated impacts, although these are partly due to drought as discussed above. The costs to a family of lost supplies of milk were estimated at \$300 - 600 over the milking season, based on the market prices of substitute protein foods to prepare 2 family meals per day over the milking season, and the estimated market value of small scale milk sales. The value of lost or dead animals can be estimated using their replacement costs at market prices. In addition the value of lost supplies of dung and lost animal draught power, which impact on levels of crop production, should also be considered.

14. Lost supplies of dung as well as the increasing density of farm settlements and frequency of cultivation on the same plot contribute to declining soil fertility. This affects crop production which is also undermined by shortages of labour and animal traction (which may in part result from desertification processes) as well as low and sporadic rainfall. Estimating that 50% of typical losses of 3 months household subsistence millet supply in an average-poor rainfall year, were due to falling supplies of animal dung and reduced fertility, the cost of desertification on arable production can be assessed as \$165 for a 3 Ha farm, using market prices for mealy meal as a commercial substitute for millet.

15. In Gibeon, families were found to have suffered from lowered livestock production, extensive livestock deaths, lower income from livestock products and livestock sales, and lower availability of subsistence goods from livestock, due to overgrazing and drought. The costs can be assessed in a similar way as for Uukwaluudhi although data were not collected. In most cases available land areas are not sufficient to support subsistence farming, overgrazing and erosion results, and people rely on off-farm incomes and pensions.

16. *The monetised costs of land degradation at household level can be aggregated over a standard period. For the costs established for Uukwaluudhi, these were estimated as \$2,065 - \$2565 for a year in which 2 cattle, 3 goats and 150-200 m of farm fence were replaced, at market prices, and lost milk supplies partially replaced by alternative protein.* This excludes other costs such as the values of bush products which become unavailable and additional labour time expended on gathering etc. Most households are unable to afford substitute expenditure at this level, and so in practice different coping strategies are followed. These involve using natural substitutes (which have alternative uses and/or involve extra labour and so have an opportunity cost), relying on reciprocal support mechanisms within the community, on wage employment, or on pensions, and to a significant extent simply going without. Thus desertification has an impact on nutritional levels and lowers quality of life.

17. There are differential impacts on different *stakeholder groups* depending on their levels of wealth and poverty. Female headed households with lower labour availability fewer cattle and other capital assets are least able to adjust. Large herd owners are better able to ride out the situation and maintain incomes and subsistence, as are those with access to motorised or animal drawn transport. These groups may even benefit from increasing scarcity, and in some areas at least cattle and livestock numbers are becoming concentrated in fewer and fewer hands.

18. On the assumptions that the approximately 124,000 families living in the

northern communal areas face similar degradation-related losses in crop production as those in Uukwaluudhi, and that milk production of cattle is lost by half the northern communal households, then the aggregate subsistence losses amount to \$43 million per year at market prices. If lost access to fencing and fuelwood is included, assuming households replace only one quarter of their annual needs with commercially-bought substitutes, a further annual cost of \$37 million is incurred. *This indicates total subsistence losses, in terms of reduced output and resource-availability due to long-term degradation, are in the region of \$81 million per year for households in the northern communal areas.* These estimates exclude the costs of extra time and effort spent on collecting fuel, fencing, and herding cattle to more distant pastures. In addition, livestock ownership is reduced by desertification (as well as by drought). *If the cost of replacing 2 cattle and 3 goats is included, for half the NCA households, an additional \$30 is added to the costs, making a total of over \$110 million.* Although these aggregate figures are based on general assumptions, and they represent primarily subsistence losses and so are not reflected in national economic accounts, they are of a similar order of magnitude to the losses estimated for the commercial beef industry due to bush encroachment (see below). Moreover they represent livelihood and subsistence losses for the majority of the population, although they apply to only part of the country, and may thus be considered to be at least if not more important than the losses to the commercial sector.

Causes of desertification in communal areas

19. A number of underlying economic and socio-economic causes of desertification processes are identified for the communal areas. These include population growth and population pressure on land and resources; this however must be considered in the context of the partition of Namibian territory and the exclusion of the indigenous population from some of the most productive areas. Within the communal areas however, increasing human numbers and human settlement does place increasing demands on remaining forests, and arable and grazing land.

20. Another factor of major importance is the absence of any effective system of land and resource rights resulting from the breakdown of *systems of common property resource management*, the transformation of the role of traditional leaders and headmen under the colonial regime and their subsequent loss of effectiveness and authority under changed circumstances of increasing land pressure and freedom from colonial rule. As a result there is a situation of *open access* to common lands, under which vulnerable and scarce resources have no effective protection, and in which those with the resources to pay off traditional leaders can exert a controlling or exclusive influence over significant areas of grazing land.

21. This situation is exacerbated by the lack of an effective land policy which has facilitated the increase in enclosure of grazing land by large herd owners and businessmen, in the belief that an eventual land reform will legalise de facto private ownership of land. Because of these changes, small herd owners face diminishing access to traditional seasonal watering points and grazing land, which is now frequently severely degraded by large herds. While land policy remains unresolved, there is no real legal basis for the development of collective land ownership or effective mechanisms of common property resource management by local communities.

22. A further factor bringing about degradation of grazing land and leading to economic costs for the users is the history of poor planning and management of waterpoint development, especially boreholes. These have frequently been sunk in reaction to periodic droughts and increases in demand without proper consideration of their spacing, the capacity of surrounding land, and the changing patterns of grazing demand. As large herds have tended to establish a more permanent presence at water points, pasture degradation in coalescing circles has ensued. Salinisation of shallow wells and boreholes may also occur, depending on soil conditions and the salinity of underlying aquifers because abstraction of water takes place at a far greater rate than recharge, owing to the demands of large numbers of livestock.

23. A series of other policy factors have a bearing on desertification trends by their effect on the disincentives they create for conservative land and resource management. The historical absence of effective rural development policies for the communal areas has resulted in very little in the way of marketing infrastructure, support for agriculture, or off-farm employment and investment opportunities. In addition drought management policy has been largely reactive, does not encourage livestock farmers to destock, and does not engage with the need for preventive land management.

Economic costs in the commercial farming areas

24. In the commercial sector the primary economic cost imposed by desertification results from bush encroachment in the northern beef ranching areas. This is estimated to affect 8 - 10 million Ha, and to reduce production by up to 30 %, or 34,000 tonnes of beef per year. This in turn is estimated to have resulted in annual losses worth approximately \$100 million, over the past 40 - 50 years; the annual loss is considerably higher at today's prices.

25. Bush encroachment processes are poorly understood and very difficult and expensive to reverse, and further research is required. Calculations made by the researchers indicate that mechanical and chemical treatments are too expensive to warrant widespread use and yield negative returns; chemical treatment and burning also carries further environmental risks. Game farming is a profitable alternative to beef production which may reduce encroachment but requires high capital investment and there is limited scope for further development since it is highly dependent on tourism.

26. Charcoal production is a profitable method for removing bush but is constrained by lack of markets. Intensive, rotational grazing management shows considerable promise as a method of avoiding encroachment while maintaining high levels of income, but more data is required to demonstrate its effectiveness and justify its extension.

27. The smallstock industry in the south faces problems in maintaining profitability to cover its costs, and drops in international prices as have occurred in the karakul pelt market, and in the mutton market as may result from the GATT agreement, subject farming to further pressure. Farmers' attempts to adjust to adverse circumstances by maintaining or increasing stocking rates may lead to further rangeland degradation. However in view of the fact that the environment is already extremely arid and unproductive desertification does not appear to be the main issue for livestock farming in the south.

Causes in commercial areas

28. In commercial areas both north and south, overstocking in order to maintain high levels of production and profitability appears to be one negative factor degradation, although in southern areas where smallstock farming predominates, very low rainfall is the major factor limiting pasture and animal productivity. As a result degradation is believed to be taking place although animal numbers have remained roughly constant, and further research is required to establish its extent.

29. Negative policy factors include continued availability of drought subsidies on a *post hoc*, per animal basis, which effectively reward poor land management and overstocking, rather than discouraging it. Instead, drought monitoring and prediction needs to improve, in order to enable farmers to destock and adjust in advance. The uncertainty of land policy also has an effect on the commercial sector, undermining confidence, inhibiting long term planning and investment, and encouraging the short term mining of land and vegetation resources.

30. International price factors and trade agreements also have an impact on the commercial sector. Access to protected markets effectively provides a subsidy to the beef and livestock markets, and changes in quotas and tariff structures under GATT, and changes to SACU which lower prices or market demand for Namibian exports may influence stocking rates. However there is no clear cut relationship between price changes, stocking rates and land degradation, because farmers may either seek to withdraw from the industry or diversify, or they may increase stocking rates to compensate for lower prices by producing more. Much depends upon farm management strategies and the ways in which farmers respond to exogenous change.

Impacts of desertification at national level

31. National level impacts in the communal sector include the aggregate losses of subsistence, income and capital livestock assets. These are reflected in lower nutritional levels and standards of living and poor food and energy security at household and regional levels. In addition there is lost potential productivity, trade and employment, primarily in agriculture but also in the wildlife sector,

32. In the commercial sector there are losses in production, leading to losses in farm incomes, tax revenue, export earnings and employment. In addition, potential commercial timber resources stocks are under severe pressure from deforestation and woodland degradation.

33. In addition to the direct costs of desertification on subsistence, incomes and revenue, it is also necessary to consider the actual and potential indirect costs imposed by the need to invest in programmes of rehabilitation. Substantial programmes of public spending may be required in order to safeguard and restore water supplies for human and animal populations as a result of salinisation due to poor management, planning and excess demand. In addition desertification is ultimately likely to impose further demands on welfare spending and for employment creation and income generation in the non-farm and urban sectors.

34. Desertification imposes finite limits on the productive potential of agriculture and the contribution of the sector to national economic growth is unlikely to grow. It exacerbates the exodus of young male labour from the communal areas and raises the demand for off-farm incomes, reinforcing the extremely uneven pattern of rural / urban development in Namibia. If land degradation continues unabated, then the contribution which agriculture makes to subsistence in communal areas will be considerably reduced, and it is unlikely that programmes of investment in industrial development and employment creation will be able to keep pace. Substantial welfare costs are likely to be borne by the present and the next generations of rural Namibians, possibly in the form of more and more severe drought impacts, and slower recovery, necessitating extensive relief programmes. There is thus a case for significant short and medium term investment in sustainable agricultural development and good preventive land management to contain desertification trends and to maintain the productivity of communal sector natural resources.

Conclusions and Recommendations

35. As a result of desertification there are national level policy needs for the clarification of agricultural strategy and land policy, as well as for the closer integration of drought preparation with the control of land degradation, and the phasing out or elimination of drought subsidies. In addition there is a need for improved environmental assessment, not only on a project by project basis, but also for programmes of investment and policy, especially in the water sector. The introduction of natural resource accounting, and the careful assessment of costs and benefits of desertification related programmes and investments. In general, agricultural and regional development policies need to be assessed from an environmental point of view, and the sets of incentives available to farmers modified so as to encourage better, longer term land and resource management.

36. The study makes recommendations for further research into the causes and consequences of land degradation in Namibia. This should involve an integration of biophysical and socio-economic research, not only to provide the data for an adequate assessment of economic costs, but also to allow for effective monitoring of desertification processes and the effectiveness of efforts to combat them.

37. Remote sensing provides a powerful tool for monitoring changes in vegetation, and the techniques have potentially useful applications alongside socio-economic monitoring and ground-based participatory resource appraisal and planning involving local communities. Bush encroachment, rangeland quality, deforestation, fire and fencing monitoring are all potential topics for this sort of interdisciplinary investigation.

38. Other areas for participatory research are sustainable woodland utilisation, (eg coppicing and rotation systems) crop yields, manure and soil fertility, and the development of common property management systems for woodlands, rangelands and wildlife. As well as technical ecological aspects, this work also needs to consider economic, institutional, legal and socio-cultural dimensions.

39. The report concludes by making recommendations for training and human resource development, for professionals, technicians and at community level. Environmental and resource economics is an important specialism, but emphasis also needs to be placed on interdisciplinary approaches to environmental management and on agricultural economics. In-country research projects for Namibian graduates supervised by appropriate regional or international institutions should be identified and developed, together with capacity development for national training institutions. Professional development and training should be linked with and training at local and community level so as to effectively respond to local development needs and build community-based resource management capacity. Environmental education at all levels is also important, and the value and the need to maintain the renewability of fragile land and water resources should be emphasised.

Two sections of the full report have been extracted and reproduced here:

Section 4: Case Study Findings and Implications

Section 5: Recommendations for Research, Policy and Training

The Table of Contents of the full report is also reproduced as an appendix. Copies can be found at the DEA, MAWRD, DERU, and other libraries.

Section 4: CASE STUDY FINDINGS AND IMPLICATIONS

4.1 Overview

The case studies established that the nature of the causes and consequences of desertification are quite different in the communal and the commercial areas, as anticipated.

The drops in outputs and economic losses that may be resulting from degradation processes on commercial farms are relatively easy to identify, despite the lack of data on the levels of degradation and bush encroachment and the lack of ecological understanding of the dynamics of causation. In addition, the consequences for the national economy in terms of the levels of output, economic activity, and export and tax revenue are much clearer.

In the case of the communal areas the situation is much more complex, especially in the north, although perhaps in some ways reasonably well understood. A number of different biophysical and socio-economic conditions are at work, interacting in complex ways. The stakeholders and economic consequences are multiple, and consequently, generalisation and extrapolation to the national level is much more difficult. Moreover the fundamental conditions of access to the land resource are much more limited in the case of the communal areas.

4.2 The communal areas: Gibeon and Uukwaluudhi

The two areas, Uukwaluudhi in Omusati Region (part of former Ovamboland) in the north of the country, and Gibeon, in Hardap Region (part of former Namaland) in the south are quite distinct agro-ecologically. Ovambo areas, with higher rainfall support much more varied vegetation, including woodlands, savannah and seasonally inundated grasslands. Mixed farming predominates, including rainfed millet production and a high proportion of cattle in the livestock sector, and population densities are much higher. The rainfall in the south is much lower, and insufficient for crop production. Since the rains do not permit the growth of well developed grasslands, small stock predominate over cattle. In addition the topography is more varied in and land in the southern semi-desert areas is significantly more prone to soil erosion.

A further distinguishing feature is that the land resource in the southern communal areas was never intended to support the population, and Namaland was in effect a "tribal" homeland created by the Odendaahl Commission, in part through the allocation of unproductive former commercial stock land. In contrast Ovamboland was never subject to commercial occupation, although sharply demarcated from the rest of South West Africa by the veterinary cordon fence, and indigenous farming systems were relatively undisturbed.

4.2.1 The impact of desertification in Uukwaluudhi

A number of simultaneous degradation processes are taking place in Ovambo areas, affecting not only rangelands and pasture, but also woodlands and arable land. There has been extensive deforestation and woodland degradation since historical records began in the last century, due to population pressure, and stocks of trees and tree products are declining. As a result there is a growing user cost, in terms of increased in labour time, increased transport costs, and expenditure on commercially available substitutes, notably for building materials and fuelwood. Since pressure is continuing there will be a significant future costs in delivering substitute resources to those provided by the natural woodlands.

Rangelands are under pressure due to the expansion of human settlement, high cattle numbers, recurrent drought, the absence of effective systems of rangeland management, and badly planned water development. Grazing is now scarce in the vicinity of homesteads, available pasture is less able to support livestock, and there are changes in the patterns of mobility of herds. Animals

VALUING THE COSTS OF RESOURCE DEGRADATION

TYPES OF COST	POSSIBLE METHODS OF VALUATION
Deforestation	
Increased time or transport costs for fuelwood collection or substitute costs of commercial fuel	opportunity cost of labour, transport costs market prices
Increased time for building materials collection, fence building and maintenance or substitute costs of commercial fencing building materials or lost value of natural substitutes	opportunity costs of labour market prices market prices or lost earnings
lost value of non-timber forest products	market prices or lost earnings
Wildlife	
lost recreational /cultural value of wildlife	willingness to pay / invest
lost value of bushmeat/ animal products	market prices of commercial substitutes
lost existence value of forests and animals	willingness to pay / not monetisable
Rangeland degradation	
Lost capital value of dead animals	market prices for restocking
Lost value of milk production due to death and absence of animals and low pasture productivity	market prices of substitutes market price of reduced sales
Additional expenses maintaining animals on distant pasture	herding, transport and water supply costs
Fertility loss of arable land	
Lost value of arable production due to fertility decline commercial	market prices of substitutes for lost crop production or replacement costs of manure / fertiliser.

now spend a large part of the year at distant cattle posts served by boreholes, and where there is intense local degradation of pasture. As a result of these changes and the persistently unreliable rainfall of recent years, livestock numbers are now lower, livestock are less productive, and important livestock products such as milk and manure are less available. The economic consequences include a run down of local people's capital assets (in the form of livestock), and lower levels of income and subsistence.

In addition shortages of animal manure are hastening the run-down of fertility on arable plots,

compounding the effects of drought and labour shortages in depressing crop production . All in all desertification increases the vulnerability of farming and livelihood systems to the effects of drought, and hinders recovery after drought. For poor people in particular it is increasingly difficult to maintain livestock, especially cattle, and there is growing differentiation in livestock ownership and access to good quality grazing land between rural rich and rural poor.

In general terms the processes of desertification are more complex in the north, and a wider range of resources are at stake, forests and woodlands and arable land in addition to rangelands and grazing resources, which are the primary resource in Namaland, and common to both areas.

**SOME INDICATIVE MONETISED COSTS OF RESOURCE DEGRADATION
FOR AN UKWALUUDHI HOUSEHOLD**

	\$ per year
Lost fuelwood supply	\$720
Cost of commercially purchased fuelwood 1 bundle/day @ \$2 per bundle	
Lost fencing materials	\$400 - \$640
Cost of purchasing wire and poles for replacing 1/5 of fence around mahango field	
Lost livestock due to lack of access to grazing, exacerbation of drought	\$480
Replacement cost of 2 cattle, 3 goats	
Lost milk output due to lost/inaccessible cattle	\$300-600
50% of loss of 6 months output of small milking herd Costs of purchasing substitute protein plus loss of income from sale of surplus	
Reduced millet production due to shortage of cattle dung	\$165
Purchase of commercial substitute foods (mini-meal) for 1.5 months	
TOTAL notional monetisable costs which might be incurred in a single year:	\$2,065 - 2,565

These costs are beyond the means of most households in Ukwaluudhi and the Ovambo region, according to data available. In practice people's coping strategies are to:

- use natural substitutes, which has an opportunity cost, either for the labour time or for the substitute's better alternative uses;
- use commercially available substitutes, at urban or village prices
- rely on informal family or local support structures, which may carry reciprocal obligations;
- go without;

all to varying degrees, according to the opportunities and means available.

Notes:

1. Non monetisable economic costs are excluded
2. Building and house/fence maintenance costs have not been calculated and are excluded, although in principle monetisable.
3. It is assumed that 3 months' millet requirement and 6 months' milk output is lost, of which 50% is attributable to long-term degradation rather than drought. In practice, these two sets of losses are inseparable and the costs faced by households would be higher.

4.2.2 The impact of desertification in Gibeon

In Gibeon, where the quality of the range is generally poor, the main impact of desertification has been vegetation degradation and reduction in grass cover. As a result of continued pressure, and lack of overall management of the impoverished range, livestock nutrition is poor, productivity is in decline, and animals are more susceptible to drought and disease. The economic costs of desertification involve a reduction in available livestock products for both subsistence and sale, resulting in lower levels of household income and nutrition, and a high level of dependence on off-farm income sources and pensions.

4.2.3 The impact of rangeland degradation, north and south

Although the processes and effects of desertification are more complex in the north, there are nonetheless, a number of common features to rangeland degradation in the two cases, and a number of points of contrast.

- * In each case there is vegetation degradation due to localised overgrazing, especially around water points, combined with the effects of drought, and the impact of these two processes is difficult to dissociate. The nature of the economic consequences are similar, with similar costs imposed on rural households: lost subsistence production and lost incomes. In addition to the user costs there are external costs imposed on local communities by outsiders with large herds exploiting common land.
- * In both cases people report decreasing availability of milk as a result of low pasture productivity, and also of dung. In Ovambo, the shortage of dung has a critical impact on arable production. In Gibeon there is virtually no arable farming, although dung is used for fuel and for building.
- * In southern communal areas there are indications that livestock sales as a source of income are more important and that there is a greater reliance on meat in the diet. Consequently the loss of livestock numbers and declines in livestock prices have a greater direct effect on both incomes and diets in Gibeon. In Uukwaluudhi livestock sales appear to be less important and the losses to subsistence involve primarily lowered access to milk, and lower cereal outputs as a result of multiple factors, including the scarcity of dung due to declining pasture productivity and changing patterns of cattle mobility.
- * In both cases water problems (limited water sources and salinisation) are major constraints on livestock farming and tend to rank highest in local people's minds when desertification is discussed; in each case there is political pressure on government to improve water supply.
- * In both areas, there has been a similar history of breakdown of land management systems. In former Namaland a system of land management by "traditional" leaders was instituted with the creation of the homeland, although it is not clear whether or not it ever really served to manage the land resource in the best interests of the people as a whole. In Ovambo there was a pre-existing tradition of common property resource management although this was manipulated by the South African regime and has subsequently proved inadequate. In both cases the traditional leaders appear largely discredited, and the problems of large herd owners (with or without access to private land) grazing on communal ranges by payment of the headmen appears to be a growing problem.
- * The pattern of rangeland degradation appears to be more extensive in the Gibeon areas owing to the low productivity of the range, whereas in Ovambo it is more confined to the areas around water points, dwellings, roads and arable land. However since these

developments are growing in number and the use of remaining grazing corridors is largely unregulated, degradation is intensive.

- * There is some problem of encroachment by unpalatable or toxic pioneer species in each case. In the south this may be more severe, but localised, whereas in Ovambo the risks are rather of gradual changes in the composition of annual and perennial grass and herbaceous plant populations.
- * Enclosure is a developing problem in Ovambo, whereas in Namaland, where legal title to some former settler farms has been available, there is a problem of over stocking of some fenced farms.
- * There is a similar pattern of differentiation amongst richer and poorer stakeholders in natural resources, and amongst larger and smaller herd owners. External stakeholders, such as absentee cattle owners and business people have a role in each case but appear to be more numerous and powerful in the Ovambo region.
- * In both areas firewood is growing in scarcity and women spend increasing amounts of time collecting it. In the south there is a great scarcity of woody biomass, except in seasonal river valleys because of low rainfall, and animal dung is more important as a source of fuel, although in parts of Ovambo, local scarcity may be approaching similar levels in the more densely settled central areas. Although Ovambo still has possibilities of supply from remaining woodlands however, population pressure on firewood and building timber stocks is much greater.
- * The situation in the south is already extremely hard because of extreme aridity and lack of land. In northern areas, with higher population, and greater productivity, and a richer natural resource base, there is more at stake with desertification: more people stand to lose, in multiple ways, and if present trends continue the future costs may be much higher.

4.3 Commercial farmlands case studies

4.3.1 Northern Commercial Areas

There is a lack of reliable data on the area of land affected by bush encroachment, the causes and the precise effect it has upon beef production. Aggregated data for the cattle population and the numbers of animal marketed has changed little between 1981 and 1992 (Section 1). The national cattle population has remained between 2.08 and 2.26 million during this period with relatively small annual variations. It is impossible to deduce from this data a declining trend in productivity. Whether bush encroachment has stabilised or not is unclear. The effect is not however, the result of large scale reclamation works by farmers, a small minority are attempting to tackle the problem of bush encroachment.

Bush encroachment has a serious effect upon the productivity of individual farms and stocking rates are estimated to have fallen by 30-40% over the past 40-50 years. It is estimated that this fall in stocking rates may result in an annual loss in gross farm income of around \$100 million.

The mechanical and chemical treatments for bush control are currently too expensive to warrant their wide scale use. The returns to bush clearance will not cover the costs of treatment over a period of ten years. There would have to be a considerable increase in the price of beef to make these activities viable. This is unlikely in the foreseeable future with the GATT agreement to come into effect in 1995.

Charcoal production is a profitable method of removing bush but further development is constrained by a lack of markets for the product. Game farming is a profitable alternative to beef production but requires high capital investment and is beyond the capacity of most farmers. Whether there is potential for further development of this industry is questionable as it is highly dependent upon tourism for its income.

Intensive grazing management displays some potential as a means of controlling bush encroachment and increasing incomes. However, there is a shortage of available data to prove conclusively that this potential warrants the extension of this technique.

There is concern amongst the farming community that the lack of a definitive policy on agriculture and land reform is retarding investment in commercial farms and leading some farmers to seek short term gains at the expense of the environment.

The major implications for policy and future research resulting from this study include:

- the need to improve the collection and analysis of data on bush encroachment, in order to establish its true extent, causes, impact and the viability of methods of rehabilitation. Methods should include the use of remote sensing techniques to establish the true extent of bush encroachment, and its rate of change.
- the need to compare the available farm management data from commercial farms (which is believed to be extensive) so that the best management systems can be identified and the rate of bush encroachment assessed;
- it is essential that government devise a policy on land reform and agriculture to improve farmers confidence and allow increased investment (if appropriate) in their farms.

4.3.2 Southern Commercial Area Case Study

Small stock farmers have in recent years switched from karakul pelt production to Dorper mutton production in response to the declining demand for karakul pelts. There is no precise data, but this change may have been associated with a decline in the productivity of pastures. However, the small stock population has remained relatively constant between 1981-92 with the exception of 1983 at between 4-5 million. The number of animals marketed during this period has shown an upward trend (0.75 million in 1981) and reached 1.35 million in 1993. This data does not indicate a decline in productivity as a result of land degradation.

Small stock farming is undergoing a crisis with income only sufficient to cover costs of production which is partly the result of poor producer prices, drought and farm sizes that are too small to generate a reasonable return. Those farms most at pressure are smaller units and those that have borrowed heavily in recent years.

It is generally believed that environmental degradation is taking place in the southern commercial farmlands (even if the production data do not support this) and involves the destruction of useful vegetation. This degradation is probably taking place as a result of overstocking, in particular by smaller and indebted farms.

The causes of degradation can be summarised as follows:

- falling incomes and the need to keep more stock to make a living;
- overstocking, leading to pasture degradation and falling incomes;

- the switch to Dorper sheep rather than karakul, without adjusting stocking rates;
- persistent drought;
- drought relief, which discourages farmers from destocking early in drought as they await the government payments;
- drought relief payments for purchasing fodder which enables farmers to keep livestock and prevents range recovery after drought.

Falling incomes are associated with:

- increased taxation;
- uncertainty about land reform and an unwillingness to invest in farm improvement;
- poor producer prices;
- uneconomic farm size in relation to producer prices.

The future for mutton prices is bleak and income is likely to be further squeezed by the depressing effect of cheap mutton imports after the inception of the GATT agreement. This may have the effect of increasing the number of farmers suffering from insufficient income, who in turn are forced to increase stocking rates which will lead to accelerated degradation. This is likely, in the long term, to cause the collapse of the small and indebted farms.

4.4 The case studies in the national context

The case studies are illustrative of land degradation and land management problems in Namibia, although we are conscious that without careful investigation of the areas not covered by the study it is very difficult to generalise about the economic costs of desertification. The case studies were chosen in part because serious degradation risks had already been identified in those areas because of population pressure, the intensity of land use and mismanagement.

4.4.1 The communal areas

Nonetheless, especially in the case of the communal areas, serious problems of a similar nature are known to exist and it is reasonable to assume that the types of economic cost identified, if not their scale, are representative of the national picture.

* *Losses of subsistence and income for rural families*, from crop and livestock production, although in areas where crop production is not possible on any scale (e.g. Hereroland), the significance of the costs incurred as a result of poor grazing management and changes in the pattern of access to land are likely to be more significant. Where mixed farming is practised (e.g. in Kavango and Caprivi), the linkages between the two sectors are important and the costs of degradation are also likely to be felt by arable farmers. The productivity of traditional pastoral management systems, where livestock are kept for multiple benefits, has been decreasing.

* *Relatively higher costs borne by poorer and female headed households*, with lower access to labour and capital assets. These households are less likely to have possibilities of investing cash or extra labour time in acquiring substitutes for the subsistence benefits lost through desertification.

- * *Growing burdens on women's labour time* as a result of increasing scarcity of firewood, water and bush products.
- * *Increasing importance of access to off-farm cash income* in order to pay transport costs and market prices for substitutes for farm or bush products.
- * *Increasing importance of access to motorised or animal drawn transport* as a result of growing scarcity of these products, as well as milk and manure.
- * *Many of the coping strategies adopted by people, allow substitution of subsistence benefits in the short term, but involve higher external social costs;* opportunistic firewood sales, use of living timber, palm and marula nuts for fuel, year round use of seasonal grazing, and the growing use of donkeys as draught animals all carry a social cost by depleting the stocks available to others and to future generations.
- * *The growing inadequacy of existing "traditional" mechanisms for allocating land, and controlling access to grazing, water and forest resources*
- * *An increasing tendency for enclosure of land* by entrepreneurs and large herd owners, in the absence of effective means of land allocation and in anticipation of the privatisation of enclosed land

4.4.2 The commercial areas

The principal economic impacts of desertification in commercial areas are the user costs of lower productivity and profitability imposed by the bush encroachment and overgrazing which result from poor grazing management and overstocking. Production losses in northern commercial areas due to bush encroachment are directly attributable to land degradation problems. In the south overgrazing leads to poor pasture development which is especially problematic when rains are poor; production losses are thus frequently due to a combination of desertification and drought processes. A number of factors linked to desertification and common to commercial areas as a whole can be identified from the case studies; these require continued attention and monitoring..

- * *The growing significance of bush encroachment* and the importance of improving the ecological and economic understanding of the causes, and possible alternative solutions especially improved methods of grazing management.
- * *The importance of attention to stocking rates* which are variable according to agro ecological conditions, and types of livestock (e.g. dorpers or karakul sheep). Very careful management is required in order to maintain stock in arid variable environments, and farmers need to balance availability of buffer grazing resources, and supplementary feeds, with the needs to destock and develop alternative income sources.
- * *The effect of price factors which depress returns and profitability* and may lead to farmers overstocking in the absence of alternative income options.
- * *The impact of policy factors such as drought subsidies* which may lead to overstocking, and bring about net economic losses through pasture degradation, although delivering short-term financial benefits to farmers.
- * *The impact of international policy factors* and changing patterns of access to global markets which can affect farm profitability and influence stocking rates and management practice.

4.5 Economic Impacts at the macro level

The type and scale of economic losses attributable to land degradation processes in Namibia are summarised below. In some cases, where data is available, we have calculated indicative costs, based on the figures presented in the regional case studies. These figures should be treated with great caution however, in view of the fragmentary data on which they are based, and the consequent somewhat arbitrary nature of many of the assumptions which have had to be made in order to arrive at a quantitative measure of costs.

4.5.1 Subsistence and income losses in the communal sector

We have estimated that over the years, crop production in communal area may have been reduced by 3-months supply, or around 270 kg (worth \$330 at substitute market prices), a year (Box 4, case study 1), for a household of six. Milk production losses due to fewer or more distant cattle may be around \$900 (Box 3, case study 1), in an average rainfall year, as opposed to a severe drought year. If 50% of these losses is attributed to desertification as opposed to the poor rains, the desertification costs per household are \$615 per year. In addition, land degradation contributes to livestock losses through loss of access to pasture, exacerbated impact of drought, and slower recovery from drought. The cost of replacing two cattle and three goats would be \$480. Families have also lost access to fuelwood and fencing materials due to deforestation: if these were substituted entirely with purchased wood, a bundle of fuelwood per day would cost \$720 per year, and replacement of one fifth of a mahango field's fence, would cost \$400 - \$620. As the box on page 12 shows, total costs per households could reach over \$2,000 in one year.

These are only indicative figures, and it is very difficult to generalise about the impact of such changes across the communal areas as a whole. Nevertheless, given that there are around 124,000 rural households in northern communal areas, of which most grow crops and around half own or used to own cattle, very tentative calculations can be made of the current cost of reduced output and resource availability now compared to many years ago: if three quarters of rural households in the NCAs faced similar crop losses due to lack of manure (from their own or neighbours' cattle) and increased time pressures, and one half of households suffered losses of milk supplies then the aggregate cost faced by communal farmers is around \$43 million per year. If, in addition, each households replaces one quarter of their annual fuelwood and fencing needs with commercially purchased materials, a further \$37 million is incurred. **The total cost, of lost subsistence and cash income and increased expenditure, is therefore in the region of \$81 million per year.** This excludes capital losses of livestock attributable to desertification (see 4.5.3 below) and the cost of additional time and effort spent on securing resources due to diminished availability.

Although this slightly less than the losses estimated in the commercial sector due to bush encroachment (below), the cost in welfare is more significant in that they represent subsistence losses for a very much larger number of people, whose alternative options are extremely limited.

It should also be noted that these figures do not capture the increased costs of cattle keeping (herding, provision of water etc) which result from poor pasture availability. Although productivity in the strict commercial sense does not apply to livestock keeping in the communal areas, overall, there appears to be a lowering of productivity of traditional forms of pastoralist land use (where cattle are kept for their multiple benefits). The rising cost/benefit ratio (increased costs and relatively fewer benefits) of cattle in a degraded, arid environment, make them less useful as a form of drought security for the poor.

4.5.2 Declining food security

The major impact of these losses is to further undermine nutritional levels and food security in the

communal areas. The production losses noted above reflect drops in average production, which in the case of cereals is already insufficient to meet subsistence needs throughout the year, and not the total deficit of cereal production against requirements. In practice some of the losses are made good, through market purchases of food, but only because people have additional income sources. These incomes thus come under additional strain because of land degradation. At regional and national level, the requirements for additional food transfers including food imports, as well as income transfers are likely to grow as land degradation proceeds.

4.5.3 Livestock losses in the communal sector

Communal area livestock production accounts for 10 - 12 % of agricultural GDP (IFAD 1993), or about 1 % of total GDP. Its contribution to rural livelihoods in communal areas is much more significant however. In so far as desertification processes are responsible for the death or disease of livestock, they contribute to the capital losses faced by communal area households at times of drought or in poor years. According to veterinary service figures cattle numbers in the former Ovamboland areas alone have fallen by 185,000 in the two year period to 1994. Although this estimate may include some sales (the basis of the most recent stock census figures is not clear), and the losses cannot be directly attributed to land degradation rather than drought, at a potential sale price of \$700 per head, the figure represents an estimated total loss of \$129.5 million, or \$64.75 million per dry year.

In addition to exacerbating during drought, desertification may also reduce long-term livestock ownership of many families by making grazing less accessible, increasing herding costs, weakening cattle, and increasing competition for and privatisation of pasture. If, over the years, 50% of households have lost 2 cattle and 3 goats, the aggregate cost across the northern communal areas (at market prices for replacements) is \$30 million. So in a year when 5 such stock are lost and/or replaced, the total costs faced by communal farmers, including the subsistence losses in 4.5.1, are over \$110 million per year.

4.5.4 Loss of potential agricultural marketing opportunities in the communal sector

70% of livelihoods, including those in the communal areas are dependent on agriculture. Although the primary problems are the historical underdevelopment of indigenous agricultural under colonial rule, and the continuing lack of effective strategy today, land degradation also plays a role by depressing levels of agricultural production and holding back the emergence of trading and employment opportunities from the communal agricultural sector. In addition the uncontrolled impoverishment of the natural resource base in communal areas reduces the potential contribution of forestry and wildlife to local and regional economies.

4.5.5 Lost commercial production due to bush encroachment and range degradation

8 - 10 million hectares of commercial beef range, mainly in the Otjivarongo/Grootfontein area, are estimated to be infested with encroaching bush species reducing available grazing by 30%. *This is believed to lead to losses of production of approximately 34,000 tonnes of beef, worth \$102 million, per year.* Average gross income lost by the 2,000-plus individual farmers is of the order of \$49,500 per farm per year. If production costs averaging 50% of revenue are not incurred for the infested land effectively withdrawn from production, average *net* income lost is approximately \$24,700 per farm. It should be noted that at current beef prices the value of lost production would be even higher.

Although cattle numbers are lower than they might be without bush encroachment, total numbers of cattle and levels of beef production have nevertheless remained more or less constant in the period 1981 - 1992, suggesting that farmers have managed to adjust, although not by successful control of bush encroachment.

The situation certainly does not merit investment in herbicidal control which has a negative cost benefit ratio in financial terms and also carries environmental risks. Bush utilisation in charcoal production is promising, but there is a need for market development for Namibian charcoal. Intensive rotational grazing may prove more rewarding but needs much fuller investigation.

In addition to bush encroachment there are losses of profitability of small stock enterprises in the arid south-west, where total availability of pasture may be declining due to drought, leading to some farmers going out of business. In the south the collapse of the karakul sector, due to international market factors may have an environmental impact, by encouraging overstocking of sheep and goats of different breeds, in order to maintain profitability, affecting the overall productivity of the range, although overall numbers of sheep and goats are not increasing. No attempts have been made to quantify the impacts of these changes however.

4.5.6 Lost export earnings and tax revenues

The annual losses in tax revenue to the state due to lost production from bush encroachment are estimated at \$12.7 million. 80% of commercial livestock production is exported (IFAD 1993) and the total losses in the export value of beef production may be as much as \$500 million over the last 30 years.

4.5.7 The costs of expenditure on subsidies and drought relief support

In addition to their direct costs in terms of recurrent government spending, drought subsidies, although providing short term benefits for farmers incur environmental costs by encouraging farmers to overstock, and offering a disincentive for farmers to adjust their management practices to the requirements of a variable, drought-prone environment.

4.5.8 Employment

Commercial agriculture directly contributes only around 10.7% of annual GDP but is an important source of employment as well as providing important linkages with secondary sectors such as input supply, processing and transport. Bush encroachment may have contributed indirectly to limiting growth in employment.

The losses of profitability and the failure rate of small stock enterprises in the arid south causing some farmers to go out of business and leading to a loss of employment opportunities for farm labour and also to shrinking in the size of the secondary sectors of input supply and meat processing. (As farm size increases total employment opportunities and output are likely to decrease). A similar situation may emerge in the northern commercial areas in the face of declining production .

4.5.9 Fuelwood scarcity and energy security

Total annual fuelwood consumption in Namibia has been estimated as 1.66 million cubic metres (Ollikainen, 1991). Although this volume of wood represents primarily particular species which are preferred for fuelwood, in relation to a total estimated mean annual increments of woody Biomass for the country of 34 million tonnes (World Bank estimates, Erkkila and Siiskonen, 1992), consumption levels do not give particular grounds for concern (1 cubic metre of wood is roughly equivalent to 1 tonne). A more serious problem however is the levels of household and regional energy security in the high population areas where forests and woodlands are being rapidly depleted. While regional supplies need to be conserved, fuelwood markets need to develop in such a way as to redistribute fuelwood from surplus areas, to the potential deficit areas, where scarcity is leading to price increases, and to mining of woodlands by commercial suppliers, and to growing opportunity costs for subsistence fuelwood gatherers.



Loss of Mopane: from trees to shrubs

According to local residents, mopane trees used to grow in this area of Uukwaluudhi, but now only mopane shrubs grow.

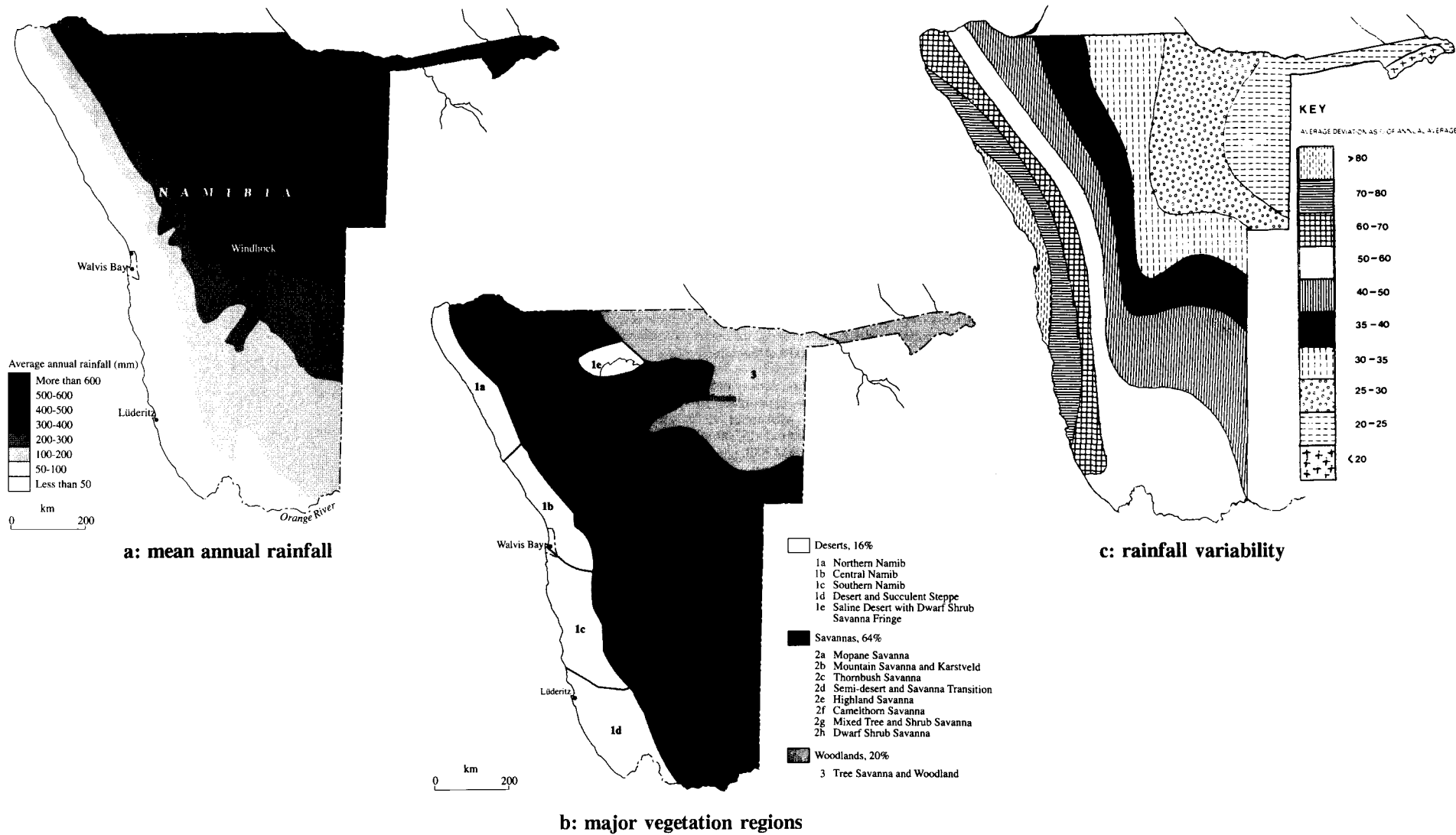
Credit: DERU



Fencing for the fields

Due to growing scarcity of mopane timber, this farmer has to use more, thinner, branches, and palm leaf stems for his fence than he used to. A typical 3 hectare homestead with mahangu field requires 800 metres of such fencing.

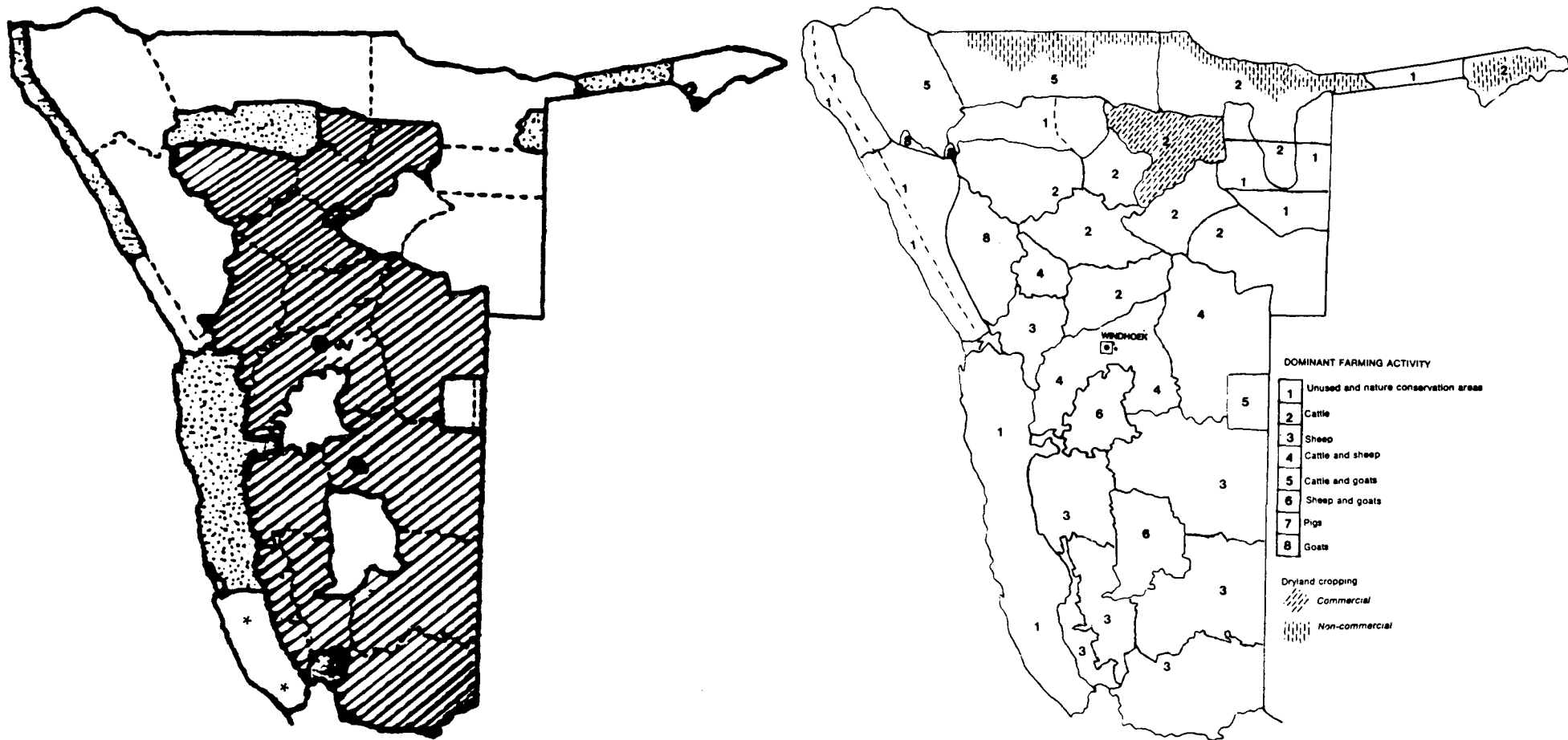
Credit: DERU



Vegetation and rainfall zones

Moving from south-west to north-east, vegetation density and average rainfall increase. The driest areas, the south and west, also experience greatest variability of rainfall.

Sources: A and B reproduced from Moyo et al, 1993, adapted from Erkkila and Siiskonen, 1992. C reproduced from Adams and Werner, 1990, adapted from van der Merwe, SWA, 1983.



a: Land tenure
 Commercial farmlands (hatched) 45%. Communal land (unmarked) 40%.
 Proclaimed conservation areas (stippled) 13%. Protected diamond area (starred) 2%.

b: Farming activities

Land tenure and farming activities in Namibia

In northern communal areas, approximately 120,000 farming households practice mixed subsistence farming (mainly cattle and millet). In commercial areas, there are approximately 6,000 farms, raising cattle (in the north/centre), sheep and goats (in the south), for commercial sale and export. In the southern communal areas, approximately 20,000 households rely on small-stock for their livelihood.

Sources: A reproduced from Brown, 1993. B reproduced from Adams and Werner, 1990, adapted from FNDC, 1989.



Converting bush encroachment to charcoal on a farm near Okahandja

Credit: DERU



Melkbos (milk bush)

An invasive plant that appears to thrive in some degraded areas around Gibeon, causing blindness and sickness among livestock and humans.

Credit: DERU

4.5.10 Depletion of timber stocks and lost potential future income

By tropical African standards Namibia is not highly endowed with timber resources. Nonetheless, timber stocks are such that there is some potential for increasing national self-sufficiency in timber products, and for limited exports. Policy on commercial timber exploitation is good, with stumpage costs for commercial species set at a high level, and there are requirements for in-country processing of sawn timber, allowing Namibia to maximise the benefits from its small-scale timber industry. However, there are no effective controls on the depletion and degradation of woodland resources, leading to damage to standing timber stocks, undermining longer term resource potential.

According to the Forestry Directorate, approximately 300,000 ha of woodlands are subject to degradation due to fire and illegal harvesting each year, preventing regeneration of timber stocks. The mean volume of growing stock of commercial species (*Pterocarpus angolensis* and *Baikia plurijuga*) has been estimated at 6 m³/ha, comprising 2-3 trees of these species with sawlog volumes of 2 -3 m³ (1968 figures given in Erkkila and Siiskonen, 1992), for Caprivi and Kavango. If the whole area of forest subject to degradation is assumed to contain this volume of timber (which it may not), then 1.8 million m³ are at risk each year. At the stumpage price of \$400/m³, the annual losses of timber standing stocks may be worth up to \$720 million.

It should be emphasised that this figure represents damage to standing stocks, not lost timber production, since only a small proportion of the timber stock is exploited commercially, and markets may not exist on anything like this scale. Moreover, even if they were it cannot be assumed that commercial forestry would be the appropriate use of this land. Nevertheless, assuming that 50% were available for agriculture and artisanal use of timber by local people, the annual losses of exploitable timber stocks would still be \$360 million.

4.5.11 The long term costs of water mismanagement

Water is one of Namibia's scarcest and most precious resources, and its sustainable use will be a critical factor in sustaining agriculture and rural livelihoods. Improper use can deliver short term benefits in crop and livestock production, but where supplies cannot be sustained, for example where boreholes become salinised or simply dry up, these benefits will not be sustainable, and future crashes in production can be expected, in view of the high costs of supplying water from alternative sources. In general terms the rate of water abstraction should not exceed the rate of aquifer recharge; given sparse rainfall and high evaporation rates, long term planning for aquifer protection is critical. Groundwater supplies in regions such as Ovambo, which are subject to salinisation are the most critical.

To all practical intents and purposes the salinisation of soil and groundwater resources is irreversible, and attempts to tackle the problem, even where large quantities of water are available for flushing and drainage (which they are not) are prohibitively expensive.

Water sources of all kinds may be subject to mismanagement, and although pumping and pipeline schemes, for instance from the Cunene river, represent additional and relatively unconstrained supplies by comparison to Namibia's ground and surface water resources, uncontrolled use should be discouraged. This is not only because of associated damage to grazing land, but because these supplies themselves may not be unlimited and may be subject to limitations and price premia, upstream abstraction, and to the impact of drought in Angolan watersheds.

4.5.12 Summary of macro-economic costs

Although indicative costs and orders of magnitude are not available for the whole range of costs incurred as a result of desertification processes, they may be summarised as follows

- Losses of commercial beef production worth \$102 million per year plus additional losses for small stock production, reflected in lost export earnings and tax revenues, lost employment, and greater expenditure on drought relief payments and other subsidies;
- Subsistence losses for communal farmers worth around \$81 million per year (lost grain, milk, fuel and fencing), plus a proportion of capital losses of livestock during drought years worth \$65 million (losses are exacerbated by degradation). These losses are reflected in lower food security and nutrition, increased time and effort to maintain living standards, higher demands on wages and income transfers;
- Lost potential productivity, trade and employment in communal agriculture;
- Losses of energy security, with corresponding welfare costs for communal sector households;
- Lost potential subsistence and productivity derived from bush products and wildlife in the communal areas;
- Losses in the value of standing timber stocks, with consequences for the future productivity of forestry in Namibia.

4.6 Future trends and long term prospects

Environmental degradation is one of the factors constraining continued growth in the commercial livestock sector which has presently reached a plateau. If bush encroachment and poor land management continues production might be expected to decline. In the communal sector, the declining quality of land resources is a major obstacle to the development of agricultural production and trade, and if not addressed, is likely to limit further the contribution that agriculture makes to rural livelihoods and food security, placing additional demands on other sectors of the economy.

Because land degradation in both communal and commercial farming areas increases the vulnerability of farm livelihoods and incomes to the effects of drought, which is a persistent feature of the Namibian environment, it is likely that the economic costs of desertification to farmers will continue to rise. In addition, since a number of degradation processes, such as deforestation and pasture degradation around water points, become irreversible once a certain intensity of resource use is reached, the long term resource costs will continue to rise, in terms of diminishing resource stocks available for future use.

It is not possible, however, to predict the rate at which costs will rise, for two reasons: firstly, we do not know the rate at which degradation is proceeding and resources are being damaged or irreversibly depleted; secondly it is not possible to predict what changes may occur in the macro economic and policy environment within which degradation takes place. (A number of suggested areas for policy development and change are discussed below in Section 5).

Nonetheless it is possible to sketch out some of the possible longer term economic consequences if current desertification processes continue.

- Diminishing returns from communal sector agriculture, both crops and livestock: livestock, particularly cattle, will become a riskier, less productive investment particularly for poor households, and this will continue to undermine the renewal of fertility of arable plots, using manure. The decline of agriculture will exacerbate dependence on welfare payments such as pensions and food aid in times of drought (the periods during which food supplements are necessary will get longer, for poorer households at least), and

general dependence on off-farm incomes. The continuing migration of male labour from communal areas will compound the shortage of agricultural labour further undermining farm production. Because of the lack of productivity of agriculture, there will be few prospects for employment creation in agricultural trade, processing or related secondary activities

- Increasing social differentiation in rural areas between rich and poor, with growing inequalities between poor households, especially female headed, and those owning large herds of cattle, or with access to urban incomes, enclosed land and private water points.
- Commercial agriculture is unlikely to expand and may even decline, if bush encroachment proceeds and cost-effective methods of control are not widely adopted. This may lead to some abandonment of land and withdrawal of capital from the agricultural sector. Employment prospects in commercial farming, and secondary sectors are therefore also poor.
- Rural-urban migration will continue to develop and will accelerate the pace of urban growth. There will be a need to generate more jobs in mining, fishing, manufacturing and urban areas generally, and there will be rising demands on urban services. The rural-urban income gap will become wider, with rural households increasingly dependent on urban remittances, as opposed to a more mutually interdependent prosperity between town and country which could emerge under more favourable ecological conditions and a more even model of regional development.
- As time goes on, in view of the risks of growing population pressure on diminishing rural resources such as fuelwood and freshwater which may prove impossible to manage sustainably, there are likely to be needs for increasing public expenditure on bulk provision of water and firewood to rural areas.
- One corollary of a growing disinvestment in agriculture, and labour shortages, is that eventually land pressure may be effectively reduced, permitting some level of recovery, and perhaps some local increases in land availability. Ultimately some opportunities may open up for the development of smallholdings in former commercial areas and for the further development of conservation related land use such as game farming and tourism. However it will take considerable time before rural resource pressure is relieved and for investments in urban employment and development pay off in terms of jobs, economic growth and settlement opportunities. Moreover, if present trends in the concentration of cattle ownership and in *de facto* land holding by enclosure, are not arrested, any potential future benefits of eventually alleviated land pressure will be captured by rural elites, rather than ordinary farm households.

In terms of long term prospects, desertification underlines the fact that agriculture has extremely limited potential for growth; its approximately 10% contribution to GDP is unlikely to expand significantly, even in the event of favourable changes in global markets, and the approximately 1% of GDP which communal agriculture contributes is very unlikely to expand, given the historically low levels of investment. Economic growth will depend much more heavily on other sectors such as fisheries and mining, to which much greater levels of investment are likely to be directed.

The costs of increasing resource pressure are therefore likely to be borne by present and emerging generations of rural Namibians. Although Namibia's prospects for growth and development may rely on non-agricultural sectors, agriculture still makes a very important contribution to subsistence. Although investments in industrial development may be a priority, their long gestation time means that alternative income and subsistence sources are unlikely to become available in the

short and medium term, in which the human costs of resource degradation in the rural sector are potentially very high. In addition, the implication of an irreversible decline in agricultural production as a result of desertification processes is that the recurrent contribution to subsistence which agriculture makes would become lower, and to this extent would need to be sustained from other sources.

As a result shorter term investment programmes in rural development to meet today's needs and those of the early 21st century are appropriate in order to alleviate pressure in the short term on both rural and urban resources, and the inevitable burdens of welfare spending which desertification combined with drought will impose. Investment in agriculture, especially communal sector agriculture should not be dismissed as marginal, by macro-planners and decision makers, since there are significant long term potential returns to investments in arresting desertification and restoring sustainable management in communal areas, in the form of healthy levels of farm production and developing local markets in crop, livestock, forestry and wildlife products.

4.7 Economic causes of desertification

Although a complex range of causes are involved in desertification processes many of the factors underlying land use trends are economic or socio-economic in nature, and the case studies have attempted to highlight these. With reference to the chain of causation, introduced in section 2 (Belshaw *et al*, 1991), these factors derive from a number of interrelated sets of circumstances, namely the nature of agrarian society, the strategies and policies pursued by the state, and the international economic environment. Those causal factors, identified by the researchers are summarised below with a focus on the structure of available land use incentives, deriving from historical socio-economic conditions and the current policy framework.

4.7.1 Distribution and access to resources

Access to land in Namibia is primarily determined by historical developments, and this provides the background to understanding patterns of resource use which tend towards land degradation. A fundamental limitation is the confinement of the indigenous population to the communal areas, although in the north these also represent the areas with the greatest arable potential. Historically, however, the population has been excluded from the most productive pastoral areas, and established patterns of transhumance across wide areas, which permitted adaptation to a highly variable environment, across wide areas, have been disrupted. In addition in some communal areas, notably the south, people are confined to areas which are clearly too small to support them, particularly since extensive livestock rearing is the only agro-ecological option available. These historical developments, combined with population growth have led:

- a) to the development of net levels of population pressure which exceed the capacity of the resource base, in terms of available water, pasture, and forest resources. As a result livestock numbers are falling relative to population, and productivity is low.
- b) to a mismatch between the productive capacities of the resource base and the individual and collective socio-cultural expectations of rural society. Individually, the aspirations of achieving wealth, security and status through livestock ownership can only be realised by a minority, at the cost of overstocking locally available pasture, and therefore at the expense of others. Collectively, the relatively unstructured open access "management" of extensive natural resources, which was dependent on low population densities and an established consensus concerning traditional boundaries, can no longer function.

Existing systems of inheritance confer no hereditary rights to land, and no proprietary rights to pasture, providing no incentive for families to pursue long term sustainable land use. Access to

land is generally acquired by making nominal payments to the headman, who consequently has no incentive to promote sustainable use or equitable allocations. Moreover, those with the ability to pay, and to invest in fencing can acquire *de facto* access to grazing land by enclosure. On common land there is no effective right of exclusion, and grazing commons may be used by large herd owners who also have access to privatised pasture.

Internal socio-economic differentiation variations also has an impact on resource use, whereby the poor, with less capital and without access to transport, have lower, and apparently diminishing access to woodlands water and pasture. Combined with their lack of cattle, as sources of manure, draught power and income, they are compelled to make increasingly unsustainable, competitive use of the limited resources available to them locally.

4.7.2 Policy factors

The contemporary policy environment mediates the impact which historical patterns of resource access have on actual patterns of resource use, by creating incentives and disincentives to use land resources sustainably or unsustainably.

Land policy since independence has up to now made no changes in the rights of access to land established under colonial rule. Land reform remains on the agenda however, creating some uncertainty and expectations as regards rights to land. Lack of progress on land rights since independence is in fact contributing to exacerbating existing inequalities, and provides a basis for developing sustainable frameworks for land management at local level.

- * In the commercial areas, a belief that government may eventually nationalise land for redistribution encourages a short term mentality of mining the land for maximum short term profitability and discourages long term husbandry.
- * In the communal areas, there is an expectation that land reform will eventually sanction private land ownership, and formalise the status quo; this encourages those with sufficient cattle and resources to enclose land as a rapid, cheap route to private acquisition. Within existing law there is no effective sanction against this behaviour, and no disincentives, as there might be under a system where market prices were payable for land acquisition in limited areas.
- * There is at present no scope for collective legal rights to land and resource ownership, and so there is no framework for villagers to engage in collective resource management, and within which traditional authorities could play a constructive role. Work by the Ministry of Environment and Tourism to extend the conservancy concept for wildlife management to communal areas is however encouraging in this respect.

Drought Policy has up to now discouraged preventive management of land, water and livestock in both commercial and communal sectors.

- * In the commercial sector the state has provided drought subsidies to livestock owners on a per head basis, which promote overstocking and discourages good land management.
- * In the communal sector drought relief has been essentially reactive, and has not taken a longer term strategic approach to strengthening the resilience of farming systems, which requires recognition of the inter-relationships of the impacts of

drought and resource degradation. Drought relief has included food aid, and credit for acquisition of animal and feed supplements, but most notably borehole development to provide water for livestock. Because this has taken place in an unplanned way, this has also encouraged communal farmers to overstock, while creating degradation on the areas of pasture surrounding boreholes.

Pricing and taxation policies have never been applied to rights to use either water or grazing land, and as a result these have been treated as free goods. Although water pricing measures are now due to be introduced, this will need to be done very sensitively owing to the level of political pressure for continued state support in the face of scarcity and growing water demands. Differential pricing may have to be considered as a way of regulation and promotion of greater equity in resource use.

The lack of an effective rural development policy severely penalises regional development in the communal areas and the absence of investment in agriculture and agricultural marketing creates no incentives for farmers to produce and market surplus crop or livestock products, or for the development of local trade and processing.

There has been very little investment in the development of agricultural research, or in the provision of appropriate rural services such as credit, or possibilities of improving the accessibility of animal traction and manure. Likewise there is no framework for small scale investment in grain mills, transport, or fuel efficient stoves, which might save labour, particularly female labour, and perhaps alleviate resource pressure. Public awareness of resource management issues needs to develop, which in part depends on rural literacy and general education. Opportunities for wildlife management, and for tourist development also need to be identified in the communal areas; although they are for the most part destocked of game, conservation and wildlife represents an area of unrealised resource potential, which may be an alternative to agriculture in some areas.

4.7.3 Regional and global economic factors

Exogenous factors such as world prices and international trade agreements have an impact on resource use in the commercial farming sector which produces goods for export and to some extent relies on internationally traded inputs.

International prices affect the incentives for production for the export market, and changes can provoke a range of responses including intensification, diversification, or withdrawal from farming. The implications for resource use and land degradation are not clear cut, and need to be considered case by case. The collapse in the price of karakul pelts has considerably worsened the prospects of the industry, but farmers' response has been to diversify into other breeds, which require greater areas, or higher quality range land to support them. While some farmers have reduced stocking rates accordingly, others appear to have maintained them, in an attempt to maintain profitability or compensate for earlier losses, leading to pasture degradation. However it is not clear whether it is the price changes themselves that may be affecting stocking rates and rangeland quality, so much as farmers' own levels of awareness and the sustainability of existing land management methods.

Trade agreements can affect the incentives for sustainable land management in two ways: Firstly by changing the price of products, and thus the terms of trade available to the farmer; secondly, by changing conditions of access to export markets, by changing the

structure of tariffs and quotas. A number of different trade agreements are relevant here:

GATT: Although GATT is expected to depress beef export prices by 17-20% (Low, 1994), as a result of lowering tariff barriers to Namibia's currently protected markets such as South Africa. However it will also provide opportunities for Namibia to penetrate other previously protected markets. This may compensate, to a degree, for the fall in world market prices. If this opportunity is to be grasped however, it may prove necessary to implement research and policy changes for the commercial livestock sector (as discussed in section 5), in order to promote the sustainable management of larger herds of cattle which command lower prices per head.

SACU: The Customs Union has provided Namibia with protected, tariff-free access to South African markets, allocating in return a share of the revenues. Under GATT Namibia would in theory lose its protected access to South African markets through the Customs Union which might influence the profitability of commercial livestock farming with corresponding effects on stocking rates. The effects of GATT on the future of regional trading blocks like SACU is unclear however, as is the future of SACU itself, following political change in South Africa. Outside of the Customs Union, South Africa would remain a natural market for Namibian beef and livestock products, although Namibia might find itself bearing a higher proportion of export costs, such as marketing and transport, while perhaps receiving a higher share of revenues. In the long term, the loss of protected markets may serve to reduce grazing pressure and release land from commercial livestock production; in the short term however farmers may continue to overstock in an attempt to compensate for losses in income.

The Lome convention: Namibia's accession to Lome has provided a level of access to the European market which has provided a certain boost to the beef industry which may compensate for falls in prices or losses of protected access to South African markets under GATT. However it is also important to note internal changes in European markets not covered by the convention, such as the changes in access to the German game meat market brought about by the accessibility of venison supplies from the east following German unification. This might for instance, affect the incentives available to farm game as a more sustainable alternative to cattle.

In the absence of widely adopted systems of intensive management, any global price and policy changes which promote the beef industry by providing incentives to increase production will tend to increase stocking rates which is liable to lead to an increase in the rate of bush encroachment on commercial farmland. If prospects for beef exports improve significantly this could affect the communal sector as well, and where there is investment in marketing and veterinary infrastructure, there would be incentives for large herd owners to move production on to a commercial footing. This could have a number of different effects however: on the one hand promoting the privatisation of communal farming, perhaps leading to similar grazing management problems experienced in commercial areas, and further skewing the distribution of available pasture towards the large herd owners. On the other hand there would be incentives for farmers to practice a more regular off take of animals, to supply domestic and possibly export markets, thereby alleviating tendencies to overstock.

IMPLICATIONS FOR POLICY, RESEARCH AND TRAINING

5.1 Policy needs at national level

As noted in the discussions of economic impacts and causes, desertification trends and the costs these impose are likely to generate a number of demands and requirements in the medium term which have implications for policy.

5.1.1 Communal areas

In the communal sector, Namibia is likely to face rising popular expectations, reflected in levels of popular demand for:

- jobs, off-farm incomes, employment and income generating activities in the informal sector;
- on the welfare system, in terms of pensions and food aid;
- for additional, secure sources of water for humans and livestock;
- for improved agricultural extension and veterinary services;

In policy terms these demands will all need to be addressed; however the policy issues involved in longer term resource use planning are much broader. These concern the needs: for investment in rural development; for a drought management strategy based on sustainable resource management principles rather than reactive support for unsustainable patterns of resource use; to develop alternative forms of investment and income generation in rural areas; and to consider pricing arrangements for levels of pasture and water use at a commercial or near-commercial scale.

Policy development for the communal areas should examine the scope for reducing the incentives for unsustainable resource consumption for short term financial gain, while increasing the incentives for better long-term economic land management, by dividing policy reforms in the following areas:

- *provision of marketing and transport infrastructure to facilitate the marketing of products such as meat, milk, fuel and manure from surplus areas;*
- *development of rights of local communities to jurisdiction and proprietorship over local resources, as well as to the revenues that flow from them;*
- *promotion of rural banking facilities, to provide alternative forms of saving to livestock;*
- *resolution of questions of land policy and clarification of the circumstances and conditions under which individuals may acquire land;*
- *application of workable systems of user charges, fees and permits for example for water, grazing rights, commercial fuelwood exploitation rights etc.*

5.1.2 Commercial areas

For the commercial areas the following suggestions for policy development are made

- *The capacity of the extension services to address issues of range ecology and good range management should be improved:* The problem of declining productivity of the commercial rangelands might be addressed by improving management methods for instance in cases of bush encroachment in the northern commercial areas. Further research is also required to demonstrate the effectiveness and wider applicability of promising methods of rotational management, and assess the needs for their incorporation in agricultural strategy.
- *The need to reduce and fine tune drought relief assistance and other subsidies so as to avoid incentives to overstock:* If subsidies are to be provided at all there is a need to investigate the possibility of redirecting them to encourage commercial farmers to destock at the most appropriate time (at the onset of drought) . At present these subsidies encourage farmers to keep stock longer than is desirable in anticipation of the subsidy, thereby exacerbating degradation. Destocking, in the longer term , although ecologically desirable may tend to have the effect of reducing incomes, leading to the smaller farmers and those indebted going out of business. Declining profitability however may provide opportunities for government to purchase farms for redistribution to communal farmers under improved methods of individual or collective management.
- *The need to improve drought monitoring and prediction to enable them to adjust management accordingly, and to provide more timely assistance for farmers to destock:* This will be particularly important if subsidies are to continue as they will require accurate drought monitoring and prediction to ensure animals are not kept on the range for extended periods under these conditions. Drought prediction will enable farmers to make informed decisions about when best to destock and may allow them to sell when prices are more favourable, although this is by no means certain given that most may have to sell at the same time.
- *Market research and development for bush utilisation in charcoal production:* There is potential for the production of charcoal from bush encroached land and markets have been identified in Europe. However, to achieve a consistent and reliable supply this requires not only more producers, but also more organised production, and possible larger manufacturing plant. Farmers themselves probably do not have access to the capital or know-how and may require outside assistance to develop the industry. In the longer term a market for charcoal, or firewood may develop in deforested areas of northern Namibia. Further economic investigation is required to identify whether or not there is a case for subsidising the development of charcoal production, and transport and marketing in the communal areas. Since the removal of bush may make a contribution to the energy needs of the country, the economic costs may be significantly less than the financial costs.
- *The need to clarify policy on land reform and agricultural strategy:* It is of paramount importance that the government develop a policy on land and agriculture to improve confidence amongst commercial farmers to enable them to

plan investment and to discourage the short term overgrazing of the range. Without these policies uncertainty prevails and there is a danger that farmers will seek short term profit at the expense of the environment and be unwilling to make the necessary fixed improvements to their farms which, in the longer term, will be essential for the maintenance of production.

5.1.3 Policy recommendations

In view of these considerations, and the wider needs to monitor the economic costs of desertification processes, the following policy recommendations are made:

1. *Agricultural and rural development strategy*

There is a need for a national agricultural strategy which includes equitable distribution of the benefits of investments in research, extension, marketing support and agricultural services, for commercial and communal sectors, according to social needs rather than the present levels of contribution to GDP. Desertification trends underline the importance of agricultural strategy for the communal areas, given the declining levels of subsistence from agriculture, and the costs and difficulties consequently faced by rural households. The economic impacts of desertification compound existing tendencies for communal area farming systems to become either a declining subsistence /welfare net for the rural poor, or alternatively to provide commercial opportunities for emerging rural elites. Neither of these models is likely to prove sustainable in terms of the resource costs involved.

An alternative focus on regional development of the communal areas is necessary to promote more balanced patterns of development which provide opportunities for rural households as a whole, and to alleviate the pressure on urban services by promoting modest agricultural development and generating complementary local off-farm income opportunities.

2. *Land policy*

Some resolution and clarification of land policy is urgent, so as to avoid the short term mining of resources and the speculative enclosure of land, to allow for long term investment on the basis of greater certainty, and to create stable legal bases for the progressive redistribution of areas of commercial farmland (on a willing seller basis), and for collective management of land resources in communal areas.

3. *Desertification control and drought preparedness*

A more careful, thorough analysis of the inter-relationships of rainfall variability, recurrent drought and desertification processes, in terms of their impacts on the environment, and patterns of land and resource use, is required in national policy making.

Desertification control programmes should be more closely integrated with the development of preventive land and resource management programmes to reduce the impact of drought and rainfall variability on farm production. Since desertification increases vulnerability to drought, in practice the type of practical measures required are the same in both cases, and so available resources should be consolidated and parallel

programmes avoided.

Desertification appears to involve higher levels of land use pressure and resource consumption during drought, due to unsustainable stocking levels and cropping practices in limited areas. It therefore hinders recovery after drought, increasing and prolonging the needs for drought assistance, involving increased costs. Drought management strategy should address the drought coping strategies of both commercial and communal farmers, and policy should be designed so as to strengthen the resilience of farming systems while discouraging excessive short term resource consumption and degradation

As regards the forms of drought relief in the commercial sector, government should abandon drought relief payments to livestock farmers as it encourages overstocking and probably advances range degradation.

4. *Environmental Assessment of projects and policy*

The fragility of the land and water resource base requires that systematic attention be paid to environmental assessment, not only of individual development projects, but of their incremental impact, e.g. through water development programmes, and to the environmental impact of sectoral policy e.g. on land tenure, on livestock development and on drought relief. Increasing emphasis should be placed on the economic valuation of environmental costs and benefits, rather than on qualitative assessment of impacts, so as to make the economic trade offs implicit in policy and development options more explicit to decision makers.

5. *Natural Resource Accounting*

It is recommended that Namibia should begin to develop natural resource accounts to record the changes in natural resource stocks, for instance, in the productivity of grazing land, timber and fuelwood stocks, wildlife resources, and where possible the changes in their economic value, as an adjunct to national economic accounting. The same principles might be applied to the fisheries and minerals sectors (if they are not already) where resource economic principles are more developed. By providing for regular assessment of the state of the natural resource base, natural resource accounting can provide an overview of the levels of sustainability of national and sectoral economic growth.

6. *Assessing the costs and benefits of desertification control and policy measures.*

Economic valuation can assist in quantifying the scale of the economic costs of land degradation, and compare them with whatever economic benefits which current patterns of resource use and development may be generating, as an aid to national, regional and local decision making. Correspondingly, economic valuation allows an assessment of the level of potential benefits which might be realised from project assistance and changes in policy, and assessment of the cost benefits of programmes which invest in desertification control. Although the potential benefits are high, investment in desertification control should be carefully appraised. As shown in the northern commercial areas case study, the majority of technical solutions pursued hitherto for bush encroachment appear to produce a negative rate of return. In general we do not recommend expensive programmes of land reclamation or technical solutions to the complex processes of

change underway in human ecology. Instead appropriate adjustments in policy and in sectoral investment strategy which emphasise conservative resource use, together with investments in agricultural, forestry and wildlife production local social and institutional development, education, emphasising sustainable livelihood benefits for local people offer much more promising ways forward.

5.2 Research

The research implications of the present study fall into two areas. Firstly, linked biophysical and economic / socio-economic research to understand more about the extent, causes and impact of land degradation in Namibia. This involves longitudinal research, and the development of adequate baseline data and subsequently time series data so as to assist with the monitoring of environmental change and its impact in the longer term.

Secondly policy research at both macro and micro level to help inform decision makers and land managers of practical options for change so as to strengthen sustainability of dry land management and reduce the current and future costs of desertification. Once again this research is interdisciplinary in character, although we recommend strengthening of its economic capacity and the development of a resource economics research and policy capacity in Namibia.

Because monitoring should be developed around the needs for practical application and policy we are not recommending an expansion of pure research for its own sake, but rather, the development of capacity around practical research projects of value to Namibia. Therefore we discuss monitoring and policy research under a series of headings reflecting suggested practical resource management topics. These are not intended to be exhaustive.

5.2.1 Vegetation monitoring and its application to local and regional planning

Continued development of vegetation mapping and monitoring through remote sensing (using NOAA and LANDSAT imagery) and development of NDVI values and ground trotting techniques and vegetation mapping, by the Etosha Ecological Institute, National Remote Sensing Centre and Forestry Directorate vegetation mapping project.

Potential topics include: grassland and pasture quality in communal and commercial areas; extent of forest and woodland degradation, and mopane shrub land in the north; bush encroachment on commercial farms; degradation around boreholes and water sources; human settlement; fire monitoring; the extent and impact of fencing and enclosure; resource appraisal for future water supply provision and for development of nature conservancies on communal and commercial land.

Application of RS resource appraisal and GIS systems may prove to be of value in the SARDEP pilot areas and should be linked with participatory appraisal and mapping of rangeland quality and assessment of social and economic costs and benefits of current and emerging approaches top rangeland management.

5.2.2 Forestry and fuelwood in the northern communal areas

A number of related areas for research are suggested:

- Patterns of commercial fuelwood extraction and marketing in the northern communal areas (NCAs);
- Market opportunities for charcoal manufacture from commercial farmland, transport and sale in the NCAs.
- Options and possibilities for rotational coppice management in community forestry (mopane), and a focus on possibilities of polewood production and marketing using indigenous and exotic species.

5.2.3 Crop yields and soil fertility

The information base on the productivity and yield of communal area farming systems is very weak, and both regional and on-farm data collection and monitoring need to be improved.

Time series crop yield and marketing data is required for the Northern Communal Areas, as well as rainfall data, are required in order to make any realistic assessment of the area

Agronomic and on-farm participatory research into farm yields, manuring practices - including labour aspects - and fertility requirements is also recommended.

5.2.4 The Social costs of resource degradation in the communal areas

The impacts of losses in crop and livestock production on the household economy with a focus on poor and female headed households. The levels and implications of dependency on livestock, milk, and manure and on local sources of fuelwood and bush products should be investigated, in terms of labour time, nutritional costs and options and availability for substitutes. Available household coping strategies, including the part played by reciprocity and mutual exchange need to be better understood, together with their impacts on the environment and on resource availability. A closer linkage between arable and livestock development work (e.g. through the SARDEP programme), and a social welfare focus (e.g. through the UNICEF IABPs) should be sought.

5.2.5 Resource management in the southern communal areas:

Further research is required into the extent of rangeland degradation, and into changing levels of income, livestock numbers and household consumption amongst the communities affected, in order to assess the economic costs that desertification may be imposing. Biophysical research into the extent and patterns of soil erosion and bush encroachment would also help to clarify levels of range degradation. Research into the cost/benefits of the repair of perimeter fences to fenced farms, and of fencing grazing management and rehabilitation measures on the unfenced communal areas is recommended. In addition research into the nature and extent of the 'donkey problem' would also be desirable

5.2.6 Development of Common Property Resource Management

Research into the opportunities and constraints for collective resource management in the communal areas, in particular with reference to existing systems of regulation and the role of traditional authority. Anthropological, legal and economic approaches to the functioning of local institutions and to local policy development are recommended, as opposed to purely sociological study.

Work with pastoralist associations and management committees so as to formalise tenure and access rights to seasonal grazing and water resources is required.

5.2.7 Economic instruments for environmental regulation

The application of environmental and natural resource economics to the development of instruments for the regulation of grazing, water and fuelwood use, for instance use through the introduction of user fees and tradable permits for grazing by large herds or for commercial fuelwood extraction.

The existing set of policy incentives available to both commercial and communal farmers do not encourage conservative resource use; policy research needs to consider the negative impact of current uncertainties in land and agricultural policy, as well as the efficacy of existing policies on water and forest resource use, and the impact of macro development, and devise measures which encourage conservation and discourage resource-degrading farm strategies.

The effectiveness of existing and proposed environmental regulations needs to be assessed, for instance existing forest regulations which originate in colonial legislation are not wholly appropriate and are almost entirely inappropriate.

The development of a fiscal system for communal areas may provide opportunities to improve environmental regulation.

At national level, the National Planning Commission needs to become involved in the development of workable policy instruments and in the environmental assessment of wider policy developments.

5.2.8 Bush encroachment in commercial areas

If it is felt necessary to firmly establish the true extent of bush encroachment and range degradation it will be necessary to:

- establish appropriate environmental and economic indicators for identifying and measuring the extent of encroachment;
- compare historical and recent remote sensing data;
- search and locate historical and recent farm management data to compare stocking rates taking into account breed changes and increases in animal size;
- contact farmers' producer groups for a variety of management systems and regions and compare and contrast their output;
- contact farmers using intensive management and grazing systems (beef) and compare their farm management data with that of more traditional systems;

- depending upon the results of the above research develop an extension message that reflects the best management system for controlling bush encroachment and range degradation.

5.3 Training and human resources development

5.3.1 Professional Human resources development

Namibia should seek to develop a pool of skilled professionals whose services are available to government and the NGO sectors in the fields of Environmental Management and Natural Resource Policy, Environmental and Natural Resource Economics, and Agricultural Economics.

5.3.2 Specialist training

Although economic approaches are important, emphasis also needs to be placed on the subject matter with which economic specialists must deal. Where desertification is concerned this concerns a variety of technical areas of land use planning, resource appraisal and ecology, as well as agriculture and rural social development. Therefore some degree of interdisciplinary training is recommended. This will mean offering some specialist training in economics to graduates of other disciplines, and offering relevant specialisms to economists. In other cases training in agricultural development and natural resources management with strong economics components would be desirable. The research team has found that these are the main areas where professional development is needed; although resource economics is important, as a pure professional discipline it is probably more directly relevant to the fisheries and minerals sectors, whereas in agriculture and the rural environment a more integrated, interdisciplinary approach would be of more value for most professionals.

5.3.3 Regional training and in-country research

Too much hope should not be pinned on the quality and content of specialist postgraduate training overseas, which will in all cases need to be made relevant to the Namibian context. For this reason, training courses which offer scope for supervised in-country research, while students are engaged in practical service should be identified. These might include external M.Phil. or D.Phil. degrees to follow on from Masters courses, or extended masters programmes with a research component which could be pursued in Namibia. One possible source of appropriate taught course and research training which should be investigated is the Centre for Applied Social Studies at the University of Zimbabwe. Complementary economics training might need to be arranged for students following training programmes here, or at other institutions specialising in natural resource management.

5.3.4 International collaboration

Collaboration with University of Namibia by external institutions with specialisms in resource economics, agricultural economics and environmental management is to be strongly encouraged, so as to provide some emphasis on these disciplines which are largely absent from in-country training and research programmes.

5.3.5 Non-graduate technical training

At a non-graduate level, the introduction of basic economics and resource management components into the curricula of agricultural training colleges should be investigated. Although a pool of more highly qualified people is required, the principles of sustainable management as applied to Namibia's natural resources and economy need to become more accessible and transferable at all levels. Indeed this should be one function of a developing cadre of skilled professional environmentalists.

5.3.6 Training at local and community level

These principles are also relevant at local and community levels, in particular in the context of initiatives to support the collective management of rangeland, forestry and wildlife management. Resource management is therefore an important component of the training of community development workers. In addition the techniques of PRA (participatory rural appraisal) could benefit from wider diffusion and application in Namibia. Not only do they provide valuable tools in research and community development, but they are also a channel whereby existing local knowledge of natural resources and their use can be accessed and applied and for identifying and understanding people's priority social and economic needs. Finally there is a need for appropriate training in land use, grazing and farm business management, and for local institutional development and wider awareness raising and training at community level as pursued by SARDEP, without which higher level training will not be effective.

5.3.7 Wider education and awareness raising

Policy changes and regulation alone will not be enough to change patterns of resource use which lead to degradation in Namibia. General education is required, and the school curriculum is an appropriate vehicle, within which economic and ethical approaches to environment and natural resources can be incorporated. Some of the basic economic concepts applied in this study need to be explained and made accessible to new generations - who will be the critical actors, as well as those most affected by desertification.. For instance the ideas that there is a difference between private and public benefits and costs; that nature's gifts of rainfall, water, pasture and wildlife are not free and all resource use has a cost which will be borne by someone, the user or future users; that access to natural resources carries with it the obligation to maintain and sustain them; that people have inequitable access to natural resources and that this affects their livelihoods and behaviour. These issues could easily be incorporated within existing approaches to environmental and development education.

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