A PRELIMINARY ASSESSMENT OF THE ECONOMIC IMPACT OF DESERTIFICATION IN NAMIBIA

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A REPORT PREPARED FOR THE DIRECTORATE OF ENVIRONMENTAL AFFAIRS (MINISTRY OF ENVIRONMENT AND TOURISM), AND THE DESERT ECOLOGICAL RESEARCH UNIT OF NAMIBIA

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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 a result of degradation are not relected 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 ewe 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 of lost supplies of milk were estimated at $300 - 600, based on the market prices of substitute protein foods to prepare 2 family meals 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 a farm fence were replaced, at market prices. 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. 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 on some areas at least cattle and livestock numbers are becoming concentrated in fewer and fewer hands.

18. On the assumptions that for the approximately 124,000 families living in the northern communal areas face similar costs in terms of losses crop and livestock production to those identified in Uukwaluudhi, and that 50% of rural households partly depend on livestock, the aggregate subsistence losses are estimated to be worth $96.7 million, over one year, at market prices. If veterinary service estimates of a drop in cattle numbers of 185,000 for Ovamboland in the period 1992-94 are correct, the total capital value lost would be $64.75 million a year, at market prices for a grown animal. Although these 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. 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 their 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 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 inn 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 aregional 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.

SECTION 1. RATIONALE AND BACKGROUND TO THE STUDY

1.1 Rationale and methodology

It is a widely held view that Namibia is suffering from a process of land degradation or desertification as a consequence of periodic droughts, population growth, and poor land management which involving overgrazing, deforestation and salinisation. These processes are said to be reducing the productive potential of the land and leading to soil erosion, loss of nutrients, an increase in less preferred plant species and general changes in ecosystem functioning (Seely and Jacobson, 1994).

Desertification is a complex problem associated with climatic change and variations and biological responses to these changes, poverty and increasing demands placed on natural resources by growing human populations. The term should not be taken to the expansion of natural deserts and particularly sand dunes into agricultural land. Rather, it is described as "the diminution or destruction of the biological potential of the land, which can lead ultimately to desert like conditions", or "the impoverishment of terrestrial ecosystems under the impact man".

In many circumstances, and Namibia is no exception, it is difficult to separate the activities of humanity and their effects upon the environment, from cyclical changes in the environment (drought), but as populations grow it seems likely that the effect of human activity will become more pronounced. The population of Namibia is expected to double in the next twenty years, which without suitable policies and programmes to develop sustainable systems of management is expected to place increasing pressure on dry lands in the country. Poverty itself is likely to result in the over-exploitation of resources and measures to improve living standards and incomes will be essential to prevent the mis-use of resources.

The colonial inheritance has contributed to processes of land degradation as it forced indigenous peoples into communal areas, prevented annual migrations and provided them with little support in terms of agricultural extension or access to markets for their produce. This has resulted in a dependence on traditional forms of production with little use of modern technology and low output per unit of land. Poor planning as regards the provision of water may also have contributed to degradation. However, land degradation is not only a feature of the communal areas but also manifests itself as bush encroachment and pasture degradation in the commercial farming areas, which is associated with poor management and declining incomes.

The aim of this study is to indicate the economic significance of desertification in Namibia. The approach taken will be to examine the causes and effects of land degradation processes in three case study areas of the country and to assess and quantify, where possible, the effect of these process on:

- peoples livelihoods, agricultural output, incomes and subsistence;

- local and national economic prospects and their effect upon food security and development of the agricultural sector.

In addition it is necessary to consider the costs and benefits of any degradation control methods and assess the influence of national policies on processes of degradation. It is also necessary to separate the effects of short-term cyclical outputs on production from the longer-term declines in productivity resulting from land degradation processes. To achieve an adequate assessment of the economic costs of desertification as defined above the study is dependent, to a degree, on data collected over a reasonable time-frame rather than on anecdotal evidence of productivity declines which may or may not reflect the true nature of these changes.

1.2 Geography and climate

Namibia has a surface area of 824,144 square kilometres and a human population of 1.402 million (National Planning Commission,1993) with an estimated annual growth rate of 3% (Davies, 1993). Population is highest in the north of the country, which on the whole benefits from higher rainfall, increasing towards the east. The country consists of a coastal plain and a high plateau separated by an escarpment 80-130km inland from the coast. German colonial interest is responsible for the Caprivi Strip which provided access to the Zambesi.

FAO classifies 78% of Namibia as arid and 21% as semi-arid. The country is the driest in southern Africa. Highest annual rainfall totals are found in the north eastern corner of the country where it is estimated more than half the population of 1.78 million live.

The coastal desert zone occupies 18% of the country and is characterised by highly erratic rainfall, virtually no permanent vegetation and a mean annual rainfall of less than 25mm.

The semi-desert zone covers 30% of the land area and includes the whole of the plateau south of Rehoboth with a mean annual rainfall of 100-250mm. Rainfall is erratic and semi-dwarf shrub land vegetation predominates. Acacia bush land is found to the north of this zone as rainfall increases. Sheep and goat production predominate, with some cattle and donkeys.

The dry semi-arid zone comprises the northern uplands, the central uplands and part of the Kalahari. Mean annual rainfall varies between 250-500mm. Vegetation consists of open Acacia woodland and grassland providing good pasture for livestock. Beef production, both communal and commercial, predominates on the hardveld areas in the northern and central parts of the plateau.

The moist semi-arid zone occupies the north-eastern corner of Namibia where mean annual rainfall exceeds 500mm. The Otavi highlands or karstveld (commercial) and the Ovambo

floodplain (communal) provide conditions for mixed farming. More than half the population of the country inhabits these areas, with high livestock densities and production of millet, sorghum and maize.

1.3 The economy

At independence in 1990 Namibia inherited a badly integrated and sectorally unbalanced economy. Around 90% of the goods produced in the country were exported and about 90% of the goods used in the country (including half the food) were imported. The minerals and mining sector provided about 75% of total export earnings and agriculture remained dominated by the export-oriented commercial ranching sector.

Mining remains by far the most important sector the economy although export earnings are in decline and fell by about 20% in 1991. Uranium mining output contracted during 1992 partly in response to declining demand and falling world prices. High grade diamond deposits are being gradually depleted on-shore but there is optimism that off-shore sources can be economically exploited. Interest in oil exploration has been stimulated by discoveries of large reserves of off-shore natural gas.

With a per capita income in excess of US$1,000 Namibia has been classified as a middle income country by the UN. However, income distribution is highly skewed in favour of the richest 5% of the population, who are mostly white and receive 70% of the national income. Thus large numbers of the indigenous population are reliant on wage labour and subsistence farming for their livelihoods. Average per capita income in the subsistence farming sector was estimated to be US$85 in 1988.

A major cause of inequality and poverty is unequal access to land, and land reform remains a largely unresolved contentious issue. The land Reform Conference in 1991 sought to tackle the issue but appeared to endorse the view that the only efficient and environmentally acceptable method of managing rangeland is to continue the policy of dividing it into commercial viable fenced units. This view has increasingly come under criticism and there are frequent calls for government to develop a definitive policy on land. Both land and agriculture suffer from a lack of clearly defined government policy.

1.4 Agriculture

During the 1950s the agricultural sector contributed about 45% to the nation's GDP. By the 1980s this had declined to around 10% (Davies, 1993), and the contribution of domestic food production was estimated to be less than 3%. Agriculture remains the most important employer in the country and 70% of the population are dependent upon the sector for their livelihood. At independence the sector was divided into three distinct parts, commercial ranches owned by white farmers occupying about two thirds of the useful agricultural land; 120,000 smallholder families practising mixed farming on 5% of the usable land in the north

east; and around 20,000 livestock raising household on communal lands in the centre and south-east of the country.

Agriculture in Namibia is regularly affected by drought and the scarcest resource is water. Currently only about 6,500 ha of land are under any from of irrigation and the potential for expanding this area is extremely limited. There are no perennial rivers within the country's borders apart from a short stretch of the Okavango and ground water resources are already heavily exploited.

Agricultural research has concentrated almost exclusively on livestock production. Programmes were developed to serve the needs of cattle and smallstock ranchers and are not well adapted to the post-independence concern for the smallholder, mixed farm sector. Research has been aimed at breed improvement and adaptation to a harsh environment with little research on pasture improvement or the impact of livestock management on the environment.

1.5 The communal agricultural sector

The pattern of agricultural development in the communal areas has been shaped by the dictates of colonial apartheid policy. Indigenous inhabitants were confined to Kaokoland, Ovambo, Kavango, Caprivi, West and East Hereroland, Bushmanland, Damaraland, Rehoboth and Namaland with the exception of wage labourers required by the colonial state. These territories comprise 40.8% of all land in the country and with the exception of Rehoboth land tenure is communal. Extensive livestock production is found in all these regions and is estimated to contribute 12% of agricultural GDP (IFAD, 1993). In the north livestock production is combined with crop production. It is widely believed that a combination of poverty and traditional farming techniques are leading to processes of land degradation and deforestation. While this may be true to some extent, land shortages, the lack of effective systems of local resource management and population growth all have contributed to degradation. In addition poor planning of water development programmes also play a role, as discussed in the communal area case studies.

Sanga cattle predominate in the northern regions which are well adapted to local conditions and goat and sheep production in Namaland and Rehoboth. Most stock owners in the communal areas are subsistence farmers whose objective is to maximise stock numbers rather than sales. There is therefore a tendency to build up stock numbers in drought free years to ensure the survival of a nucleus breeding herd during drought. Inequality in access to and ownership of livestock is great and said to be increasing.

Dry land arable crop production in the northern region is based on family holdings of between 2-4 ha with hoes and animal traction providing the power for farm operations. Animal manures are used but artificial fertilisers and modern high yielding varieties are almost unknown. Productivity is low and rarely sufficient for household subsistence. There is

therefore limited marketing of annual crop production although livestock are marketed both locally and at Meatco abattoirs. As the colonial administration paid little attention to agricultural development in the communal areas there is an absence of historical statistics relating to production and output.

1.6 The commercial agricultural sector

Commercial farming in Namibia is primarily oriented towards livestock production and comprises around 4,400 farmers (Table 1.1). Average farm size in the northern districts where cattle farming predominates was 5,500 ha in 1991. The southern drier districts are more appropriate for extensive sheep and goat production where farm size averages 7,500 ha. The commercial agricultural sector contributed an average 10.7% to Namibia's GDP during the 1980s. However, extensive livestock production does contribute further to the economy indirectly, as it is strongly connected with secondary sectors such as input supply, food processing and transport. Commercial agriculture is reported to account for 27% of private sector employment (Central Statistics Office, 1992) and it has been estimated that up to 70% of the country's population are directly or indirectly dependent upon agriculture production for their livelihood (including communal areas). The commercial sector is the country's largest single provider of wage employment (Adams and Werner, 1990).

In addition to meat production the commercial agricultural sector also produces a limited amount of arable crops including maize, sunflower and sorghum. Crop farming is carried out in the Otavi highlands in areas on above 500mm of annual rainfall which are estimated to extend to some 23,600 hectares in 1990 (National Planning Commission, 1992).

Cattle and karakul pelt production have traditionally dominated commercial agricultural production. Fall in the demand for karakul pelts has reduced the importance of this breed in recent years and this is reflected in the figures in Table 1.2. However, karakul pelt production has been replaced to a degree by mutton production in response to demand from South Africa. The growing importance of mutton exports is reflected in the number of smallstock marketed in recent years (Table 1.3).

Beef is the mainstay of Namibia's agricultural economy and the country is a net exporter of this product, the major markets being the European Union (EU) and the Republic of South Africa (RSA). The cattle population appears to have remained between 1.8 and 2.3 million head since the mid 1970s despite there being major droughts during this period. Conservative stocking and the purchasing of concentrate feeds may enable farmers to overcome the worst effects of drought.

The number of cattle marketed by commercial and communal farmers has remained relatively constant at between 300,000-350,000 head per annum over the last decade (Table 1.3).

Table 1.1. Farms, farmers and average farm size in the commercial sector 1991

District	No. of farms	No. of farmers	Total area (million ha.)	Average farm size ('000 ha.)
All districts	6,327	4,460	34.89	5.51
Mostly beef production (total)	4,275	2,757	19.35	4.53
Gobabis	829	592	4.04	4.87
Grootfontein	838	451	2.66	3.18
Karibib	209	138	1.39	6.63
Okahandja	337	207	1.43	4.25
Omaruru	164	118	0.85	5.18
Otjiwarongo	450	293	1.96	4.34
Outjo	512	387	2.63	5.13
Tsumeb	220	127	0.89	4.06
Windhoek	716	444	3.51	4.90
Mostly mutton production (total)	2,052	1,703	15.53	7.57
Bethanien	186	167	1.97	10.59
Mariental	769	702	4.52	5.87
Keetmanshoop	480	342	3.26	6.78
Luderitz	56	55	1.07	19.10
Maltahohe	220	188	2.06	9.38
Karasburg	341	249	2.66	7.80

Source: Republic of Namibia 1992 Statistical Abstract

Table 1.2 Livestock populations in Namibia 1974-1993 (millions) (commercial and communal areas).

Year	Cattle	Sheep	Goats
1974	2.98	3.75	1.31
1975	1.84	4.48	1.40
1976	1.97	3.45	1.45
1977	2.00	4.29	1.47
1978	2.09	4.43	1.59
1979	2.64	4.68	1.45
1980	2.48	4.47	1.91
1981	2.08	3.46	1.41
1982	1.91	2.61	1.28
1983	1.80	2.28	1.17
1984	1.88	2.60	1.28
1985	1.87	2.58	1.54
1986	1.98	2.74	1.54
1987	1.86	2.81	1.41
1988	1.97	3.04	1.56
June 1989	1.68	3.05	1.46*
Dec 1989	2.01	3.24	1.77**
June 1990	2.05	3.35	1.86
Dec 1990	2.08	3.32	1.85
July 1991	2.13	3.14	1.80
Dec 1991	2.21	3.29	1.99
July 1992	2.32	3.16	1.87
Dec 1992	2.20	2.86	1.75
June 1993	2.23	2.56	1.53

Source: Directorate of Veterinary Services Stock Census June 1988 to June 1993
* excluding Ovamboland ** estimates only for Ovamboland Dec 1989 - June 1993

Table 1.3 Marketing of livestock in Namibia 1981-1992 (heads of livestock)

Year	Cattle pop. million	Total market-ed	% offtake	Small-stock pop. million	Total market-ed	% offtake
1981	2.08	473,375	22.8	4.87	750,735	15.4
1982	1.91	323,317	16.9	3.89	714,035	18.4
1983	1.80	268,646	14.9	3.45	467,641	13.6
1984	1.88	268,890	14.3	3.88	538,771	13.9
1985	1.87	301,045	16.1	3.98	747,427	18.8
1986	1.98	304,084	15.4	4.28	685,246	16.0
1987	1.86	348,200	18.7	4.22	786,661	18.6
1988	1.97	327,002	16.6	4.60	778,688	16.9
1989*	1.85	346,378	18.7	4.76	1,047,319	22.0
1990	2.06	323,460	15.7	5.19	1,088,204	20.1
1991	2.17	333,845	15.4	5.11	1,089,871	21.3
1992	2.26	364,796	16.1	4.82	1,337,215	27.2

Source: Directorate of Veterinary Services Stock Census June 1988 to June 1993 and Republic of Namibia, Economic Review 1993.

* excluding Ovamboland

SECTION 2. ECONOMIC APPRAISAL OF LAND DEGRADATION AND DESERTIFICATION

2.0 Introduction

This section explores the relevance of a variety of concepts and approaches in environmental economics developed in recent years. A number of these approaches are subsequently applied in the case studies. The following section (3) considers recent debates and issues in the questions of rangeland and dry land degradation.

We take as our starting point the definition of desertification in use in Namibia, as directed by the terms of reference: "a process of land degradation whereby the biological productivity of the land, and its ability to support populations are severely impaired or destroyed" . Desertification is considered to result primarily from human land use in arid and semi-arid lands rather than from solely natural processes of climatic or agro-ecological changes.

2.1 Understanding the causes and impact of degradation

There are many differing views concerning the seriousness of land degradation and desertification in the dry lands of the world. With few exceptions almost no economic analyses of the impacts of land degradation have been successfully accomplished, and it is difficult to find evidence that measures taken to combat degradation are worthwhile, in cost benefit terms (Belshaw, et al, 1991).
Before any analysis can be made it is important to establish a clear understanding of what degradation is, and of how it arises.

Trade-offs and stakeholders in resource use

Firstly it is necessary to decide, what actually constitutes environmental degradation. For example, deforestation may be considered degradation by a conservator of forests but not by the shifting cultivator. Bush encroachment is considered degradation by cattle farmers but not by herders of goats. Consequently there are **trade-offs in the uses to which natural resources are put**. The benefits of economic exploitation, and of conservation cannot be realised simultaneously for a given resource, although we can attempt to achieve a balance in the uses to which resources are put. A prime case for Namibia is the trade-off between water point development and the quality of pasture resources in the immediate vicinity; we cannot have a water supply and expect no degradation to occur on the surrounding land, this is simply the price to be paid for watering cattle in the dry season. In most cases this is considered an acceptable price to pay, if grazing is otherwise plentiful.

In considering these trade-offs we should also consider the **different stakeholders in natural resources** - the social groups or sets of economic users who benefit in different ways, from different uses or allocations of resources. Stakeholders can generally be characterised by

different degrees of power, influence and access to resources; for instance commercial farmers, the owners of large cattle herds, government institutions, and communal farmers. In the water point example it may be necessary to reconsider the trade-offs being made if large herdowners monopolise access and degrade the surrounding pasture. As discussed in the northern communal areas case study, poorer local farmers, whose water demands are more limited, may gain no benefits from the water supply, while losing access to seasonal grazing they formerly used. To coin an English expression, one man's meat may be (and frequently is) another man's (or woman's) poison.

The chain of causation

Secondly, it is important to consider that land degradation arises from multiple causes, including immediate biophysical factors, as well as what a number of analysts have described as the proximate and ultimate causes of degradation. These are, broadly speaking the land use factors and the underlying social, economic and policy factors which produce them. These have been conceived as operating in a "chain of causation" to bring about losses of environmental quality and productivity. Figure 1 demonstrates that soil erosion can manifest itself as a result of such a chain, with multiple causes stretching from the level of government policy to the decision making of individuals.

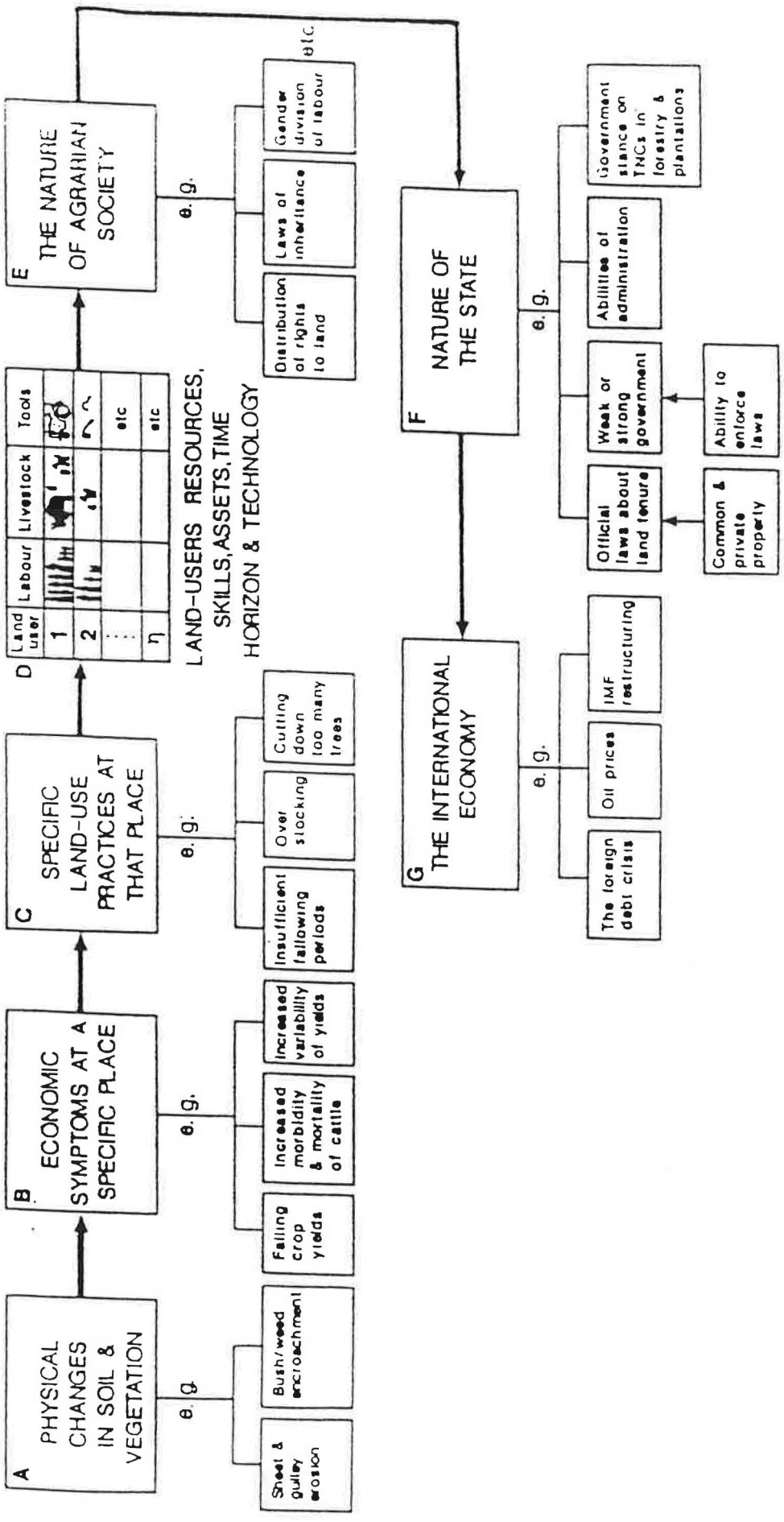
The causes of desertification, land degradation or changes in productivity may be many and varied and social and economic conditions should not be ignored as contributors to the process. For instance, although the cause of rangeland degradation may be the presence of too many livestock or inappropriate stock management, it will be essential to determine the reasons why people keep livestock before attempting to explain the ultimate cause of the problem and propose solutions.

Measuring land degradation

Measurement or classification of degradation is essential if a realistic economic analysis is to be undertaken. Processes of land degradation have extreme variability both spatially and temporally. The scale of the problem is therefore often difficult to assess, since the results of degradation may only be felt over a long period. Moreover when social survey methods are used respondents may often appear to question whether their environment is in fact suffering from degradation, since they are in the process of putting it to productive use. Especially in short term or "snapshot" assessments of land degradation, observer bias can often easily be incorporated into supposedly objective measurement.

The variability of arid and semi-arid conditions often prevents accurate measurements of changes in productivity over time as periodic drought confuses the picture. Measurement of degradation is not the objective, unbiased and neutral procedure that some scientists would have us believe. Under some circumstances different conclusions have been arrived at from the same data

Figure 1. Explanation of the causes of soil erosion, "the chain of explanation" (Belshaw et al, 1991).



(Belshaw et al, 1991). Nonetheless, some assessment of type, level and biophysical impact of degradation that has been or is taking place is essential if any economic assessment is to be achieved.

2.2 Poverty, environmental entitlements and time preference

It is becoming widely recognised that one of the major causes of land degradation is poverty and it must be accepted that where poor people are involved in causing the degradation they are often unable and unwilling to pay for the costs of soil and water conservation works to tackle the problem. People with limited access to resources are frequently forced to take a short term view and degrade the environmental resources on which they depend, out of immediate necessity, ignoring the future costs their actions impose on themselves and others. Two concepts are useful in explaining this predicament.

Firstly, poor people can be said to have limited **environmental or natural resource entitlements.** Environmental entitlements - by analogy with the "food entitlements" approach to understanding food security - are the patterns of rights and access which people have to natural resources in their livelihood systems (Leach and Mearns, 1992). Access to resources is determined and structured by underlying socio-economic factors and processes such as land and wealth distribution, as well as biophysical factors such as climate variability. Because poor people have no alternatives but to draw on the limited entitlements available to them, often reducing the resource potential of their natural environments, they can be said to be suffer from poor **environmental security.** Entitlements or access to natural resources is thus a prime feature of poverty which should be considered in assessing the causes of degradation.

Resource entitlements involve some degree or other of rights to access and use natural resources, made available through private or common property ownership, through rental, loan or exchange access to public or open access resources. Access, ownership or use or resources may be more or less secure, depending on the degree of control the user has over the resource, and the sanctions available against those who violate established resource rights do not abide by established conditions of use. Land tenure is a case in point, where land users may have greater or lesser degrees of security according to the tenure regimes in force. However systems of resource rights or tenure can also govern the use of other resources, such as trees, tree products, water, pasture and grazing, and very often complex sets of resource rights may exist. In some circumstances land and resources may be subject to overlapping or conflicting tenure regimes, for instance were they are subject simultaneously to sets of regulations which may be traditional, and contemporary in origin, and where the law does not provide a single, comprehensive framework of rights.

Insecurity of resource rights is frequently associated with a a tendency for resource degradation by the users. This is generally explained by their lack of a long term stake or interest in the value of the resource, which might provide some incentive for the users to use it conservatively in the expectation of future benefits. In economic terms poor people may be

considered to show a **high rate of time preference with respect to natural resources**, under conditions of resource scarcity or insecurity. In other words a resource such as firewood, water or grazing land may have a much higher value for them now, in the present time, than in the future, where it is required immediately for subsistence or income generation. Society as a whole, however, may place a higher value on future resource use than on immediate use present, favouring resource conservation for the greater good of future generations. In this way **the private rate of time preference is said to conflict with the social rate of time preference**.

Although poor people have been widely criticised for their behaviour (for instance by colonial administrators and conservationists in Africa), it is important to note that those stakeholders showing a low rate of time preference in resource use can often afford to do so only because they benefit from a greater share of resource entitlements, or they themselves are less dependent on limited land resources for survival. In addition, high rates of time preference are not only a characteristic of the poor but also of wealthier stakeholders or entrepreneurs who may be engaged in the short term mining of resources for their own private gain. Finally, an important conclusion is that where those with limited access to resources are targeted for participation in resource management and conservation schemes, such as soil conservation, tree planting, wildlife or grazing management, projects should yield some concrete, transparent short term benefits for them, otherwise they will have no incentives to participate.

2.3 Financial and economic costs and benefits: user costs and externalities

The conflict between private and social interests in consuming recourses now or conserving them for future use is one type of case in which there is a disparity between private or individual and public or social benefits. Private financial gains can lead to wider public losses and it is therefore important to distinguish between financial and economic benefits. There may be short term benefits in the form of financial gain for the livestock farmer who uses all available pasture now and sells the resultant yield of beef, but there may be economic costs in the long term if the pasture is irretrievably degraded and it cannot support more cattle. In this case there is said to be a **user cost**.

If a resource which was also available to other users is depleted or damaged, then there may also be an **external cost**, where other resource users suffer from an economic activity, now or in the future. In the case of degradation of a common pasture resource, these costs are **on-site costs**. The external costs of economic activity are frequently registered as **off-site costs** however, for instance where soil erosion due to overgrazing upstream causes siltation of downstream water bodies, or where the privatisation of grazing land brings about excessive pressure on remaining grazing commons, leading to costs experienced by other farmers. Such costs which may not appear relevant for one economic agent, but which must be reckoned with by other users, or the public at large are often referred to by environmental economists as **negative externalities**.

By assessing the overall costs and benefits of resource use, economics can assist in determining what are the most efficient or the most equitable uses or allocations of resources. These are not of course the same things, and very often political decisions must be made as to whether or not the most economically efficient use of resources (i.e. that which provides for the greatest level of net benefits) is acceptable, or whether or not a more equitable choice involving a lower level of private benefit but also lower external costs is to be preferred.

Environmental economics introduces environmental values into the equation; these include the costs and benefits of maintaining natural resource stocks for future use, and the various benefits which can be derived from natural resources and the environment, which are frequently ignored or taken for granted in conventional economic analysis. Identifying and assessing the environmental costs and benefits involved in economic activity, policies and development projects illuminates the trade-offs which are being made, amongst different sets of values, between different users and between private and public interest. In order to do this it is necessary to have some unit of measurement so that economic values can be brought into economic analysis.

2.4 The economic value of natural resources

The economic appraisal of environmental costs and benefits relies on techniques of economic valuation.

Firstly it is necessary to consider how the value of natural resources should be understood. Most environmentalists will recognise that there are both monetary and non-monetary benefits to be derived from the environment. Indeed, much of the global debate concerning resource conservation has arisen because people recognise that many of the values or benefits of natural resources cannot easily be expressed in monetary terms. On the other hand, environmental economists have sought to express environmental values in money terms, precisely because of the need for economists and decision makers to recognise their importance and not dismiss them because they are unmonetisable. One concept developed to capture all the different aspects of the value of natural resources is that of **Total Economic Value** (TEV) (Pearce and Turner, 1990).

TEV has a number of different components. Firstly there are the benefits that natural resources confer on users, or **actual use values**. Use values are the easiest component to grasp and they are generally easy to express in money terms, especially when natural resource goods have a price, or where they have commercial substitutes with a market price. However, use values eg for resources such as trees and woodlands, are frequently multiple, and involve both direct and indirect subsistence benefits such as building timber, firewood and edible fruits and benefits, such as shade, watershed protection and soil improvement (Barbier, 1991). In addition natural environments have recreational, scientific, cultural and heritage values, which are all further components of use value. All these benefits need to be included when considering the use

value of a resource.

In addition, there are two other components of TEV which should be considered and two types of benefit that may derive from natural resources. They may also have a value for potential users, either in the current population or in future generations. This is the **'option value'** of the natural resources/environment. It has been defined as a willingness to pay for the preservation of an environment against some probability that the individual will make better use of it at a later date' (Pearce et al, 1989).

There is a third type of benefit, which is associated with people who may never actually use or expect to use the resource. People may be concerned about the quality or existence of a natural resource (eg Brazilian rain forests), even if they do not derive any user benefits from it themselves. This type of benefit is called the **'existence value'**.

The sum of the three types of values described above is the **Total Economic Value**. Total Economic Value can be given by the formula:

$$TEV = UV \text{ (use value)} + OV \text{ (option value)} + EV \text{ (existence value)}$$

In practice, the actual use value is the type of benefit most commonly estimated. Option and existence values are much more difficult to evaluate in monetary terms, although environmental economists have developed a number of empirical techniques. These are generally based on the idea of assessing "willingness to pay", but they are frequently very complex, reliant on sometimes arbitrary assumptions, and of limited applicability in developing countries. In attempting to assess the economic costs of desertification, the present study concentrated on use values, and the more readily accessible techniques available to assess them (see 2.5 below). Where they are relevant however, the importance of option and existence values should also be underlined, even if they cannot be expressed in money terms.

2.5 Assessing environmental costs and benefits in economic terms

Winpenny (1991) describes in more detail the methods of assessing the economic impact of land degradation. One method is the **Effect on Production** approach. Where there is a market for the goods or services involved, the environmental impact of an action can be represented by the value of the change in output that it causes. For example, the impact of desertification on livestock production on a given set of ranches in Namibia could be represented by the loss of income from the sale of livestock and/or their products, if all other factors, such as rainfall were considered constant.

The first step is to determine the physical effects of desertification. When this has been done the impact of the physical effects on monetary values can be determined. Therefore laboratory or field research is essential, or controlled experiments to determine the causes of degradation and their effect upon production and incomes. The main data requirements are:

- evidence of the environmental repercussions of an activity on the output of marketed goods;

- data on the market prices of the goods in question;

- where prices are likely to be affected, predictions of production and consumption responses;

- where output is not marketed, the price at the nearest market for that good, or for its closest substitute;

- an appreciation of the behavioural adjustments that producers and consumers are likely to make in response to environmental damage.

Major limitations in applying this technique include:

- poor understanding of the physical relationships between activities affecting the environment;

- difficulties associated with separating one cause from another;

- where the effect on markets is substantial a prediction of consumer behaviour will be required;

- certain markets for produce are undeveloped in largely subsistence economic systems which requires roundabout valuation methods or assumptions about comparable products.

A second technique is the **Preventive Expenditure and Replacement Cost** approach. This involves observations of actual expenditure on safeguards to prevent further environmental damage (e.g. terraces) or expenditure and investment on land to return it to its original productive state.

Information can be obtained in several ways:

- direct observation of actual spending on safeguards against potential degradation or the costs of rehabilitation;

- enquiring of people whether they are prepared to invest in land improvements or preventative methods;

- obtaining expert opinions on the cost to individuals or the state of implementing preventative actions or rehabilitation programmes.

Limitations to this technique include:

- preventative expenditure and replacement cost are constrained by the population's willingness or ability to pay, the techniques may be cost effective but poor households may not have the capital to implement them;

- it is assumed that there are no secondary benefits associated with preventative expenditure or replacement costs, when in reality there are often additional benefits;

- replacement cost assumes that full restitution of the environment is possible after damage, when this is often not the case or will require many years;

- compensating projects or programmes may have their own environmental effects which may not be fully understood.

Despite these potential limitations, these two techniques are in general more practicable in developing countries than other more data intensive techniques which have been devised. These tend to rely on the construction of surrogate markets for non-marketed goods and services, or on assumptions that resource users have substantial disposable incomes and on extensive surveys to establish willingness to pay or incur travel costs to use a resource.

In the case studies which follow the effect on production approach was the principle technique used, since it does appear to be possible to establish (albeit complex) causal relationships between environmental degradation and changes in output, and market prices for products, or for farm and natural products or for their substitutes could be obtained. In addition the researchers considered replacement costs and preventive expenditure where appropriate.

2.6 Estimating the economic cost of desertification

The case studies which follow this section have attempted to determine the main types of economic costs that can be attributed to desertification or land degradation. Although there are difficulties in attributing the economic losses experienced in Namibia to desertification alone, a (rather than to desertification and drought processes the effects of which tend to be interwoven. However, various impacts can be positively identified, and although some assumptions may be required as to what level of change to attribute to desertification processes. The effects are quantified in terms of:

- marketed outputs (crops livestock, hides/wool);

- subsistence consumption (crops, meat, milk);

- time (collecting firewood/water, watering cattle);

- requirements for substitutes for freely available natural resource goods

In addition we consider the effects of resource degradation on:

- energy or food security

- non-use values.

In practice it has often proved difficult to assess the costs of these type of changes, with the exception of commercial ranches where most livestock are produced for the market. Under these circumstances the economic cost of land degradation can be measured largely in terms of foregone production and income from livestock sales, using market prices for livestock or their products.

Where livestock are kept primarily for their contribution to subsistence needs the costs of degradation need to be measured differently. The values of relevant livestock products (milk, dung and traction power) over the lifetime of the animal, need to be included, as well as the value of offspring and the `residual' value of the animal live or dead. Valuation is problematic here although market prices could be attached to the principal livestock products.

Crop production in the communal areas is primarily for subsistence. Nevertheless there is some trade in these crops and local market prices can be used to determine the value of falls in production associated with desertification. If subsistence crops are not widely traded, the border price of imported cereals can be used instead to represent the `replacement cost' of subsistence output.

Other rangeland or woodland products such as fuelwood, that are used primarily for subsistence can be treated as tradeables, either by taking the values of commercial substitutes or the market value of the products if they were traded.

Where natural resources are put to one use rather than another (eg where palm nuts or cattle dung are burnt instead of being used for food or manure), because of scarcity of firewood, that use is said to have an **opportunity cost.** This is a useful concept for assessing environmental costs, because it describes the benefits foregone by having to use a resource with important uses of its own as a substitute for firewood. Similarly, where women spend additional time collecting firewood, that time also has an opportunity cost; which is the time lost for agricultural work or income generating activities. This opportunity cost may be easier to translate into money terms.

To conduct an economic analysis of the effects of land degradation requires quantitative data on the effects on production of the degradation process. Although for some sectors of agriculture or forestry it may be sufficient to measure changes in primary productivity, for livestock production it is evidence of changes in secondary productivity for extensive livestock systems that is required as evidence of economic impact of degradation. Where there is evidence of declining production over time and it is possible to exclude the consequences of

drought, then reliable economic effects can be computed.

In the case of commercial livestock production, bush encroachment has a quantifiable effect on production, which is simpler to establish than for other desertification processes, such as pasture degradation due to overgrazing which is difficult to isolate from the effects of drought on pasture productivity and quality. Thus it is a much simpler task to assess the economic effects of land degradation on commercial ranches than it is on subsistence farms. In addition is there a shortage of reliable yield data over time for the subsistence sector, as little produce is marketed, and attaching values to lost production (where appropriate) is not straightforward. Therefore, having established that there is a declining trend and having ascertained the likely causes estimates still have to be made as to the likely financial implications. With these limitations in mind, we have attempted to assess these implications in the case studies and in drawing conclusions for the economy as a whole.

2.7 Cost benefit analysis and desertification

There are a number of methods that can be used for appraising possible courses of action in natural resource management and the implications of environmental projects. Perhaps the most common is the economic appraisal technique known as cost-benefit analysis where costs and benefits of a course of action, or of a number of alternatives are estimated and compared. There are other related techniques, such as cost-effectiveness analysis and least cost approaches, where the desirability of certain objectives is assumed and the most cost effective or least costly means of reaching them are then assessed. (Winpenny, 1991). Where environmental costs and benefits are involved, these must be somehow measured and valued in monetary terms, for incorporation in these calculations.

Until recently, cost-benefit analysis has made little headway in treating the environmental impacts of projects or programmes mainly because of difficulties in quantifying biological processes, and in valuing the changes which may ensue. However, the developments in environmental economics discussed above allow the incorporation of environmental gains and losses into an extended form of conventional CBA. CBA has been recommended as a suitable technique to assess the costs of implementing a damage control programme over a project's lifetime (Chou and Dregne, 1993). In addition to this data on the costs of damage control, information is required on the estimated costs of on-site and off-site damage caused by the degradation process incurred over the same period of time. The monetary estimates of the avoided on-site and off-site damages from adopting the programme them become the benefits of the analysis.

Difficulties experienced with this type of analysis include:

- social costs of rehabilitation programmes are difficult to estimate because of many off-site effects which are not well documented or the connections between these effects and land degradation are not well understood;

- cost-benefit analyses at the national level rarely conduct an analysis for each degradation process prevalent in that country.

It is therefore desirable that separate analyses are conducted for each degradation process and the costs of controlling the damage. Each process differs in the kind of damage incurred and the conservation practices to be employed.

In practical terms it is necessary to:

- identify control practices that are the most economically viable;

- assess environmental changes and to what degree they can be controlled or mitigated by control processes;

- estimate the benefits and costs of specific conservation programmes from environmental changes and financial data;

- provide sensitivity tests to assess how representative the assessment is in relation to the `real' system;

- aggregate sample area analyses to consolidate data for the region or nation affected, the accuracy of the analysis decreases with increasing aggregation of data.

Some cost-benefit analyses of this type have been undertaken for projects dealing with water erosion and salinization of irrigated land, but very few have been attempted for rangeland degradation. Some cost-benefit analyses have been undertaken for projects dealing with water erosion and salinization of irrigated land, but very few have been attempted for rangeland degradation. Although the focus of the present study is on the economic costs of desertification, these also give us an implicit assessment of the benefits of avoiding desertification. These would then need to be compared with the investment costs of a control programme.

Environmental valuations of the type undertaken here should also prove of use for cost benefit analyses or other approaches to the economic appraisal of development projects, such as road and pipeline development, or livestock marketing schemes which may have positive or negative impacts on desertification processes.

SECTION 3. ASSESSING THE CAUSES AND EXTENT OF RANGELAND DEGRADATION

3.1 What is rangeland degradation?

Degradation has been described as long-lasting or permanent loss of an economic good, in the case of rangeland as an irreversible decline in livestock production (Behnke and Scoones, 1993). Abel and Blaikie (1989) have provided the following formal definition:

Range degradation is an effectively permanent decline in the rate at which land yields livestock products under a given system of management. `Effectively' means that natural processes will not rehabilitate the land within a time scale relevant to humans, and that capital or labour invested in rehabilitation are not justified.

This definition excludes easily reversible vegetation changes even if these lead to temporary declines in secondary productivity.

3.2 Can rangeland degradation be measured?

Much of the research discussed below relates to common property resource rangeland and may not be relevant to the commercial farming sector, although there will be implications, for example, in the discussion of vegetation change and succession in rangelands.

Despite much recent research into rangeland vegetation dynamics there is no generally agreed theory on the processes involved (Smith and Pickup, 1993). Many case studies have only succeeded in demonstrating that a general model does not exist; and it is difficult to assess whether particular land uses or methods of grazing management are sustainable within a particular time frame, or whether they are continuously or intermittently degrading the soil and vegetation resources upon which they rely.

Secondary successional sequences are poorly understood for many dry rangelands and in some cases may not exist (Ellis et al, 1993). It is often difficult, or impossible, to separate grazing-induced degradation (long-term loss of productivity) from natural change. Great variability in time and space influences vegetation dynamics and it is often impossible to measure accurately, because of the labour-intensive methods required, and the nature of change in rangeland vegetation. Not only is there great variation in total rainfall from year to year, but also in the effectiveness of this rainfall. In addition, soils vary over short distances in terms of their nutrient status and water-holding capacity; some areas suffer from run-off while others benefit from run-on and the deposition of eroded material.

Therefore, in the communal pastoral lands of Africa it has proved very difficult to distinguish between permanent human-induced vegetation change and temporary rainfall-induced vegetation change. This is not to suggest that degradation never occurs, but it is often patchy

and associated with water use (boreholes) and areas surrounding settlements. But it is important to note that vegetation change does not necessarily result in reduced secondary productivity and cannot therefore be accepted perse as evidence of degradation (Abel, 1993).

3.2.1 Bush encroachment

Grazing off take and fire both share the property of removing above ground plant material and in some cases lead to the mortality of plants. Grazing selects against palatable plants while fire selects for fire-adapted species. In the commercial cattle-farming areas of Namibia it is generally thought that a combination of overgrazing, a lack of fire and a reduction in the numbers of browsing game species has led to increasing bush encroachment. However, under some circumstances African rangelands have been observed to suffer bush encroachment as a result of too little grazing pressure (Bayer et al, 1991).

Woody plants have been demonstrated to have a potentially significant role in nutrient turnover and the replenishment of soil fertility in semi-arid savannahs (Bille and Corra, 1986). Leaf litter and nitrogen fixation are some of the important contributions of these plants to rangeland fertility. The 'problem' of bush encroachment in Namibia is reversible as is demonstrated in the following case study and it may contribute to decreased erosion and improved fertility. Can it therefore be considered as desertification or degradation?

3.2.2 Soil erosion

The effects of human- and livestock-induced soil erosion are difficult to quantify under range conditions. Biot (1993) noted that on the hardveld rangelands of eastern Botswana soil loss is greater than the rate of soil formation even with zero use. Therefore these semi-arid environments are naturally eroding landscapes, and while human activity may speed up the process of erosion it will be impossible to stop natural environmental change. Rangeland environments respond very differently to grazing pressure in terms of soil erosion, which is very dependent upon rainfall, slope, soil texture and vegetative cover.

3.2.3 Measuring degradation

Most measurements of degradation have measured primary production only i.e. vegetative biomass. Few have measured secondary production or changes in output from livestock (measured by birth rates, extraction rates etc.). Scoones (1992) considered secondary productivity in his study of land degradation in Zimbabwe. Cattle populations have changed little over a period of 60 years (drought years excepted) despite concerted attempts to persuade farmers to destock over this period in response to perceived degradation problems.

Tapson (1991) conducted a similar study in KwaZulu and observed little change in livestock numbers during the years 1977-88, with mortality showing a declining trend. Over the past 50 years planners and policy makers have consistently asserted that the KwaZulu range has been

overstocked by as much as 100%. Herd statistics do not support this assumption.

3.3 Is carrying capacity a relevant concept?

The concepts of rangeland carrying capacity and rangeland degradation are closely linked. Scientists and policy makers, until recently, claimed that degradation is universal and that as a consequence livestock productivity is lowered because of overstocking of the range (Behnke et al, 1993). Theories of carrying capacity have rested on classical succession theory. However theory does not work where rainfall is highly variable, mainly because this variation is more important than stocking density in determining the composition, structure and productivity of vegetation in these circumstances (Abel, 1993).

Carrying capacity has generally been determined by assessing botanical productivity in average years and has been associated with profitable stocking rates found on commercial beef ranches. It therefore has relevance to these conditions, although the management skills of the farmer are crucial in maintaining high stocking rates (see case study on the commercial beef sector).

In general terms, African pastoralists or agro-pastoralists are able to maintain higher stocking rates (per unit area) than commercial ranchers (Behnke, 1992). It has long been assumed that if stocking densities could be reduced then livestock productivity would increase. However, evidence suggests that output/ha on communal areas is often higher than that of commercial ranches and mass gain/ha increases even if output/animal decreases (Abel, 1993). Therefore it is safe to assume that destocking would have disastrous economic consequences for most pastoral producers.

For livestock specialists to be able to calculate a carrying capacity for communal rangeland it is necessary to calculate a proper use value: in other words, the amount of grazing that the range can tolerate without affecting next years production. In practice this is impossible given the heterogeneity of African rangeland, rainfall variability, livestock mobility and the (often unknown) dietary requirements of indigenous livestock. Much of the information regarding the feed requirements of tropical livestock has been derived from research station animals that are not physiologically or genetically adapted to nutritional stress.

There is an important difference between ecological and economic carrying capacity. Ecological carrying capacity can be defined as the point at which livestock populations cease to grow because limited feed supplies produce death rates equal to birth rates. Economic carrying capacity generally refers to the stocking rate that offers the best return according to the producer's husbandry practices and management objectives. It is generally considered that most traditional livestock producers hold their stocking rate somewhere below the ecological ceiling (Abel, 1990).

Arntzen (1990) estimated that stocking rates in Botswana exceeded potential carrying capacity in every part of the country and in some areas by a factor of four. Since then livestock

numbers have increased further (drought years excepted), which suggests that the limits of ecological carrying capacity have yet to be reached.

The concept of carrying capacity is of limited value where livestock producers are able to respond flexibly to the needs of their stock. It assumes that livestock are kept within fixed areas of land with recognised boundaries and is therefore more relevant to ranch production.

Bayer et al (1991) conclude that under Namibian conditions it is virtually impossible to calculate carrying capacity for the communal areas with any degree of accuracy. The carrying capacity figures in existence are not scientifically based exact figures, but rather estimates based on experience. The implementation of a predetermined figure requires very strict control over an area of grazing and is thus best suited to ranching with simple production aims (i.e. meat production). The first step in the communal areas where production aims are complex (meat, milk, intrinsic values) should not be to define carrying capacity, but to assist farmers to develop management structures which enable them to use common property resources in a more sustainable manner, where appropriate.

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 former Ovamboland in the north of the country, and Gibeon, in Hardap district (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 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.

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 salinization) 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 a 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 farm 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 marulra 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 communal 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 communal area crop production losses can amount to something around 270 kg (worth $330 at substitute market prices), a year (Box 4, case study 1), for a household of six. Milk production losses may be around $900 (Box 3, case study 1), in a recent 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 total losses would be of the order of $1230 per 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 a very tentative calculation suggests that if each of 124,000 rural households in the NCAs faced $330 worth of cereal losses, and (since only approximately 50 % of rural households own cattle) if 62,000 households faced an average $900 of dairy production losses, the total costs would amount to $96.7 million. Although lower than the total scale of losses in the commercial sector due to bush encroachment (below) these are 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 deaths 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 a 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 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, worth $102 million per year. Average losses to individual farmers are of the order of $49,500 a year; assuming 50% production costs, which are not incurred for the infested land effectively withdrawn from production, average losses of net income are approximately $24,700. 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. Methods of intensive rotational grazing may prove more rewarding but need 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.

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 *Baikea 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 Erkkili and Siiskonene, 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 of $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;

- Capital losses in the communal livestock sector of $647,000 (for cattle only), and subsistence losses of $46.5 million for milk and cereals. These losses are reflected in lower food security and nutrition, 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 sustainable, 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 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 todays 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 will 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 boreholesencouraging

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; and 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.

SECTION 5. 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 if 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 and 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 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 place 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 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 aregulation 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.

COMMUNAL AREA CASE STUDY
NO. I UUKWALUUDHI

1.O INTRODUCTION

1.1 General Situation

Uukwaluudhi is a sub-region of Omusati district, one of four districts in to which the area of former Ovamboland in northern Namibia was divided following independence. The Ovambo area is one of the most populous in Namibia, containing over 615,000 people, approximately 44 % of the national population (1991 census). The population of the Uukwaluudhi was 34,448 in 1990 (UNICEF 1990) and the population growth rate is estimated to be 3.8 - 4.2 %.

As a result of population growth and increasing human settlement during this century, increasing in recent years with an influx of returnees at the end of the war, the natural resources of the Ovambo area are under severe pressure, and a variety of land degradation processes are underway, principally deforestation, rangeland degradation due to overgrazing, and declining fertility of arable land. Although these are less advanced in Uukwaluudhi than adjacent, more densely populated areas of the Cuvelai flood plain, its land resources are subject to increasing pressure by people from elsewhere in Omusati district and central Ovambo generally.

A wide range of background material dealing with the socio-economics, farming systems and natural resources of the Ovambo area is available; this forms the background to the present economic study and is listed in the bibliography. Some of this deals explicitly with Uukwaluudhi, and in particular an environmental assessment of natural resource use (Forbes Irving 1993 is worthy of mention). The intention of this study is not to reiterate the findings of this work, but to provide a complementary economic assessment, and so only a summary of key environmental features is provided here.

1.2 Natural resources

The Uukwaluudhi region lies on the western edge of the Cuvelai flood plain and thus its eastern edge comprises the seasonally inundated grasslands (oshanas) characteristic of the region, separated by partially wooded, settled and farmed areas on the more elevated ground. The vegetation is open palm-marulla savannah broken by degraded mopane woods and shrub land. These features are established on sandy soils, derived from Kalahari sands, the area has a shallow, seasonally variable water table, prone to salinity because of the characteristics of the subsoil. The features and land use of the oshanas area as a whole is well described by Marsh and Seeley (1992).

The area to the west, bordering Kunene district (former Kaokaland) is a slightly more elevated sandy plain, broken in places by rough terrain and rocky intrusions, and characterised by degraded woodland / savannah dominated by Colophospermum mopane

(omusati, from which the wider region gets its name). This area has no shallow water table and very little seasonal surface water, accordingly it is sparsely populated. A series of boreholes have been sunk, however, mainly in recent years as drought relief measures, and the western plains are now important seasonal grazing areas.

1.3 Rainfall

The Ovambo region is semi-arid with variable rainfall, decreasing from an annual average of around 500mm in the east to around 300mm in the west. The Uukwaluudhi region stretching from the Cuvelai flood plain to the border with Kunene is subject to this east-west rainfall gradient and experiences great rainfall variability. The rainy season is from October to April, tending to fall between December and March. There is a good rainfall record for Tsandi, the population centre of Uukwaluudhi up to 1981, although no short term trends are discernible, owing to the patchiness of rain in time and space (Forbes Irving, 1993).

Rainfall fell sharply from the mid 1970s, and the 1981 data appears to indicate an approximately 30 year low. No systematic data is available from 1981, but farmers interviewed during fieldwork consistently identified the late 70s / early 80s as the period from which rainfall has been extremely unreliable. Although rains are said to have improved to some extent during the 80s, farmers referred to consecutive poor years in the early 90's culminating in the well known and southern Africa-wide drought of 1992/93. The period of the last 15 years, continuing into the present is considered to be a time of hardship involving low crop yields and extensive deaths of livestock. Farmers interviewed also consider this to be the period in which seasonal patterns of grazing and water availability have changed (apparently irreversibly, although this is substantially due to the sinking of boreholes as a drought relief measure), and degradation of woodlands and pasture has accelerated.

1.4 Agriculture and farming systems

The people of Uukwaluudhi and Ovambo generally are dependant on a system of mixed farming for subsistence involving crop and livestock production. The principal crop is millet (*omahangu*), planted on 2 - 3 ha family plots, supplemented by small amounts of sorghum, beans, squash / melons and occasionally peanuts. Milk and milk products from domestic livestock (mainly from cattle, also from goats) are an important component of the diet, and livestock form an integral component of the farming system by providing both draught power (donkeys, occasionally cattle) for ploughing and dung (cattle and goats) for fertilising the omahangu fields.

Herd sizes vary, but only a minority own large numbers; most people have at least a few goats, and the majority own only a few cattle, if any. Meat is eaten occasionally, although regular off take, even from large herds, is low. There are well established but there are undocumented patterns of exchange, barter and reciprocity amongst households whereby those without livestock gain access to animals and animal products.

There are a number of major constraints on agricultural production: notably the low and variable rainfall and a shortage of farm labour. This originates principally from the migration of male labour to urban areas and the south established during the colonial period. Also as a result of apartheid policies, the farming population of Ovamboland had no possibilities of access to arable or grazing land outside its boundaries. Possibilities of agricultural settlement elsewhere remain highly constrained today and this is a key factor underlying the high level of resource pressure throughout the region.

In addition no agricultural development assistance was directed towards the populations of the northern communal areas (NCAs) and agricultural marketing remains extremely poorly developed. As a result the majority of the population have virtually no opportunities or incentives to take up more commercialised production of either crops or livestock. Agricultural cash incomes are in most cases very low or non-existent, and demand is constrained because rural purchasing power is in general very low.

1.5 Livelihood systems and incomes

As a result of these circumstances survival by agriculture alone is not possible, and the region is substantially dependent on income transfers deriving from migrant labour remittances, pensions, local employment, and business activities. Some years ago households surveyed in the Uukwaluudhi areas had access to incomes derived from these sources in 69 %, 37%, 22% and 9% of cases respectively (UNICEF, 1990).

The situation has been exacerbated in recent years by successive droughts or poor rainfall years, and agricultural production has fallen to even lower levels, necessitating the introduction of drought relief measures and food aid (27% of families in 1990, according to UNICEF figures). Food deficits at both the household and the wider regional level are thus made good by cash purchases of goods imported from the south. These are primarily mealy meal, sugar, cooking oil and dairy products originating from the commercial areas or from South Africa.

2.0 THE ECONOMIC IMPACT OF DESERTIFICATION ON LOCAL PEOPLE

The biophysical and socio-economic features described above form the background to the understanding of desertification processes and their economic impact on the people of Uukwaluddhi and the wider region. On the basis of the definition of desertification utilised by the DEA and DERUN, this case study attempts to assess the general nature and economic impact of land resource degradation processes resulting from changing and intensifying patterns of human land use, whereby biological productivity and environmental quality is reduced, with resulting increases in risk for economic activity and human life.

The principal degradation processes observed in the study area are deforestation, rangeland degradation, and fertility deterioration on arable land. These are discussed in turn below, and their nature, extent and economic impact is considered. In assessing economic impacts, some of the concepts and methods discussed in our report's overview paper on environmental economics are applied. Where possible, utilising data from background sources, and the interviews, market surveys and group discussions conducted during fieldwork, worked examples which indicate the types of cost faced by local people as a result of environmental degradation are provided.

Two words of warning are in order here. Firstly, the indications of monetary costs are only notional and should not be treated as absolute. This is because they are based on limited data, guesstimates and assumptions made by the fieldworkers. They are intended to provide an indication of the type and scale of costs faced by people; in a primarily subsistence economy, monetary valuations are in any case a type of proxy to capture levels of hardship experienced, and only in some cases do they represent actual financial outlays.

Secondly, in the case of the lowered productivity of pasture and arable land it is impossible to separate the impact of degradation due to human land use from that of drought and the inter-annual / inter regional variations in rainfall. Resource degradation results from combined biophysical and socio-economic processes which combine in complex ways. [1]

Therefore we discuss the economic costs resulting from drought and environmental degradation combined, or make arbitrary assumptions about what levels of cost can be attributed to the changes induced by human land use and resource pressure. This

[1] For example, lack of rainfall limits the productivity of both pasture and crop lands; shortages of land resources due to population growth cause increased land pressure; and low pasture and surface water availability cause changes in the seasonal mobility of cattle involving competition for pasture and water, overgrazing, and shortages of milk and manure, leading to further land degradation exacerbating the effects of drought.

complication is less relevant in the case of deforestation, since the perennial woody vegetation is on the whole well adapted to the arid and drought prone environment.

2.1 Deforestation and woodland degradation

There are a variety of historical reports of extensive mopane (*omusati*) forests throughout the central Ovambo area, surrounding the various chieftaincies and kingdoms, and covering the ridges and plains which separate the seasonally flooded oshana grasslands. Their gradual destruction since the 1850s and continuing into this century due to the clearance of agricultural land and the consumption of enormous quantities of wood in traditional Ovambo building and fencing methods has been recorded by a number of historical observers (Erkkila and Siskonen 1992).

All the older people and traditional leaders interviewed during the case study remembered substantial woodlands surrounding the more recently settled areas of Uukwaluudhi. These have now disappeared almost entirely from settled areas, and on the basis of discussions with local people we estimate that woodlands capable of supplying mopane or other timbers suitable for fuelwood and building materials are now between 2 km and 10km away from homesteads.

Throughout much of the area, mopane remains the dominant vegetation, within uncultivated parts of fenced plots and on common land, but has largely been reduced to its shrub form due to repeated cutting and browsing by livestock. The remaining accessible woodlands have also been substantially degraded. Although Mopane regenerates well through coppicing, trees which are sufficiently well grown to provide building poles and good quality fuelwood are becoming more and more scarce. Dead and dried wood is preferred for fuelwood, but increasingly live branches are being cut, and removed immediately or after short periods. Remaining trees may be stumped for building stakes, if well grown coppice branches are not available, and commercial operators can remove whole trees for sale as building poles and firewood.

A variety of useful trees occurring in crop fields, close to settled areas, and around excavated wells and dams (*omufima*) remain protected for their fruits or importance in providing shade or medicinal products. In addition low-value trees with limited uses and not preferred for firewood, such as Epupwaheke, remain common in settled areas.

2.1.1. Fuelwood availability

The principal economic effect of decreasing fuelwood supplies in Uukwaluudhi is the additional time required for collection incurred by women and girls. In the outlying settled areas of the district, collection now takes hours rather than minutes; one local woman's estimate suggests that a 10 km round trip for collection of three days supply takes four hours (or 1.33 hours per day) as opposed to 10 minutes for 2 days supply from a readily available source 15 years ago - a 24 fold increase. Although these losses of women's

labour time have an opportunity cost, at present this is not prohibitive and the majority of households still collect fuelwood rather than buy it.

Where supplies are more distant, and when donkey cart or motor transport is available, fuelwood and building/fencing supplies tend to be collected by men, and this appears to be the norm for other Ovambo areas such as the southern Oshanas areas, where forest may be 45 km away or more. By donkey cart this can involve a group of men and boys in a 2 day trip, although 2 - 3 weeks supply may be collected.

The opportunity costs of additional time spent on fuelwood collection involve limitations of time available for women to spend working in the fields or engaging in income earning activities such as gathering bush products and craft work. The costs are therefore manifested in losses of farm yields and incomes. Because fuelwood collection times are so variable however, and there are many other additional demands on women's labour time, it is not possible to quantify the costs that may be due to the fuelwood scarcity factor.

Fuelwood prices sampled during the field study varied quite widely, from 1$ to 5$ a bundle according to the point of sale, often being sold on the road close to the collection point, to urban consumers passing in cars. The standard price for firewood collected commercially and retailed in Oshakati and some rural Ovambo markets appears to be $2 per bundle for mopane or mopane mixed with other woods. Since women respond by rationing use more carefully when supplies are scarce, whether wood is gathered or bought, we assume that one bundle, carefully used will be sufficient for a day's cooking. At this price, the minimum monthly monetary costs of fuel can be calculated as $60 per month, at current market prices. This figure represents a reasonable estimate of the cost involved at today's prices although in practice, once fuelwood depletion has reached the stage where rural families have to buy in markets, the increasing distance of commercial supplies would force up transport costs.

It should be noted that Uukwaluudhi also provides a source of fuelwood for commercial extractors from neighbouring areas and so the depletion may well continue to accelerate beyond the rate of local use.

Although Uukwaluudhi rural families do not in general buy fuelwood, if supplies continues to diminish, the opportunity cost of additional time spent gathering will eventually become prohibitive, and it will need to be bought. Alternatively, substitutes with other important uses may be burnt, such as animal dung, palm and marrula nuts; these are already used in some cases. Bottled gas supplies are sometimes partially substituted for fuelwood and may work out slightly cheaper. However gas requires the capital outlay to purchase the stove and the bottle, and would normally require motorised transport for refilling; it is thus beyond the reach of most families.

2.1.2 Building materials

Except where mopane woodlands are reasonably well stocked with maturing trees, the traditional timber stockades to surround dwelling compounds (*egumbo*) can no longer be built from local materials. These continue to be the preferred form of fencing for dwellings however, and so farmers will seek to obtain them across long distances or from commercial sources. This, together with the need for maintenance of existing stockades, and to provide main posts for fencing to surround crop fields (*epya*) places continued pressure on remaining woodlands. Throughout Uukwaluudhi, and elsewhere in Ovambo, it is evident however that homesteads are now being built from smaller, inferior grade poles.

Fences of mopane branches are also the traditional form of surrounding for crop fields, although farmers are responding to increasing scarcity by substituting wood with various other materials, including thinner and much more readily available mopane brushwood, the

BOX 1. The value of local timber and the costs of substitute fencing

1. The value of mopane used for fencing and building

A 3 ha farm, 100m x 300m, requires a total of 800m of fencing.

The value of harvested timber can also be calculated in order to obtain a monetary estimate of the value of wood used, and the costs in terms of standing timber lost. Namibia has set the stumpage cost of felled timber at $400 per m3, the cost paid to the state by the two timber concessionaires operating officially in the country. Although this price is relatively high, it is a reflection of the national scarcity of timber and so here we use it as an estimate of the value of mopane building timber.

For fencing

value of 1 m length 10cm2 mopane stake	$4
value of 1 m length 5 cm2 mopane stake:	$1

Assuming a 2 metre spacing for fence posts, 400 would be required;
An approximate 20% / 80% mix of 10cm2 and 5cm2 posts was observed:

value of 80 (20%) 10cm2 stakes	$320
value of 320 lm x 5cm2 stakes	$320
Total cost of mopane stakes for a 3 ha field	$640

For building

A traditional Ovambo homestead has been estimated to require 7,700 poles for the palisade fence surrounding the dwelling (Erkkila and Siskonen 1992)

value of 1.5 m length 10cm2 mopane poles	$6
value of 1.5 m length 5 cm2 mopane poles	$1.5
Cost of 7,700 poles used (assuming 20% 10 cm2 poles, 80% 5cm2 poles)	$18,480

2. The costs of substitute fencing

An 800 metre fence requires 2400 metres of wire, if a three strand surround is used, and 400 fence posts at 2m spacings. A 20% / 80% mix of commercially available poles is assumed. Oshakati market prices for treated eucalyptus poles are used.

Cost of 2,400 metres of wire @ 17 cents/metre	$408
Cost of 320 1.2m / 5cm diameter poles @ $2.50	$800
Cost of 80 1.2m / 10 cm diameter poles @ $12	$960
Total cost for substitute fence materials, as observed	$2,168

A higher cost alternative are rolls of 0.9 m high wire netting, at a cost of $4.9 per metre, or £3,920 for the netting alone. This would however reduce the costs and labour requirements of the traditional mopane brushwood, which would otherwise be added to a 3 strand wire fence.

stems of palm leaves, millet stalks and thorn scrub. Fences made from these materials require much more regular maintenance, imposing greater burdens on scarce farm labour. Alternatively, farmers may be able to afford to purchase fencing wire, or more expensive wire netting, and occasionally manufactured fence poles on the market at Oshakati. A combination of methods is frequently encountered: surrounding the field with 3 or 4 strips of fencing wire, strung between wooden posts at 1.5 to 2 metre intervals; this fence is then fortified with available natural materials, principally brushwood.

2.1.3 Non timber forest products

The majority of commonly used non-timber tree and woodland products are not considered to particularly scarce or in diminishing supply in Uukwaluudhi. This is because medicinal and fruit trees, such as marula, *omuye (Berchemia discolor)* and *enyandi* are in general protected and not felled, and because mopane shrub land is in effect managed to provide a renewable supply of stick and bark materials for the manufacture of *omahangu* baskets, as well as the twine used for tying fences and a variety of other purposes.

Omalunga palms provide palm fronds for basket making, and palm nuts used for oil extraction, as well as being a source of alcoholic liquor. Although this kills the plant male specimens are generally selected (Forbes Irving, 1993) and recruitment of new plants can be observed to be good in the oshanas and adjacent savannahs in much of Uukwaluudhi. The gathering and processing of these products provides an important small-scale income source for some rural women; women selling them were interviewed at local markets and reported no significant price variations or increases in scarcity in recent years.

Both palm nuts and marula nuts provide fuel supplements (as does cow dung) and are regularly used in small quantities for this purpose. In view of their relative abundance at present the use of these materials for this purpose has only a marginal impact on their availability. More widespread use by poor households as a result of more serious deforestation could reduce their availability with negative consequences for crop products, nutrition and supplementary income sources, in the first instance, for those households themselves.

The availability of non-timber forest products is subject to change under increasing pressure, particularly in the case of mopane and omalunga palm products which are gathered principally from open-access savannahs where no effective management controls exist. In more densely populated parts of the Oshanas area, or where ecological conditions are less favourable to their growth stocks are already becoming substantially depleted.

Other products dependant on the maintenance of woodland habitats are however in scarce supply due to the destruction of mature woodland. These include mopane worms and anthill mushrooms, which are no longer available in significant quantities. A market exists for mopane worms, large caterpillars gathered from the trees and existing market supplies

are gathered by Herero people and appear to originate entirely from the Ruacana area or from Angola where well grown mopane woods remain intact.

2.1.4 Wildlife

The destruction of habitat, as well as hunting, are the principal reasons for the disappearance of game animals from the Ovambo region as a whole. While the eradication of supplies of bush meat bears an obvious user cost, animals also have educational, recreational and a non-use "existence" value (it is considered important and worth some investment, simply that they should exist) for indigenous African people just as they do for others. Indeed their cultural/heritage value for Africans is higher. This aspect was noted in the course of a conversation with the traditional King (paramount chief) and Queen of Uukwaluudhi. Although these values are difficult, if not impossible to monetise (the only possible method would be to assess the willingness of government, individuals or communities to pay for the reintroduction and conservation of wild animals) they should nevertheless not be excluded from considerations of environmental costs and benefits.

2.2 Rangeland degradation

The primary causes of rangeland degradation in Uukwaluudhi are the combination of high cattle numbers, poor rainfall, which limits the regeneration of pasture, and the poor positioning and management of water points and boreholes. This leads to local overgrazing around water points, in transit corridors in settled areas and along roads.

2.2.1 Livestock numbers

The veterinary service has recorded the numbers of cattle in the Ovambo region as 485,520 in 1992, and according to FAO/IFAD data there has been a long term increase in numbers from 379,542 in 1962. Although a trend of long term increases is clear, there are considerable fluctuations due to drought, and numbers are believed to have fallen during the 1970s and 80s, although no reliable estimates of numbers in these periods are available. Present numbers of cattle in the region are also uncertain, but have been estimated by DVS to be as low as 300,000. Overall there appears to be a declining ratio of cattle to human populations (Tapscott, 1990).

Nonetheless there is a tendency for people to restock rapidly after drought, when they can afford it, the herd sizes of large cattle owners and business people are believed to recover rapidly and there are known to be large influxes of cattle on to the local market from Angola.

2.2.2 Distribution of livestock ownership

Patterns of cattle distribution have changed considerably. Uukwaluudhi traditional leaders described how earlier this century only local elites had large herds and cattle

ownership was not common amongst ordinary people, who began acquiring cattle from the 1950s and particularly in the 1970s. Despite fluctuations, herds of 20-30 animals were said to have been common in parts of Uukwaluudhi, with only a small minority (lone elderly and female-headed households) owning none . Villagers widely reported substantial and sometimes drastic declines in cattle and livestock numbers from 1981 however, due to drought and disease. In some cases, as a result of continued poor rainfall in the early 90s, the majority of people were reported to own no cattle at all, with around 25% of people estimated to own only 4 - 5.

This picture bears out FAO/IFAD statistics (EC 1993, consistent with data in UNICEF 1990) for Ovambo which suggest that 51% of households own no cattle and that only 4% own more than 50, with 16% owning up to 10. Although more people own goats than own cattle, there is a similar pattern, with 43% of households owning none, according to the same source. As noted by Tapscott (1990) it appears that there is now a tendency for growing differentiation in the size of herds, as wealthier people with more animals and higher off-farm incomes are in a stronger position to invest in animals and restock, concentrating cattle in their own hands. This view is supported by changing patterns of access to available grazing and water. Cattle losses as a result of drought and rangeland degradation have a serious cost for both large and small cattle owners.

Although accurate statistics are not available, numbers of goats and donkeys appear to be increasing, and there may be some tendency for people to switch to these animals which are more drought resistant and capable of browsing on a wide range of vegetation. Almost all farmers appear to have switched from cattle to donkeys as all-purpose draught animals.

2.2.3 Patterns of cattle mobility and migration

According to Uukwaluudhi elders, transhumance was not widely practised in this area in former times, since adequate supplies of dry season water were available close at hand, at least for small herds of animals. Generally poor rains since 1981, and diminishing availability of local grazing as human settlement has increased has clearly led to increases in cattle mobility. The practice of "ohambo" (transhumance) is now widespread, amongst small and large cattle owners.

The development of piped water supplies and boreholes as drought relief measures, especially since independence in 1990, has enabled the survival of larger numbers of cattle through seasonal migrations to cattle posts established near water points in grazing areas far from the main human settlements. This has promoted the permanence of large herds in these areas throughout the greater part of the year for instance on the western plains of Uukwaluudhi, providing unprecedented grazing opportunities for large her d owners, sometimes leading to the establishment of permanent settlements at cattle posts. The result has been competition for grazing, especially in poor rainfall years, and intense local overgrazing and land degradation, as cattle populations become too large for the available pasture resources.

2.2.4 Diminishing access to pasture

Pasture availability around water points is partially controlled by large herd owners who have established permanent cattle posts there. In Uukwaluudhi these are frequently outsiders from elsewhere in Omusati district and further afield. Rangeland degradation in the vicinity of boreholes has accelerated, and degraded pastures are more vulnerable to drought. In these circumstances limited pasture availability due to drought, rather than regular seasonal water scarcity, has become the major factor limiting cattle numbers, especially for small herds, whose access to dry season and emergency grazing is now restricted due to the growing dominance of large cattle owners.

Box 2 Results of semi structured discussion with Uukwaluudhi SARDEP committee members

Cattle numbers were said to have generally declined since the early 1980s principally as a result of drought and disease. In some cases numbers of cattle present in villages fluctuate considerably from year to year according to the availability of pasture. This does not mean that large numbers are lost but reflects the increasing practice of transhumance in response to drought conditions. However it was clear that competition for pasture land, diminishing access to grazing and water and changes in rangeland quality also play a role in increasing the vulnerability of livestock to drought and disease. Livestock numbers were difficult to assess as people are reluctant to disclose the size of their herds. However it was suggested that people might own either a small number of cattle (4 or 5), or perhaps 17 - 18, or alternately have much larger herds of 100 or more.

In the more urbanised and densely populated areas such as those around Tsandi people described how increasing human settlement had virtually eliminated available pasture close to home, resulting in longer journeys for grazing. Local water points near settlements may be from 1 - 10 km distance away. Greater mobility is also required to obtain borehole water as a result of poor rains and increased competition for water both around the homestead and on the range. As a result increasing numbers of animals stay for long periods of the year at distant cattle posts on the western plains. Boreholes are also frequented by outsiders from other districts, some of whom maintain large herds, who have constructed permanent cattle posts and tend to control the surrounding grazing areas.

Pasture grasses were ranked according to their qualities and preferability in wet and dry seasons and according to the frequency of their occurrence. A number of recent changes in the availability of particular grasses were described, although none of these appears to have severe consequences at present. Two preferred perennial species (*Etolyongolo* and *Okanunjela*) were considered to be less common than previously, and one (*Olusheelo*), although not highly preferred, has virtually disappeared. Disappearance was ascribed to consumption of the roots by donkeys and other animals. One particular annual species (*oshinamone*) was described as a dominant coloniser of more heavily used pasture, although this was considered to be a useful grass. Two unpalatable invasive shrubs (ligolo and Ombyogo) were also reported to colonise degraded areas, and an unknown unpalatable invasive grass was said to dominate areas cleared of vegetation, sprouting at the beginning of the rains and preventing the development of other species.

As a result, borehole development and the associated pasture degradation has a disproportionate effect on cattle-poor households, who are most severely affected by the lowered availability and diminishing productivity of pasture. This factor explains the

growing socio-economic differentiation in livestock ownership amongst people in Ovambo noted by a number of observers (Tapscott, 1990; FAO/IFAD 1993) and reported to the researchers during fieldwork by the people of Uukwaluudhi. As water development proceeds, and if rainfall and borehole and grazing management does not improve, there are risks of large scale crashes in livestock numbers, with disastrous consequences for livestock owners as a whole. Poorer households reliant on small numbers of livestock stand to suffer most.

2.2.5 Economic impacts of declining pasture availability on households

Losses in livestock numbers and productivity are a consequence of both drought and poorly planned water development, and rangeland degradation. These phenomena, which are closely connected, especially where access to dry season pasture is effectively uncontrolled, on an open-access basis. Lower quality pasture resources, and the livestock they support, are more vulnerable to drought and limited rainfall, and less able to recover from drought episodes. The increased competition for water and available pasture that occurs because of drought and less reliable rainfall also intensifies the rate of pasture degradation. Although relatively few cattle may die of thirst, or of starvation, poor pasture leads to poor nutrition and greater vulnerability to disease, which is often the immediate cause of death. Poor nutrition and higher rates of disease also imply lower animal productivity.

Local people incur the costs of this situation in a number of ways:

* loss of livestock capital assets in the death of animals, due to lack of water and pasture. Animals are not available for sale or slaughter when circumstances require
* loss of animal productivity due to under nutrition and poor health. This results in lower supplies of milk for home consumption, and lower prices and poorer meat supplies in the event of sale and slaughter
* lower supplies of milk and animal manure for fertilising the fields as cattle spend longer periods away from the homestead at cattle posts because of scarce water and pasture. Both these effects result indirectly in lowered human nutrition and food security.
* increased burdens of labour and financial costs incurred in herding livestock away from home for a greater part of the year

Since cattle are sold or slaughtered for meat infrequently in the Ovambo area, it is not appropriate to consider their value solely in terms of the marketed off take of live animals, which is low. Although cattle may fetch between $400 and $800 per head, at current market prices, according to the size and the condition of the animal, distress sales are rare, even under drought conditions, owing to the lack of marketing facilities. The real impact of dry land degradation for subsistence livestock producers is felt through the losses of animals as multi-purpose assets, and it is therefore more appropriate to consider the replacement costs of the lost goods and services involved such as milk, butterfat, manure, as well as the residual value or replacement costs of the animal itself.

The impact of lower milk availability on household food security is discussed in the example in Box 3, while the economic costs of shortages of animal manure for crop production are discussed under degradation of arable land.

Box 3 Costs of lost output of milk as a result of poor pasture development and prolonged absence of cattle

Assumptions:

- A herd of 4-5 milking cows provides 20 litres of milk / day during the milking season (6 months)
- A 6 person household consumes 40 litres/week, shares some with family and neighbours, sells some locally making $17-35 / week, and makes some butter fat for future use or sale.

If accessible milk output is halved:

- the family could sustain its subsistence supply, but reduce quantities available for sharing and sale, leading to a loss of income estimated at $10-20 / week or $40 - 80/ month, over 6 months.

If milk supply is lost entirely:

- The family will have to substitute milk with locally purchased milk/alternative protein foods, eg spinach and meat, and reduce milk consumption.
- Estimated cost of substituting for 2 milk based meals a day at market prices for substitutes is $15 - $30 week or $60-120 / month
- Total estimated monetised costs: $100 - 200 / month
- Total costs over 6 months: $600 - 1,200

If 50% of losses are attributable to land degradation processes: $300 - 600

Note: These estimates do not incorporate the lost value of butterfat for subsistence and sale. Where supplies are reduced, potential income from sale is lost; if supplies are lost entirely substitution with purchased butterfat or cooking oil at market prices is likely.

2.3 Degradation of arable land

Millet yields in Uukwaluudhi have declined in recent years, owing to a number of factors, including low rainfall, lack of labour, shortage of animal draught power and poor soil fertility, amongst others. These last two factors are exacerbated by the desertification processes affecting woodlands and pasture owing to the additional demands made on women's labour time and the requirement that cattle spend long periods away from the homestead in search of grazing and water. It is not possible to separate the impact of land degradation on crop production from that of drought, but there are growing indications that it has a significant effect.

It is noteworthy that survey findings indicated that 1992 yields of omahangu averaged 44 tinfulls (oorata) for female headed households compared to 60 tins for male headed households (Owambo roads baseline survey). This difference cannot be attributed to

rainfall, but rather to additional labour scarcity and lower female resource entitlements, including limited access to animals for manure and ploughing.

On the basis of on farm trials, it has been established that applications of up to 8 tonnes of manure per hectare (equivalent to the annual output of around 6 large cattle) can produce a doubling of millet yields (MAWRD / ICRISAT, 1993). Although there are no firm data on the amounts of manure that are or were applied to Ovambo fields, there are clear indications that applications are falling significantly as a result of changes in the seasonal location of cattle.

Uukwaluudhi farmers described how supplies of manure were now limited as a result of declining cattle numbers and the prolonged periods of absence of cattle at cattle posts not only in the dry season, but throughout the year. Although cattle generally return to the homestead to graze on crop residues after the harvest, contributing a certain amount of organic matter to the soil, the present tendency is for the animals to leave the farm directly afterwards, in June rather than August, because of the lack of water and pasture.
One old man described how farmers generally divide the field into sections which are manured before planting each year in rotation over a period of years, using animal dung accumulated in the kraal. In former times supplies were sufficient for 5 - 8 years for each part of the field; now however each part of the field requires fertilisation after only two years, although only very little supplies of manure are available. Dung from 20- 30 cattle in the kraal for 6 months was said to be sufficient to adequately fertilise half a millet field.

In one area where cattle numbers have declined drastically (Ondukuta), the village development committee described how the majority of residents now had no manure available at all from their own cattle. This, together with poor rains, meant that millet yields were now very low or non-existent. Those with only 4 or 5 cattle had very little manure relative to the requirements. People with off-farm incomes might be able to go to the cattle post to buy manure from the owners of large herds, at a cost of $170 per truck load, or $400 - $500 including transport. Although large doses of manure would be ineffective or damaging in the absence of good rains, the majority of farmers are clearly unable to purchase manure on the scale required to compensate for the gradual exhaustion of the soil.

Box 4 Lost crop output resulting from reduced supplies of manure, due to diminished supply from household cattle

Assumptions

- Field estimates that average family harvests have fallen by one third in the last 10 -15 years, (from 9 to 6 months staple food supply);
- minimum family food requirements for 6 -8 people of 3 kg/day, or 90kg / month;
- Replacement by commercially available maize meal at a minimum cost of $60 / 50 kg;
- 50 % of production costs are attributable to drops in the manure supply, rather than other factors.

Minimum replacement cost of 3 months food supply (270 kg):	$330 approx.
50% of production losses due to lack of manure , rather than drought:	$165

2.4 Soil erosion

Soil erosion is less significant than other aspects of desertification in Uukwaluudhi since the soils and topography are not highly erodible or particularly prone to wind and water erosion. The loss of topsoil and destruction of soil structure is most apparent around boreholes and water points, and in urban areas. There is evidence that limited wind erosion does occur in these areas, particularly in the late dry season when vegetation cover is reduced, resulting in some export of silt and clay particles from the topsoil which becomes progressively sandier, with some corresponding loss of mineral exchange capacity and marginal losses of fertility (Renaud and Pelkonen, 1994). In themselves these losses are not considered to be highly significant in economic terms however, since soils are already extremely sandy, and the areas in question are already highly degraded.

2.5 Impacts on stakeholders

In Uukwaluudhi every body suffers from environmental degradation, although the economic impacts in the longer term are likely to be more severe than today. Poor people have little alternative but to continue to exploit available land, pasture, forest and water resources to meet their short term subsistence needs, irrespective of the longer term user costs of increasing scarcity.

Box 6 provides an indication of some of the monetisable costs of land degradation faced by an Uukwaluudhi household over a year. Although the costs are not all borne in monetary terms, it provides an indication of the economic levels of hardship faced. Clearly those with less resources suffer more, being less able to meet substitute expenditure. According to the results of a UNICEF survey (1990), Uukwaluudhi households were amongst the poorest in Ovambo, with average incomes below $200 a year, a fraction of the costs indicated below.

BOX 5 VALUING THE COSTS OF RESOURCE DEGRADATION

TYPES OF COST	POSSIBLE METHODS OF VALUATION
Deforestation	
Increased time or transport costs for fuelwood collection	opportunity cost of labour, transport costs
or	
substitute costs of commercial fuel	market prices
Increased time for building materials collection, fence building and maintenance	opportunity costs of labour
or	
substitute costs of commercial fencing building materials	market prices
or	
lost value of natural substitutes	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
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	market prices of substitutes for lost crop production or replacement costs of manure / commercial fertiliser.

BOX 6 SOME INDICATIVE MONETISED COSTS OF RESOURCE DEGRADATION FOR AN UUKWALUUDHI HOUSEHOLD

Annual substitute costs of fuelwood @ $60 / month	$720
Minimum costs of substitute fencing materials (wire and poles only, not netting)	$400 - $640 outlay
Capital losses of animal stock (eg 2 cattle @ $150 each and 3 goats @ $60 each)	$480 outlay
Replacement costs of 6 months' lost milk production (subsistence and trade)	$300 - 600
Substitute costs of lost arable production due to lack of manure	$165
Total of notional monetisable costs which might be incurred in a single year:	$2,065 - 2565

These costs are beyond the means of most households in Uukwaluudhi 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. 50 % of assumed losses of milk and dung production are attributed to environmental degradation rather than drought. In practice these two sets of losses are inseparable and the costs would be higher.

Better off farmers, who may own larger herds of cattle and have additional sources of income also suffer, although they are less vulnerable to the impacts of drought and land degradation. Because cattle represent a capital asset as well as a resource with multiple uses, it makes sense for the owner to maintain cattle numbers even under drought conditions, since a larger herd is more likely to have more survivors, and despite big short term losses as cattle die, he will be in a stronger position to restock. Despite the user costs of pasture degradation in the short term, the large herd owner is better able to maintain his long term position than those with few or no livestock ,who generally face a deepening spiral of poverty. As a result, although cattle numbers appear to be falling or over a longer period, remaining roughly constant, ownership of cattle by poorer

households is declining, and large herd owners and businessmen are in a position to amass even larger numbers of livestock.

Although nobody directly gains from, resource degradation, some are in a position to exploit the opportunities offered by scarcity, for instance through control of grazing areas, sale of milk and manure, and commercial fuelwood extraction. The situation of resource pressure in Uukwaluudhi is promoting increasing differentiation in terms of access to resources, with consequent impacts on levels of income and farm production. In general terms those with access to resources such as cattle, transport, and cash incomes have greater levels of food, energy and natural resource security. According to their level of assets (numbers of cattle, motorised or animal drawn transport, and levels of off-farm income) they will be more or less secure, and have more or less opportunities for further gain.

In general the poorest households with lowest resource entitlements are headed by women or elderly people. Limitations of farm labour, and lower income levels, and limited households assets makes them more vulnerable to resource degradation, and more dependent on the support of local communities (whose prosperity as a whole appears to be falling) or on external income transfers.

A wider consideration is that where drought persists and resource management is not improved, deepening poverty and vulnerability to environmental change is likely to impose greater burdens on public spending. increasing levels and frequency of drought relief and pension payments are likely to be required, in order to make good the costs which the poor themselves will become less and less able to meet.

3.0 CAUSES OF LAND DEGRADATION

The causes of degradation are complex, and involve long chains of causation incorporating socio-economic, land use and natural biophysical changes. In view of overriding role of changes in land and resource use practice, against a background of drought and variability of rainfall, the following discussion focuses on the primary economic and socio-economic factors..

3.1 Population growth

The growth of population within a limited area, exacerbated by the settlement of returnees from Angola and elsewhere at independence in 1990 is undoubtedly a major factor contributing to resource pressure in Uukwaluudhi and throughout the Ovambo area. In addition to internal population growth, the district is also settled by outsiders. Since there are scarce possibilities for households to settle elsewhere in Namibia, Uukwaluudhi is one of the places on the fringes of central Ovambo which is somewhat less densely populated and thus tends to be favoured for settlement by people from the adjacent areas of Uukuambi, Ongadjera and Ombalantu.

3.2 Land and resource rights: The breakdown of common property management

Questions of property rights are a key factor determining people's economic opportunities, in that they determine people's access to land and resources. In Uukwaluudhi, the way in which traditional systems of tenure and regulation have changed historically, in the colonial period and in the present time are particularly important.

Before South African occupation traditional chiefs played an important role in regulating access to land and resources and operated system of tribute and taxation through levies in kind (FNRDP, 1993). The occupying regime utilised their leadership to establish a system of local regulation whereby village headmen and sub-headmen granted access to land for settlement through collection of fees, settled disputes, and became collectively a forum for discussion of community needs and problems. Because of their collaboration with South Africa however, their authority came to be resented, and during the liberation struggle, contested to some extent.. Since independence, however, although the chiefs and headmen retain a role, traditional systems of jurisdiction have less credibility and authority.

In previous times, village headmen had overall responsibility for resource management, including the regulation of grazing, and the protection of trees and waterpoints, although in practice these functions were generally carried out by individuals, on land which had been allocated to them or for waterpoints and dams which they had excavated themselves. Unfenced resources were common property for village communities, and in the absence of undue population pressure, their use could be regulated by consensus, under guidance or authority from the chiefs and headmen.

The headmen's system of regulation offered a means for them to accumulate revenue and power, and although the traditional leaders of Uukwaluudhi still assert the need for regulation of treecutting and for good environmental management, individual access to available land for settlement and cultivation , or permission to fence off common land as permanent grazing land can normally be obtained on payment of a fee (local sources). The headmen's role no longer serves resource management objectives, and they have very little authority. Attempts to exert it are resented as restrictions on individual and collective freedom which people believe should no longer be exerted following independence.

As a result of these transformation of traditional systems of regulation of land and resource use, what were formerly common property systems of tenure and management can be said to have broken down into an open-access situation. In these circumstances there is no effective control of former common land and resources, including no protection or conservation of grazing corridors in settled areas, common woodlands or of those trees and water points which are not protected by taboo or by consensus of local users. Access to private land can be secured by payment, and in this way wealthier individuals can frequently secure exclusive rights to grazing to the detriment of local communities, and enclosure is beginning to develop. Even though this remains rare in Uukwaluudhi (it is common elsewhere in Ovambo) the general open access conditions on the rangelands encourage everyone to act for themselves, and to make use of whatever pasture and wood resources they can, while they can get it.

Another aspect of local land and resource rights is the system of inheritance, whereby property and land is not automatically passed to a man's wife or children on his death. While a widow's husband's family may make claims on his property, his children are expected to pay anew for the rights to land use. When children marry, because they do not expect to inherit the land, they tend to establish new settlements elsewhere. Under these arrangements, households have no long term security of tenure, and consequently no incentives to engage in good long term land management, for instance by the planting or good husbandry of trees.

3.3 Land Policy

At present, land policy does not adequately address these conditions, and it appears that the development of enclosure in the communal areas, as well as representing the seizure of individual grazing rights in order to feed and water large herds, may also be developing in the expectation that a future land reform will formalise *de facto* private occupation of land. Until and unless there are clear signals to the contrary, it will be difficult to dissuade large herd owners from this practice, and persuade them either to seek formal land title elsewhere, or to engage in more collective management. Moreover, and perhaps more importantly for Uukwaluudhi, there is at present no formal basis for the development or restoration of common property management systems, whereby community or user

groups can regulate land and resource use, with the rights to secure the benefits and revenues accruing, if necessary excluding outsiders.

3.4 Water development

In the past people and cattle in the Ovambo area were dependent on surface water accumulating from rainfall, trapped in earth dams from the oshanas' seasonal flood, and on shallow hand dug wells, tapping the main shallow aquifer, or smaller local perched aquifers. Under lower population densities these supplies generally proved adequate, except in times of drought when transhumance to perennial water sources elsewhere in the region was necessary.

These sources of water are still important today but have required supplementation. Many shallow wells are prone to salinity and salinisation of the main shallow aquifer appears to be an inevitable consequence of the geological history of the area, notably the long term drying process of the inland Etosha drainage basin.

In the 1960s and 70s a bulk water system was developed, diverting water from the Cunene river on the Angolan border to central Ovambo through the Etaka canal, formerly an important seasonal water course through Uukwaluudhi (according to local elders and traditional leaders). Together with road developments, this has altered the flow of water in the Oshana system to some extent, affecting recharge of the aquifer to the south (Marsh and Seeley 1992). Vegetation along the boundaries of this infrastructure is also subject to overgrazing.

A pipeline system pumping purified water from Ogongo to Oshakati was developed in the 1970s, and subsequently numerous branches have been added, supplying water to small towns and to watering points for cattle on the southern Ovambo grasslands. Further pipeline development is planned, notably in eastern areas, such as towards Eenhana in the eastern woodlands, where there are risks that multiple branches will encourage intensive settlement, deforestation and overgrazing along a belt surrounding the main pipeline.

In addition the droughts of the 1970s, 80s and 90s led to the provision of boreholes to exploit deep groundwater as a drought relief measure. In Uukwaluudhi these are located on the western plains, where the aquifer is prone to rapid salinisation owing to limited recharge; those boreholes sunk prior to independence are now generally saline. In many cases boreholes have been improperly planned and drilled hastily because of the levels of popular demand and the likelihood of striking water, without reference to established cattle migration routes and the likely patterns of demand for seasonal grazing.

While overgrazing in the vicinity of water points is inevitable - there is a clear trade off between water supply and the quality of local land and pasture - boreholes tend to encourage changes in patterns of transhumance, settlement of communal grazing areas and the permanence of large herds of livestock on common land. In some cases boreholes have been too closely spaced promoting severe degradation of the range in concentric

circles around water points and along transhuman corridors. Further borehole development has been planned in reaction to the recent period of prolonged poor rains.

Waterpoint development poses additional problems for effective common property resource management since it takes place without attention to the development of management and access arrangements for the boreholes themselves and the surrounding pasture, while creating incentives for cattle owners to make greater use of communal grazing resources.

3.5 Rural Development Policy

The historical absence of any effective rural development policy has created an environment in which livestock provide the only readily available form of capital investment and in which adaptation to the onset of drought conditions is difficult. Although marketing facilities which might encourage destocking, if financial gains could be realised from livestock sales, livestock numbers have been maintained at artificially high levels by the free provision of water sources. On the whole current incentives encourage farmers to maintain large herd sizes throughout drought periods. The lack of serious attention to rural development compounds the problems resulting from absence of a clear policy on land in the communal areas, and hinders the development of local structures for land and resource management. In addition there has been no investment in the development of sustainable or alternative supplies of fuel, building materials, animal feed or animal manure, and very little research to support improved farm production or land management.

4.0 DEGRADATION IN THE WIDER OVAMBO REGION

Many of the issues discussed above are characteristic of the Ovambo region as a whole, with which Uukwaluudhi has many features in common. Although the security of Uukwaluudhi's natural resources is in a delicate balance because of growing internal and external resource pressure, the problems are if anything greater elsewhere, notably in the more densely populated central Cuvelai floodplain, where desertification could be described as more advanced.

* Deforestation is more severe and woodlands are highly degraded, now more or less confined to impoverished mopane scrub and protected field trees. Building materials and fuelwood are scarcer, and a wider range of substitute materials are used, resulting for instance in heavier depletion of the *omalunga* palm. Gathering and fence maintenance demands more labour time, increasing the opportunity costs, and fuelwood, when sold locally, is more expensive.

* Deforestation is sometimes thought to be continuing rapidly in the mixed woodlands to the east of the Cuvelai. However evidence from aerial photography has shown that there has been little change since 1972 (Renaud and Pelkonen, 1994). The woodland boundary is a natural one, dependant on soil type, and does not appear to be shifting eastwards. Settlement has been limited due to the lack of surface water, and the nature of the vegetation cover makes the forested areas less suitable for grazing. At present areas such as Uukwaluudhi may well be under greater pressure from commercial fuelwood harvesting to supply neighbouring areas where depletion is already more advanced. However there could be rapid change as result of water pipeline development (see 3.4 above).

* The grasslands to the south and south-east (Mangeti) of central Ovambo are subject to greater grazing pressure, where water is available, forming part of the preferred migratory routes for large herds of cattle. The presence of the pipeline makes the southern areas less dependent on boreholes subject to salinisation. Enclosure of grazing land around water points by businessmen and large herd owners is more common and appears to pose a greater threat to small herd owners than in Uukwaluudhi.

* There are no comparative data available on stock ownership, crop yields and soil fertility in the central Cuvelai area, but is likely that owing to settlement and grazing pressure that poorer people tend to own less livestock, and that omahangu yields are lower owing to greater shortages of farm labour and animal manure.

5.0 CONCLUSIONS

Environmental change in Uukwaluudhi has a gradual, incremental impact on the residents of the area. Local people face gradually increasing economic costs in terms of diminishing availability of the natural resources which form the basis of their livelihood and farming systems. These costs are experienced primarily as increasing scarcity and diminishing quality of resources with two types of results: firstly the increased time, effort and financial outlay in resource provisioning and the procurement of substitutes; secondly, diminished nutrition and food security, and lowered incomes..

The two primary forms of resource degradation resulting from the continuing pressure of human and animal populations on the resource base in Ukwaluudhi are

i) deforestation and woodland degradation, and

ii) diminishing pasture availability and localised rangeland degradation.

Poor rainfall also inhibits the recovery of grasslands, and limits the availability of surface water for cattle during the rainy season, and increasing density of human settlement increases the competition for local water supplies. As a result of the shortages of pasture and water, despite the provision of boreholes, cattle numbers are in general decline in Uukwaluudhi, although there are shorter term increases as people restock in the event of better rains.

In addition, especially in poor rainfall years, cattle spend increasing amounts of time away from the homestead at cattle posts on the western plains where borehole water is available. The absence and reduced numbers of cattle limits the supply of manure available to fertilise the omahangu fields, which has been an integral component of the farming system. As a result, there are two secondary effects of rangeland degradation (and drought):

iii) a decline in the productivity of arable land, depressing the yield and availability of staple food crops. The impact of this decline in fertility is often limited however, and partially masked, since rainfall has been the primary factor limiting food production in recent years.

iv) reduced availability of milk due to the extended absence of cattle resulting in lower nutrition. In terms of the human consequences, this effect is combined with those of lower milk availability due to poor pasture / animal productivity, livestock deaths, and diminished crop yields.

To summarise the costs in economic terms:

The increasing labour demands and higher prices faced by people in obtaining fuelwood and building materials, and in securing access to grazing land and water for their animals

carry an opportunity cost in that the time and money involved cannot be used for other purposes.

Diminishing access to the rangeland resources which form the basis of livestock rearing also contribute to poor animal health and lower livestock numbers, reducing yields and food availability and running down people's capital assists.

A further effect of diminishing livestock numbers and the greater distances travelled in search of pasture and water is a drop in the amount of animal dung available for manuring crop fields, limiting the effectiveness of this widespread method of fertility renewal traditional in Ovambo farming systems.

The primary constraint on agricultural production however is rainfall, which appears to have been generally lower since the early 1980's, and which has resulted in lower quality grazing and lower crop yields. As a result the impact of resource degradation cannot be separated from that of poor rains, and the principal agricultural difficulties, food shortages and income losses experienced by people are those imposed by drought. The impact of drought, however, is exacerbated by resource degradation, since the lowered productivity of the resource base increases the vulnerability of both natural and human systems to scarcity and variability of rainfall. In consequence, the natural resource base is highly insecure, as poverty and limited resource entitlements continue to drive the process of desertification.

Although resource management systems are extremely weak, the levels of degradation and *de facto* privatisation of land are less advanced than elsewhere, and the interest of village communities, local government and traditional authorities, together with SARDEP and the Environment Ministry offers opportunities for the development of improved resource management in Uukwaluudhi.

COMMUNAL AREAS CASE STUDY
NO.II: GIBEON AREA (NAMALAND)

1.0 INTRODUCTION

Namaland is a communal area, 58% of which is comprised of former fenced settler farms, to which the occupants have legal rights; and the rest of which is made up of communal lands. It is a region of low rainfall in which the dominant vegetation is dwarf shrub savannah and a mixture of perennial and annual grasses. Considerable parts of the region have only limited vegetation cover.

The region is better suited to small stock than large stock, and about 50-75% of the population own livestock of various kinds. Nevertheless, the quality of the range is generally quite poor, and consequently most people's livestock ownership levels are quite low. Most people are very poor, but there is considerable economic differentiation and the so-called "commercial communal ranchers" are quite wealthy and have large numbers of small stock. State pensions are the main source of income for about 40-50% of households.

The economic costs of degradation take two forms. One is a reduction in the quantities of subsistence products that are available to households, who must purchase other products to replace them or reduce their food consumption: livestock provide meat, milk and dung for subsistence consumption. The other form is reduced incomes from livestock sales. Most livestock owners do not at present obtain any income from selling livestock, but income from livestock sales was probably more important in the past, when livestock numbers, quality, prices and demand have been higher.

The main form of desertification is vegetation degradation, primarily in the form of a reduction in grass cover. This degradation is apparent around settlements and water points, but no studies have been done of the areal extent of degradation in as a whole, and there may be parts of it that are not being degraded.

The main land use practices causing degradation are overstocking of particular areas, and overgrazing, leading to depletion of seedbanks and reduction of perennial species, due to the destruction of rootstock, and excessive trampling by livestock. On the whole the range tends to be in relatively good condition in the fenced areas, but some farmers in these areas may overstock because they are very poor and there are few alternative sources of income apart from livestock sales and pensions. In the non-fenced areas, there appears to be a "tragedy of the commons" type situation, which is exacerbated by the activities of the commercial communal farmers, who make it difficult to establish effective communal management of the range.

Communal areas such as former Namaland were never intended to provide agriculture-based livelihoods for the majority of their inhabitants. In order to improve the livelihoods of the

poorer people further land, preferably of a higher quality, needs to be incorporated into former Namaland, on the one hand. On the other hand, increased efforts are required to provide alternative sources of income. In addition, the competition between the poorer farmers and the commercial communal farmers needs to be reduced, and the benefits of the communal range distributed more equitably than they are at present, by developing effective methods of collective range management.

2.0 DESCRIPTION OF THE CASE STUDY AREA

Namaland covers an area of 2,145,082 ha. It is surrounded by the white commercial farming regions of Mariental to the north, Maltahohe to the west, Keetmanshoop to the south and Bethanien. Most of Namaland in the Karas region, but the northern part of it (including Gibeon) is in Hardap region. The majority of the communal area is a plateau ranging in altitude from 900 to 1200 metres above sea level.
The main districts in former Namaland are Gibeon, Tses and Berseba. The largest human settlement is the town of Gibeon, which has about 4,000 inhabitants. The fieldwork for this study was done in and around Gibeon town. The settlement pattern is largely determined by the availability of water; and the population distribution within the farming area is very uneven.
In 1991, the population of former Namaland was 16,234, with an annual growth rate of 2.4% during the previous decade (DRD, 1992, pp 15-16).

Land Ownership and Distribution
Fifty eight percent of former Namaland comprises former settler farms. These were transferred to the communal area in line with the recommendations of the Odendaal Commission. They were incorporated into the former reserve as fenced or partially fenced-off units. Up to 10 families with their stock were allocated to each farm. The remaining 42% of land area is unfenced communal land.

Climate and Vegetation
Mean rainfall is 100-200 mm p.a., increasing in a northerly direction. It is very variable, with an average deviation of 45 to 55% from the annual average (EEAN, 1992, p 76). On average, rain falls on 15-30 days per year, and although this is mainly during the summer months winter rainfall can be important during low rainfall years. Namaland has been classified as a hot desert area.

Namaland is a region of dwarf shrub savannah, the most common dwarf shrubs being Rhigozum trichotomum, Cataphractus alexanderi and Salsola sp (ibid, p 77). Rhigozum trichotomum is believed to be the most common species of shrub in the south as a whole (Mr R Hawthorne, pers comm). Stipagrostis namaquensis is the most common perennial grass growing in drainage lines, and other Stipagrostis species comprise the major ground cover in the south-western, fenced farm area (EEAN, 1992).

Livestock Numbers
Since rainfall in former Namaland is low, and vegetation is sparse, the area is only suitable for extensive small stock production. According to the veterinary stock census carried out in June 1991, the following livestock numbers could be found in former Namaland/Soromaas:

Cattle	Sheep	Goats	Horses	Donkeys
11,707	87,291	147,704	3,137	6,465.

3.0 LIVELIHOODS

3.1 Income and Income sources

There is substantial economic differentiation within the people living in former Namaland and the majority of the former Namaland population are very poor. The Directorate of Rural Development (DRD) (1992) survey found 33% of respondents had an average monthly income of less than $100, and 58% received less than $200. About 90% had an average monthly income of less than $500.

Income-earning opportunities are extremely limited, and state pensions play a central role within the overall household income. Men and women are eligible to receive a government pension from the age of 60 onwards. Since October 1991 all new applicants for pensions, and all existing pensioners who are black, are supposed to receive $120 per month; all existing pensioners who are coloured receive $200 per month. The DRD survey of people in the Southern communal areas found that 41% of respondents viewed pensions as their main source of cash.

The other major sources of income were wage-employment (c 20%) and the sale of Karakul pelts (c 20%). Wage employment is provided primarily by the government - as teachers, nurses, hostel staff etc. Self-employment is very limited.

The sale of livestock has not recently been a significant source of income for the vast majority of households, with only 17% of respondents in the DRD survey selling any livestock at all and only 2% giving the sale of livestock as their predominant source of cash. One of the farmers interviewed as part of this study gave the following current prices for livestock:

	$
goats (castrated)	100 - 130
karakul sheep	130 - 200
cattle	600 - 1000.

This farmer, who relied entirely on livestock sales for her income, was expecting to sell about 45 goats this year, which would give her an annual income of about $5175.

Although 83% of DRD respondents said that they did not derive any income from livestock sales, livestock are nevertheless a significant part of their livelihoods. They are an important source of food, in the form of meat and milk, and they reduce the amount of money that has to be spent on purchasing food. Farmers also tend to use their small stock as 'savings banks', or flexible assets that can be sold when extra cash is required .

3.2 Patterns of Livestock Ownership

The DRD survey of the Southern communal areas (1992) found that 77% of respondents owned livestock. The median number of goats owned was 35; donkeys or horses, 3; and sheep and cattle, 0. Thirty two percent of the households interviewed owned 2-50 goats; 13% owned 52-100; and 6% owned between 326 and 800 goats. The maximum number of goats owned by one respondent was 800. Two-thirds of respondents did not own any sheep at all, and 15% owned less than 50. A minority (4.8%) of farmers, however, owned 300-3100 sheep.

Twenty three percent of respondents did not own any livestock. The incidence of non-ownership was highest in the settlements, where 43% did not own any livestock: whereas in the former reserve area only 9% did not own any, and in the former settler farm area the figure was 20%.

4.0 LAND DEGRADATION

The main form of land degradation in the region is a reduction in vegetative cover and an associated increase in the level of soil erosion. One report cites a farmer as saying that the palatable perennial grass, Stipagrostis uniplumis, used to cover even extremely rocky and dry hills in 1981, whereas it has totally disappeared today (SARDEP unpublished report 1993). Soil compaction was said to be serious in some places, and wind erosion can be a problem during the period June-August (Mr R Hawthorne, pers comm).

Land degradation is said to be widespread, but the evidence for this is anecdotal and there are no available studies that have attempted to measure its extent, although Ministry of Agriculture researchers have investigated the nature of vegetation at SARDEP's test sites. (These investigations had not been written up at the time this study was undertaken, and hence the findings are not known.) It appears to be quite severe in particular localities, such as around water points and large settlements, but there may be some areas where there is little, if any, degradation. Separating the effects of land degradation on the vegetation from the effects of the 1989-1992 drought is problematic, given the lack of long-term data on trends in vegetative cover.

There is no bush encroachment in former Namaland or the south and west of Namibia in general. Generally speaking farmers and officials said that there had not been any significant changes in the types of vegetation found in the region, other than the disappearance of perennial grass species from certain areas. We were not informed of any harmful or unpalatable pioneer species, except for the milk bush. However, according to one report various invasive species can be seen in the region, including Geigeria ornativa, Pechuel-Loeschae leubnitziae and Datura spp. (EEAN 1992) .
There is an invasive species of tree, Persupless, which the Ministry of Environment is trying to eradicate in parks in southern Namibia (Mr R Hawthorne, pers comm). However, this species is beneficial from the farmer's point of view as it provides good fodder and firewood, and it is not clear whether it is present in former Namaland.

The spread of the milk bush (melkbos) was noted in the Nico area of Gibeon. Contact with the bush can cause blindness in humans and large stock and severe skin problems leading to slaughter or death in small stock. The bush appears to suppress growth of grass in its immediate area, and eradication costs are high, requiring the purchase of protective clothing and goggles, and paint to prevent the rootstock from regenerating. Farmers elsewhere did not mention it however, and it appears that its impact is local, although severe. It appears to be confined to stony and already degraded areas, though it does have a tendency to spread.

4.1 Degradation and Drought

The difficulty of measuring degradation and its impact is exacerbated by the fact that there was unusually low rainfall from the middle of 1989 to 1992, which has also contributed to the

reduction in vegetation and the associated fall in livestock numbers. It was impossible to separate the effect of any long-term degradation processes from the shorter-term effects of the drought. Animal mortality was high during the drought, and kidding and lambing rates fell dramatically. Although there were higher levels of rainfall in 1993 and 1994, interviewees said that neither the vegetation nor livestock numbers had recovered significantly since the drought period. Reduction in vegetation cover appears to be due to both drought and degradation, and it is likely that levels of land pressure are hindering the recovery of the veldt after drought. It is unclear however, whether the circumstances described by these interviewees is representative of former Namaland as a whole.

4.2 Carrying Capacity and Stocking Rates

In the mid 1960s the potential stocking rate for the Namaland region as a whole was estimated at 144,514 LSUs (Large Stock Units), based on a carrying capacity (CC) of 15ha/LSU; the number of LSUs recorded in December 1989 was only 53,277, substantially less than the potential (Adams and Werner, 1990, pp 99-100). Subsequently, however, another report suggested that the CC in the region was on average 4.5ha/SSU (Small Stock Units), or approximately 27ha/LSU - almost half the CC suggested by the Five Year Plan (cited by Adams and Werner, p 100). In a still more recent report a revised, and more conservative, recommended stocking rate of 35ha/LSU was cited (EEAN, 1992, p 79). Applying this guideline suggests that the maximum number of LSUs that could be supported is 60,343. By December 1991 the total LSU equivalents had risen to 65,212, suggesting that the region was slightly overstocked (ibid).

Data communicated to the researchers on stocking rates in different parts of former Namaland show them to be well below the CC in most cases. The stocking rates as a percentage of the estimated CC are as follows: Gibeon, 72.8%; Tses, 59.5%; Berseba, 52%; and Dreihuk, 104% (Snyman, pers comm, 1992). However, the basis of this data is not clear and it may apply only to the fenced farm areas, to which the concept of carrying capacity is more relevant.

Whether or not the stocking rate exceeds the CC for the region as a whole, or districts as a whole, there is another important issue. This is the distribution of livestock within the districts and the region. There is evidence that the distribution is highly uneven, resulting in severe degradation in some areas, and a healthy veldt in others.

Such a pattern appears to be reflected in recent estimates that have been made of the carrying capacity of different parts of former Namaland (DRD, pp 55-56). The lowest CC occurs in large parts of Gibeon and Tses Districts, at 7ha/SSU. In the other parts of the region the CC is slightly higher at either 5 or 6ha/SSU, but only a small area along the western edge of the region and in Soromaas has a CC of 5ha/SSU.

4.3. Grazing Patterns

The absence of sufficient water prevents certain areas being grazed. Thus the range management and grazing problems noted are experienced primarily in the areas with accessible boreholes and seasonal shallow dams.

Where the former settler farms are still fenced occupants can control grazing on the land and exclude other people's livestock. However, many of these former settler farms are no longer effectively fenced, and other livestock graze or browse in the area. This problem was experienced by a group of five farmers in Gibeon District who were interviewed as part of this study. They said that it was non-herded large stock (cattle, donkeys and horses) that were the problem, and that they did not know who owned these animals. They would like to have re-fenced the farm, but they could not afford to do so.

It is commonplace for large herd owners to graze stock on communal lands, even though some of them may also have exclusive access to fenced land. The Gibeon area CMC established through SARDEP condemned some of these "commercial communal" farmers for having the resources to invest in acquiring land, but refusing the responsibilities of farm management and relying on communal grazing areas. Throughout the unfenced part of former Namaland it is normal for farmers or their shepherds to move to those parts where there is good grazing available, which depends to a large extent on the geographical distribution of rainfall. Competition for grazing does not allow farmers to let these areas rest until the grass has matured (DRD, 1992). Larger farmers are able to split up their herds and send them out to different grazing zones.

According to the DRD study families that live in the settlements and own small herds do not follow any particular system of grazing or herd management The animals are kept in an enclosure near the homesteads during the night, and are allowed to roam freely during the day. Within a radius of about 8 kms around the settlements the area is heavily overgrazed. It is very rare, apparently, for animals of different families to be grouped and herded together. The concentration of animals in the area around water points and larger settlements has resulted in the denudation of the vegetation. In some cases, this loss of vegetation, combined with excessive hoof action, has made the topsoil powdered and susceptible to wind erosion. In other cases, the soil has become compacted and impermeable, reducing water infiltration and making it difficult for vegetation to recover (DRD, 1992).

The same report noted that although 1989 was regarded as having a good level of rainfall during the first half of the year, almost no recovery of the natural vegetation was experienced, and very little grazing was available. The farmers in the fenced area who were interviewed in this study also observed that the grasses had not come back in 1993 and 1994, despite these being years of good rainfall.

4.4 Fuelwood

Apparently Namaland was partly wooded until some point in the last century (Lau, cited in DRD 1992). Nowadays, the area is primarily covered with scattered dwarf bushes, although small trees still occur in drainage lines and around temporary pans. The commonest tree species are Parkinsonia africana, Boscia foetida, Acacia mellifera and A. karoo (EEAN 1992).

Deforestation does not appear to be a widespread problem in former Namaland, although fuelwood is reportedly becoming less readily available along water courses. Virtually all of the inhabitants of the southern communal areas still rely on fuelwood to provide them with energy for cooking and heating. On average, people spend 4.4 hours per week collecting wood, which suggests that fuelwood is not particularly scarce as yet. Collection is done mainly by women and children, 63% of whom say that they walk to collect it (DRD 1992). Others use donkey carts or bakkies (open backed trucks) when collecting it. Some fuelwood is sold commercially in Gibeon town.

4.5 The Economic Costs of Land Degradation

The costs of land degradation manifest themselves in a number of ways:

* fewer and/or weaker livestock available for domestic consumption, resulting in reduced consumption of meat and milk by their owners;

* another useful livestock product whose availability declines is dung: it is used as a fertiliser and in house construction, particularly for making floors;

* fewer and poorer livestock available for sale, at reduced prices, leading to lower incomes.

Another possible consequence of degradation is increasing fuelwood scarcity, which would result
in longer collection times.

There has been no quantitative assessment of long-term trends in the extent and severity of land degradation. Thus, it is not possible to separate the economic costs of degradation from the costs of drought. Box 1 gives examples of the types of costs experienced by farmers, due to a combination of drought and degradation.

Data on livestock ownership levels and prices were given earlier in section 3, but detailed data on typical livestock off-take rates and consumption patterns are not available. The estimates of monetised costs incurred by households in the Ovambo communal area case study, although they do not apply directly to the Namaland situation, show the kinds of assumptions, data and calculations that are required to estimate livelihood costs faced by communal area households.

As adequate data becomes available, it should be possible to estimate the monetary costs of land degradation using the following methods:

* Replacement costs of subsistence livestock products lost, at market prices;

* Changes in income due to changes in livestock prices and drops in frequency of sales;

* Rangeland rehabilitation expenditure as a proxy for damage costs: this might include the costs of fencing, reseeding, eradication of noxious species, and the management costs of developing community regulation.

Stock and marketing data being collected by SARDEP (Metzger, 1994; as yet unsynthesised and unpublished data) for the Gibeon area, suggest that in most cases losses of small stock were between 10 - 30%, over a two year period. However, in some places drought losses of goats were as high as 50%, and up to 100% for horses due to disease. Sales were generally low due to a lack of buyers and auction sites, although occasionally as high as 50% for sheep and goats; these figures appear to indicate distress sales.

Box 1 Impact of Reductions in Rangeland Quality on former Namaland farmers

* One farmer reported a drop in stock numbers over a fifteen year period from 200 to 100 small stock and from 35 to 6 cattle. Although livestock prices had risen in money terms (from $120 or $150 to $200 for goats; from $1000 to $2000 for cattle) they have fallen in real terms. He used to make $3000 a year from animal sales and now makes nothing.

* One farmer interviewed had moved to Namaland in 1980, when the farm on which she lived was sold. She and others were allocated one of the former white settler farms. She brought 160 adult goats with her, 80 Karakul sheep and 18 cattle. The grazing available to her stock was good from her arrival in 1980 until the onset of the drought in the latter part of 1989. Her livestock numbers have fallen and she currently has 85 mature goats, no sheep and four cattle. The goats were less affected by the drought than her cattle and sheep, some of which died as a result of the drought.

* In areas severely affected by water shortages, such as Amalia near Asab, losses of livestock can be severe in times of drought. One woman's herds had dropped from around 600 small stock to 147, and she had recently moved from Amalia to Nico because of the water problem. She reported earning $2000 a year from sales of livestock and livestock products, up to 3 years ago; this year she earned only $100 - 200. Her herders are paid $50 per month.

* Another (who lives on a former settler farm) said that, because of the deterioration of the range, she stopped taking milk from her goats this year. Instead of purchasing milk to replace it, she and her family go without milk. Similarly, families in the communal part of Berseba District tend not to milk their goats intensively, because of the low level of grazing available, and also because their animals are often far away from their settlements (DRD, 1992). By contrast those living on settler farms, however, obtain more milk from their goats.

* A farmer operating on a commercial scale, with 4000 small stock on an approximately 2000 ha former settler farm reported a deterioration from healthy profits in 1988 and 1989, to a loss of $3500 in 1993. This was primarily attributed to declining quality of available pasture.

* The costs of removal of "melkbos" are approximately $180 a month per man (one man can remove 60 bushes a month at $3 a bush, plus the costs of protective equipment and paint. Farmers are able to cover equipment costs but need support to pay the wages of a removal team.

5.0 CAUSES OF DEGRADATION

The farmers making up the Gibeon area Community Management Committee for the SARDEP test areas ranked their immediate problems as follows:

1. Poor water availability and distribution
2. Shortages of grass and pasture
3. Livestock disease and low levels of veterinary assistance
4. The spread of poisonous plants (a variable, localised problem)

In discussion farmers agreed that the these difficulties were underlain by management problems, namely the low levels of government support for livestock farming and marketing, and the problems of grazing management and regulation of access to pasture.

5.1 Land Tenure and Sustainable Range Management

The fenced areas

Farmers living on former settler farms have exclusive rights to that land by law. However, as was mentioned earlier, other farmers' livestock tend to graze on it. As a result, it is difficult for these farmers to manage the use of their range in a sound way, and overgrazing can, and does, occur, through no fault of their own. The solution advocated by the farmers' interviewed was to restore the fencing to their farm, so that they could keep the other animals out, but they could not afford to purchase the fencing themselves.

The unfenced communal areas

Rights to these areas are communal, so any farmer can graze his animals anywhere on the range. Systems of regulation are ineffective, resting on the principle of payment to traditional leaders, established during the colonial period. Payments are supposed to be deposited into a fund for maintenance of boreholes etc, but where they are made, they appear to be appropriated by the leader, who thus has an incentive to grant grazing rights. In many cases payment is not required, since the system does not function and has been discredited. After Independence, the Government announced that it intended to standardise/regulate grazing fees, but as yet no action has been taken; and, as a result, grazing fees are no longer paid in some parts of former Namaland. There is thus open access to the communal range.

Assuming that privatising these areas is out of the question, the challenge is to identify ways in which effective common property resource management can be exercised, involving rotational grazing and the establishment of a more viable and respected system of grazing fees. For this reason, SARDEP has supported the establishment of community management committees (CMCs), and with them has begun experimenting with participatory methods of range management.

A major barrier to sound community management is the existence and behaviour of the 'Commercial Communal Farmers'. These farmers currently move their herds freely from place to place, depending on where there is good grazing available at the time. They are, in effect, a law unto themselves, and have not, as yet, been prepared to abide by the wishes or decisions of the CMCs. Given their wealth, and power, it is difficult to see how they could be made to do so. This problem is particularly acute in Berseba district, where there are herds of up to 3,000 small stock (Kohlman, pers comm).

Given that commercial communal farmers may prevent sound communal management of the range from being implemented, several people argue that they should be encouraged or forced to buy their own farms and keep their stock within its boundaries. The farmers themselves, however, are unwilling to do so, as it would increase their expenditure dramatically. Even if the farms were given to them by the Government, they would have to cover the costs of various items such as fencing (of camps, as well as perimeter fences), wind pumps and the creation of water points.

Although there appears to be a consensus among officials in the relevant ministries, and in the SARDEP programme, that the present situation is unsatisfactory, it looks as though it will not change in the foreseeable future. Other options may need to be investigated, such as placing ceilings on the numbers of livestock that can be grazed by any one communal farmer; and introducing a legally binding system of grazing rights or grazing fees that would be enforced by the relevant government agencies.

5.2 The Donkey Population

Donkeys have two functions in former Namaland: donkey carts are the main form of transport, and donkeys are also a source of meat. Several people (but not farmers) mentioned donkeys as a cause of degradation of the range. Donkeys can cause severe damage to pasture because they remove all of the grass, including the roots, and can damage the bark of trees.

The donkey population has apparently grown considerably in the Southern Communal areas, although we have not seen population statistics over a time period of several years that would confirm this. Furthermore, many of these donkeys were may not be providing their owners with significant benefits. Recent statistics show that donkey numbers increased rapidly from 3,923 in 1990 to 6,465 in 1991; they then fell to 4988 in July 1993, perhaps as a result of lack of rainfall and low water availability.

It is argued that many communal farmers own excessive numbers of donkeys (far more than are required for one household's transport), and that the donkey population should be reduced in order to reduce degradation of the range. SARDEP would like to see the donkey population reduced dramatically (and a reduction in the number of horses). Anything above six or ten donkeys per household is regarded by government officials as excessive, whereas some farmers

were said to have as many as 20 or 30, or even 50 donkeys. However, according to the DRD data (1992), 84.3% of farmers own 10 or less donkeys. In other words, only 15.7% own more than 10; and only 2.4% of the farmers own more than 20 donkeys (DRD, p 60). It appears from these data, therefore, that the 'donkey problem' may have been exaggerated.

5.3 Livestock marketing

The DRD survey of the southern communal areas concluded that only a small minority of farmers sell any livestock. This was partly due to small herd sizes and a lack of potentially marketable animals. It has been argued that if farmers could be encouraged to sell more of their animals, the size of their herds would decrease and the pressure on the range would be reduced. If this hypothesis were true it would be desirable to investigate what factors are discouraging sales.

A lack of marketing infrastructure and arrangements is one factor acting as a deterrent to livestock sales. The majority of sales are of live goats to intermediaries who sell on in South Africa. Buyers' transport costs are high, animals of low quality are in good supply, and so prices are low. The producer price for live goats was reported to be $120, retailing for 220-250 rand in S. Africa. Farmers tend to sell out of a need for cash income, and otherwise have no incentives to destock.

Another important contributor to the low level of livestock marketing appears to be farmers' attitudes to, and use of, their animals. Farmers tend to regard their small stock as 'savings banks', or flexible assets that can be sold when extra cash is required . They will be reluctant, therefore, to sell their small stock until they have alternative assets or savings that can be called upon quickly when cash is required.

One reason why the donkey population is high appears to be that farmers are not well placed to sell donkey meat directly to buyers. They would have to find a number of buyers locally, and these people often do not pay for the meat immediately but buy it on credit. This seems to imply that there is lack of marketing intermediaries to sell the meat.

5.4 Population Pressures

It was mentioned earlier that the region's population grew at an annual rate of 2.4% during the 1980s. This could have been contributing indirectly to greater pressure on the range, and hence degradation of the range. This would be the case if:

(i) there was an increase in the number of people dependent on livestock for food or income; and
(ii) this led households to increase the numbers of livestock that they owned to levels that could not be sustained on the range available to them.

However, there are no data to show whether either of the above assumptions is valid or not, or the proportion of the increased population to which they apply.

According to the DRD survey cited earlier, nearly a quarter (23%) of former Namaland households do not own livestock. This survey specifically excluded the town of Gibeon, whose population of about 4,000 people constitutes about a quarter of the former Namaland population. Since a higher proportion of people in the larger settlements are likely to own no livestock (DRD 1992), the exclusion of inhabitants of Gibeon town from the survey has almost certainly resulted in an underestimate of the percentage of households owning no livestock.

Demands for livestock products from the 23% or more households that do not own any livestock do not appear to be increasing. The vast majority (83%) of livestock-owning households do not sell any livestock at all, and so it would appear that the additional food requirements of population growth amongst the 23% of households not owning livestock is bought from the shops and is mainly imported from outside former Namaland. It is not clear whether or not population growth amongst the households that do own livestock is bringing about any trend towards acquisition of animals.

Given that the land is not capable of providing a livelihood for all of the people of former Namaland, it is important that new work and income-generating activities are created, as these can help to relieve the pressures of livestock on the range. Various initiatives have been taken by the Government and by NGOs, but progress to date has been extremely limited (Ms K Hendricks, pers comm; Gibeon Youth Group, pers comm).

6.0 RESEARCH AND POLICY IMPLICATIONS

Biophysical research is required into the distribution and degree of rangeland degradation in former Namaland, including the extent and patterns of vegetation degradation and soil erosion. It would be useful to establish the distribution of the milk bush, preferably over time, and the factors leading to its spread. A better understanding is also needed as to why it is that several parts of former Namaland have a stocking rate within their estimated carrying capacity, and therefore if degradation is as widespread as some people suggest.

Economic research with local communities should be done alongside the monitoring of rangeland quality and management, so as to establish any costs of desertification for local people. This includes research into changing levels of income, livestock numbers and household consumption amongst the communities affected.

Research into the nature and extent of the 'donkey problem' would be desirable, covering three aspects. First, the impact of donkey grazing habits on rangeland degradation should be ascertained. Second, more comprehensive data on donkey ownership levels by household should be obtained, if donkey grazing habits are confirmed as being damaging to the veldt. Third, farmers' reasons for owning apparently excessive numbers should be investigated. It would be surprising if farmers did not have good reasons for doing so, and these need to be understood if attempts to reduce donkey numbers are to be effective.

Research is needed into the cost/benefits of the repair of perimeter fences to fenced farms, and of fencing grazing management and rehabilitational measures on the unfenced communal areas, in order to assist SARDEP in planning sustainable approaches to range management.

A better understanding is needed of the relative importance of the factors discouraging livestock sales, and ways of overcoming them. The development of local banking and savings facilities in the southern communal areas (for instance through a mobile banking facility) has been suggested so that farmers might be prepared to sell more livestock and put some of the cash in a savings account. This would require some assessment of the relative changes in value (in real terms) of investments in livestock and in savings.

The marketing of small stock could be affected by price changes resulting from the implementation of the GATT agreement. The implications of these changes for livestock ownership levels need to be investigated, but they are likely to be less significant in former Namaland than in the commercial sector, given the lower proportion of animals marketed.

ANNEX

SOURCES OF INFORMATION

The Gibeon district was selected as the focus of the fieldwork, and discussions were held with farmers in both the fenced and unfenced parts of the district. One of the research team attended a meeting of the Community Management Committee for SARDEP's Gibeon area programme, and visited community members at SARDEP test sites in an unfenced part of the District. In the fenced area, interviews were held with a group of five farmers who shared a former settler farm. A meeting was also held with representatives of the Gibeon Youth Group, a local organisation that is planning various initiatives to improve the quality of people's lives in and around the town of Gibeon.

Meetings were held with various officials with responsibilities in former Namaland. Mr Solomon Boois, SARDEP's representative in Gibeon, made the local arrangements for the farmer interviews and was a valuable source of information. Mr Kohlman, SARDEP's Regional Co-ordinator for the southern communal areas, was interviewed at his office in Keetmanshoop and also provided some very useful information. Ms Katrina Hendricks, a Ministry of Agriculture extension officer, provided information on initiatives to generate off-farm sources of income in the southern communal areas.

COMMERCIAL FARMING AREA CASE STUDY NO.III NORTHERN AREAS

1.0 INTRODUCTION

Three former districts, Otjiwarongo, Okahandja and Grootfontein were visited in the course of fieldwork. Discussions were held with 6 farmers and with 6 agricultural extension officers. Average rainfall varies from 350mm in the south of the area to 500mm in the north, which allow some arable crop production. However, farmers rely predominantly on cattle for their livelihoods although game farming and tourism has increased in recent years, presumably in response to falling incomes from cattle. These districts are among the worst affected by bush encroachment. Data relating to soil erosion mainly consists of information concerning water erosion on the commercial croplands of Grootfontein where actions to remedy the problem are underway on many farms. It has proved impossible to quantify the effects of soil erosion, where it exists on the rangelands of these districts.

More precise data on the effect of bush encroachment on the farms of the three districts visited is unavailable. Therefore this study must rely on the national estimates of the problem outlined in the next section. Data on farm output and income was available from some of the farmers visited which allows calculations to be made concerning the loss of productivity experienced as a result of bush encroachment. Data was also gathered on the methods and costs of bush control and the various approaches attempted by farmers to control this problem. Opinions vary enormously on the seriousness of the problem, perhaps reflecting to a degree, the variability that exists between farms and the effects of different forms of management on the spread of bush. The general consensus is however, that bush encroachment has advanced over the past 30 years, and the previous generation had much higher stocking densities than are possible today.

1.1 Agricultural productivity and incomes

Data were collected during field visits directly from farmers and farmers' producer groups. These figures probably represent the production from some of the best or most productive farmers in their respective districts (Table 1.1). It is generally believed that the most progressive farmers make up the membership of producer groups. Therefore a cattle farmer farming 5,500 ha (the mean size in 1991) could have expected a gross income of around $107,000 and a net income of $65,800 between the years 1986-93.

Table 1.1 Financial and production data for commercial farms in Okahandja and Grootfontein districts.

	Means of 20 farms in Okahandja 1986-92	Means of 7 farms in Grootfontein 1988-93
Gross income/ha ($)	20.16	18.83
Net income/ha ($)	13.78	10.17
Stocking rate kg/ha	24.0	23.2
Production kgLW/ha	8.6	8.5

Income is very dependent upon the farmgate price received for beef and on rainfall totals and the degree of effectiveness of rain. For example the net income/ha for 20 commercial farmers in Okahandja district was $5.32 in 1992/93 and $14.79 in 1993/94 reflecting the effect of drought in the earlier years. During 1992/93 costs of production were equivalent to 76% of gross income as farmers were forced to buy feed for their cattle or alternatively de-stock at low prices. Costs of production were closer to 46% for the period 1993/94.

Beef prices have remained unchanged for a number of years which has led to a decline in real incomes of commercial beef farmers. A recent increase has renewed confidence throughout the sector and farmers suggested that this may allow them to make necessary fixed improvements to their farms.

1.2 Bush encroachment on northern commercial farmlands

Table 1.2 shows the estimated surface area of seven commercial farming districts affected by bush encroachment in 1986. It was then estimated that there were 8.628 million hectares affected (Adams and Werner, 1990). The same report goes on to mention that the total area affected is close to 15.0 million hectares of all commercial farmland. This represents almost 50% of the commercial farming area of 34.89 million hectares.

The Report of the Technical Committee on Commercial Farmland, July 1992 estimated that 14 million hectares of commercial farmland in the 300-500mm annual rainfall zone were affected by bush encroachment. The ecological carrying capacity of commercial farmlands has in some cases been reduced from one large stock unit (LSU) (450kg) on 10 ha to one LSU on 40 ha. It is estimated to have caused a loss in beef production of $500 million in the past 30 years.

Table 1.2 Estimated surface area affected by bush encroachment in selected commercial farming districts: 1986.

District	Surface area ('000 ha)	Estimated bush infestation (%)	Total bush infestation ('000 ha)
Grootfontein	2,565	80	2,052
Tsumeb	894	90	805
Otjiwarongo	1,955	75	1,466
Outjo	2,628	50	1,314
Okahandja	1,432	50	716
Gobabis	4,039	50	2,020
Omaruru	850	30	255
TOTAL	14,363		8,628

Another estimate has put the area affected by bush encroachment as 8-10 million hectares (Reitfontein Farmers Association, 1993), the most affected areas being the former districts of Tsumeb, Grootfontein, Otjiwarongo, Okahandja, Omaruru and Gobabis. In the northern commercial farming area woody Biomass has been estimated to be 17.6 tons/ha with average densities of 6,800 stems/ha.

Since the 1970s there has been reported a dieback of *Acacia mellifera* which is said to have affected 1.2 million hectares as the result of fungal infection. However some of the worst affected regions in the north (Tsumeb) have not been affected by this disease (Bester, pers comm).

There is little data on the rate of bush encroachment, which makes quantification of the problem difficult. Some estimates have been made for the Waterberg area in Otjiwarongo district by comparing historic ground photographs with aerial photographs. In the early 1940s the area was open grassland with large *Acacia erioloba* trees providing ground cover of woody vegetation of about 15%. By 1961 the woody ground cover was estimated to have increased to 40-60% and in 1979 to 70-80% (The Report of the Technical Committee on Commercial Farmland, 1992). The major encroaching species are *Acacia mellifera* (blackthorn) and *Dichrostachys cinerea* (sickle bush). This data is in line with anecdotal evidence provided by farmers interviewed in the area. One farmer claimed his father kept twice as many breeding cows as the farm can support today. Another farmer reported that stocking rates fell from 8 ha/LU in 1957 to 24 ha/LU today. Data from the Agricultural Office in Otjiwarongo provide further evidence of a fall in cattle numbers (Table 1.3).

Table 1.3 Cattle populations in three northern districts of Namibia 1964 and 1993.

	Otjiwarongo	Tsumeb	Outjo
1964	161,700	87,000	150,000
1993	89,210	38,665	128,048

Although this fall appears dramatic it should not be forgotten that the size of the animals has increased during this period as a result of the introduction of new breeding stock. Further data from Otjiwarongo allowed the comparison of cow carcass weights in 1967 with those of today. A cow in 1967 had a liveweight of approximately 400kg. The average liveweight of cows found on farms in the district today is approximately 500kg. Thus modern cows are 1.25 times larger. Therefore a farmer with 400 cows today who in the 1960s kept 800, in fact has the equivalent of 500 old cows. Thus stocking rates have fallen by 300 cows or 37%. This rather crude calculation suggests that potential income may be at present 37% less than could be achieved under open savannah type grazing conditions.

Data from a farm in Grootfontein district (see Appendix A) clearly show a decline in stocking rates since the 1950s. Even accounting for a change in the size of animals this data suggests that the productive potential of the farm has seriously declined in the last 30 years from 10ha/head to 20-25ha/head.

Further evidence of a decline can be found by comparing the production from bush encroached land and land that has been cleared either mechanically or by chemical means. Data presented in the following section (based on a few farms) suggests that after removal of bush, grazing days/ha and production are doubled. This suggests that the productive potential of the land may have halved as a result of bush encroachment.

Unfortunately there appear to be few reliable or accurate data available on the density of bush encroachment. In patches it may be as high as 10,000 bushes per hectare which must effectively result in little or no grazing in these areas. Discussions with farmers demonstrated that one man's bush encroachment is another man's good grazing. Some farmers consider the presence of 1,000 bushes per hectare to be intolerably high while others are willing to tolerate this level of encroachment.

1.3 The causes of bush encroachment

Farmers interviewed in Otjiwarongo, Grootfontein and Okahandja Districts of Namibia gave a number of reasons as to the cause of bush encroachment. The following list includes their suggestions:

- overgrazing as a result of drought which reduces carrying capacity - farmers do not destock rapidly enough to prevent damage to perennial grasses;

- the prohibition of fire has prevented the destruction of non-fire resistant woody species;

- bush has always been present, there are reports from explorers of the mid-18th century, and shrubs and trees dominate the landscape in cycles of 60-90 years;

- shrubs and trees are in fact the climax vegetation, they are important for the recycling of nutrients from deeper soil layers;

- the reduction in game species over the last century has reduced the number of browsers, leading to increased populations of bush and scrub;

- the presence of bush is the manifestation of the environment protecting itself from overexploitation, it is not evidence of degradation but part of a process leading to improved fertility;

- poor management as a result of a withdrawal of government subsidies for fencing, which resulted in larger paddocks and a less systematic use of rotational grazing;

- climatic conditions favourable to the development of bush rather than grasses, followed by drier periods during which water is available only to the deep rooting woody plants;

- large trees are important for the sustainable natural production of pasture and the removal of large trees for fencing poles, fuel and pit props has allowed the invasion of bushes;

- the extraction of water from boreholes has lowered the water table and caused the death of large trees upsetting the balance of the savannah ecosystem.

Some commentators are more confident about the causes of bush encroachment. Adams and Werner (1990) insist that the problem is the result of overgrazing and overstocking which has been characteristic of the commercial farming sector for the past 40-50 years. Farmers themselves admit that some of their number overexploit their grazing resources for short term profit, being reluctant to sell animals at the onset of drought when prices are low and restocking too rapidly before the range can recover after drought. However, the problem may not be simply a question of overstocking, as carrying capacities are difficult to calculate in variable environments, but may rather be related to careful and attentive management (see Section 2.6).

Table 1.4 displays the stocking rates of 20 farmers in Okahandja district for the 1993/94 season. This table suggests that stocking rates in recent years have rarely exceeded 20 ha/LU (450kg) in Okahandja. Apart from this it is difficult to deduce further information from these figures. They probably represent differences in types of management, management skills, income expectations, levels of debt etc. as much as levels of bush encroachment or land degradation. It is impossible from this limited data to deduce whether these farmers are overstocking. A comparison of actual stocking rates with Ministry of Agriculture's

recommended carrying capacities is also of limited value. Carrying capacities vary from year to year and over longer periods of time. Good management enables some farmers to hold much higher densities of stock than those paying less attention to grazing management.

There is little doubt that the presence of shrubs and trees has a profound effect on the ability of the range to provide palatable grasses for livestock husbandry. For example de Leeuw and Tothill (1993) mention that in Botswana it is thought that the presence of 100 units of trees per hectare results in a reduction of herbaceous Biomass of 5%. Thus 1,000 units would result in a 50% reduction in available herbaceous Biomass and 2,000 units in no grazing whatsoever. If a similar effect were observed in Namibia then many areas would provide little grazing for livestock, as densities of bushes as high as 5,000-10,000 per hectare have been reported.

1.4 The economic effects of bush encroachment

Given the shortage of quantitative data surrounding the subject of bush encroachment and rangeland degradation in Namibia it is impossible to accurately assess the costs of the problem to the economy as a whole. However, the problem appears to be sufficiently serious to make it worthwhile to at least attempt to quantify the costs.

Table 1.4 Stocking rates and livestock units on 20 farms in Okahandja 1993/94

Farm	ha/LU	Total LU	Production kg beef LW/ha
1	16.6	674	8.8
2	15.5	756	8.2
3	16.2	574	7.3
4	20.3	393	6.2
5	14.0	456	6.3
6	13.0	376	8.5
7	9.0	625	8.8
8	12.8	295	13.0
9	23.9	622	5.1
10	16.4	679	6.0
11	14.1	541	4.6
12	12.4	1,120	5.8
13	21.9	415	4.7
14	19.6	303	4.4
15	15.5	633	4.6
16	22.9	557	4.1
17	15.0	476	5.1
18	20.7	710	4.6
19	18.9	217	4.9
20	19.4	283	3.1

It is assumed for the purpose of this analysis that 10 million hectares of the northern commercial farmlands are infested with bush that reduces available grazing by 30%. Available data suggest that farmers in these areas are at present producing 8kg of beef (liveweight) per hectare per year (equivalent to 4kg of carcass weight). This has a value at today's prices of approximately $3.00/kg. It is assumed therefore that production foregone as a result of bush encroachment is 3.4kg of beef/ha or $10.20/ha.

Therefore the annual loss in production is 34 million kg (34,000 tonnes or 75,500 animals of 450kg liveweight) of beef (liveweight) or $102 million. There are 2,057 farmers in the affected districts (1991) and this figure therefore represents an average loss in gross income per farm of $49,500. If production costs average 50% of output this loss represents an average reduction in net farm income of $24,700. Losses in terms of taxed income to the state (at 25%) may

therefore be in the region of $12.7 million.

It is questionable whether this amount of additional production could be marketed without a reduction in the price, although there is no restriction on the number of cattle exported to RSA. It is also of interest to note that in 1992 the Meat Board was unable to fulfil its full quota of exports to the EU under the Lome agreement and these exports showed a shortfall of 2,700 tonnes of deboned beef. However, increasing production to these levels is not realistic in the near future as an economically viable, quick and efficient method of bush control is not available to farmers (Section 3). Cheaper methods either lack markets for the products of bush clearance (charcoal) or can only realistically be expected to reap dividends in the longer term (management).

2.0 METHODS AND COSTS OF BUSH CONTROL

The following methods have been attempted in the northern commercial farmlands of Namibia:

- chemical treatment
- controlled fire
- mechanical bush clearing
- bush utilisation (charcoal)
- biological control (game farming)
- rotational grazing.

2.1 Chemical treatment

Several chemicals are used for bush control: Tordon, Graslan, Reclaim and Hyvar X (Reitfontein Farmers Association, 1993). In the past cheap finance (4% p.a. interest rate) was available for these methods.

For Grassland the application rate is dependent upon the clay content of the soil.
clay content 3-10% requires 3kg/ha = $120/ha
clay content 11-15% requires 4kg/ha = $160/ha
clay content 16-20% requires 5kg/ha = $200/ha

This dosage is only appropriate in the absence of sickle bush *Dichrostachys cinerea,* which if present will require double the dosage. The pellets are applied by air and result in 90% eradication of bush. As tree mortalities occur more water will be available for the grass layer but improvements can only be expected towards the end of the second season.

The distributor of Reclaim recommends the following doses for various soils:

< 25% clay 400g/ha = $67.26/ha
< 35% clay 500g/ha = $84.08/ha
> 35% clay 1kg/ha = $168.15/ha

The rate of application must be doubled for sickle bush. The aboricide is applied selectively by hand at the base of encroaching bushes. A labour cost of $10.00-20.00/ha will be incurred for hand application of the chemical, depending upon the level of infestation.

Both methods provide good biological results although some smaller bushes appear not to be affected by aerial applications of Grassland. Most bushes die within one year and the recovery

of grass is good. Despite this, follow up treatment is required because the increase of perennial grass species does not appear to suppress bush encroachment. To control regrowth costs $7.00/ha annually using chemicals. Other options include an occasional controlled burn, removal of bush by hand at $10.00/ha or the introduction of goats to browse the regenerating bush. Few farmers take the latter option for reasons of difficult management, expense (herding or fencing), theft or predators.

The density of perennial grass species is estimated to increase by 200-400% after treatment, depending upon the condition of the range before treatment. Grazing days per annum have been reported to increase by 100% over a period of seven years (Reitfontein Farmers Association, 1993). This would allow production to rise to 16kgLW/ha resulting in net financial gain of $24.00/ha at a price of $3.00/kgLW. A discounted cashflow is presented in Table 3.1 which demonstrates that even at a discount rate of 10%, which is quite low, the returns to treatment are inadequate to cover the costs. The average cost of a chemical treatment is assumed to be $200.00 but this may be conservative under most circumstances. For example, to eradicate sickle bush would require at least twice the investment, and hence cannot be considered to be a viable investment. There may be additional costs associated with chemical treatment i.e. pollution of groundwater and the destruction of beneficial plants and animals. These effects are unknown and therefore unquantifiable at present. They were, however, of some concern to farmers who have used this method.

2.2 Controlled fire

Fire aids the control of bush encroachment by stimulating the growth of grasses and destroying the non-fire resistant woody plants. It will destroy seedlings and saplings but rarely kills mature trees. Therefore the medium term effect of burning is not to reduce the number of trees or bushes but to suppress the establishment of young trees. Fire therefore helps to suppress bush encroachment but it will not solve the problem once it is established. To be effective burns must be hot and occur at 3-5 yearly intervals. These conditions can only be achieved on fertile sites which are not heavily grazed (Scholes, 1986). Fire is likely to be used in conjunction with other methods of bush control rather than as the primary means of dealing with an advanced problem.

Table 2.1 Discounted cashflow for chemical bush treatment

Present values of Grassland treatment (discount rate 10% p.a.) ($/ha)			
Year	Treatment	Sales	Net cashflow
0	200.00	0.00	(200.00)
1	6.36	21.82	15.45
2	5.78	19.83	14.05
3	5.26	18.03	12.77
4	4.78	16.39	11.61

5	4.35	14.90	10.56
6	3.95	13.55	9.60
7	3.59	12.32	8.72
8	3.27	11.20	7.93
9	2.97	10.18	7.21
Totals	240.31	138.22	(102.10)

The major cost associated with the use of fire is the opportunity cost of setting aside grazing to accumulate sufficient material to guarantee a hot burn. Farmers and extension staff advised that 1.5 tonnes of dry matter are required for this purpose in the northern commercial farming areas of Namibia. However, one has to question the wisdom of burning 1.5 tonnes of grass. If the range is producing this much grass is it necessary to burn?

Having decided to burn the best approach is for farmers to set aside land after good rains when there is plenty of grazing available on the farm. Fire is not effective where bush encroachment is so far advanced that it suppresses the growth of grass to the extent that there is not sufficient to allow a hot burn.

If the average production of beef per hectare in the northern districts is 8kgLW, at a farm gate price of $3.0/kgLW the cost of burning, in terms of foregone production and associated revenue, will be $24.00/ha minus any costs of production that would have been incurred.

2.3 Mechanical treatment

There are two objectives of mechanical treatment, the re-establishment of climax grass species or the introduction of planted grasses, usually *Cenchrus ciliaris.* The use of a bulldozer to completely remove all vegetation is not recommended as this leads to greater bush encroachment than before treatment, and increases the likelihood of soil erosion. There are three other methods which have displayed a degree of success in the northern commercial area:

A. crushing
B. bulldozers and chains
C. a combination of chemical and mechanical methods.

Crushing involves destruction of bushes with the bulldozer blade just above the surface of the soil which leads to minimal soil disturbance. The area is not grazed for one or two years after which a hot fire removes most of the material and cultivation can begin if required.

Bulldozing with chains entails the use of two bulldozers which move parallel to each other with a chain suspended between them to remove the bushes. Follow up treatment is the same as for crushing.

The combination of chemical and mechanical methods involves the removal of large bushes by stem burning, the poisoning of dense stands of bush by aboricide applied manually and the chopping out by hand of small bushes. This method again requires a withdrawal from grazing of the treated land for a period of two years, after which material can be removed by burning. This method has the advantage of being cheaper than the other two and selective removal of shrubs can ensure that useful species remain.

Table 2.2 Various methods of mechanical bush control ($/ha)

Method	Bulldoz-er	Prepar-ation	Tractor	Establi-shment	Wire	Total
A	188	85	100	100	75	548
B	150	85	100	100	75	510
C*		185	75	100	75	435

* manual clearing and use of aboricides

The costs of the various methods for bush encroachment of 2-5,000 bushes/ha are outlined in Table 2.2. If the desire is to re-establish climax grasses the costs will be reduced by $275 for treatments A and B and by $250 for treatment C.

In addition to the costs outlined above each method involves the loss of grazing for one or two years which results in a loss of production of 8kgLW/ha or $24.00/ha/year. Planted grazing is assumed to have a life of 10 years during which fertiliser applications and ripping will be required to maintain the vigour of the grass. These treatments require an additional investment of $33.0/ha/year.

If climax grazing is to be established the additional production resulting from treatment can be expected to be similar to that for a purely chemical treatment, i.e. 100% improvement in grazing days providing an increase in income of $24.00/ha. However, there will be additional annual costs of $7.00/ha for chemicals to prevent the regrowth of bush. A discounted cash flow is presented in Table 2.3 which demonstrates that adequate returns cannot be expected from bush clearance of this type. Even with a doubling of production this technique cannot be considered a worthwhile investment at a beef price of $3.00/kgLW.

If planted pastures are established the stocking rate achieved can reach 125-150kg biomass/ha - an improvement of 625% compared with the average stocking rate of 22kg/ha. Planted pastures are capable of producing 46kgLW/ha of beef, equivalent to $138.00/ha, a net increase of $114.00/ha. Planted pastures allow closer management of stock and the resting of the remainder of the farm during the growing season, assuming that a sufficient area is planted to allow the whole herd to graze these areas during the growing season. Farmers in Grootfontein district were attempting to devote 10% of their farms to planted pastures. Planted grazing also provides possibilities for earning extra income from the harvesting of seed and the production of hay during good seasons. A discounted cash flow is presented in Table 3.4 which demonstrates that adequate returns cannot be expected from investments of this kind. Despite

an increase in production of 400% this does not provide adequate returns to cover the cost of the investment. Some farmers in the north are able to grow a crop of sorghum or maize before planting pastures, which may significantly reduce the costs of establishment.

□

Table 2.3 Discounted cashflow for a mechanical treatment to establish climax grazing

Present values of mechanical treatment to establish climax grazing (discount rate 10% p.a.) ($/ha)

Year	Bulldozer	Preparation	Treatment	Additional Sales	Net cashflow
0	188.00	85.00			(273.00)
1			6.36	21.82	15.45
2			5.78	19.83	14.05
3			5.26	18.03	12.77
4			4.78	16.39	11.61
5			4.35	14.90	10.56
6			3.95	13.55	9.60
7			3.59	12.32	8.72
8			3.27	11.20	7.93
9			2.97	10.18	7.21
Totals	188.00	85.00	40.31	138.22	(175.10)

Table 2.4 Discounted cashflow for a mechanical treatment to produce planted pasture

Present values of a mechanical treatment producing planted pasture (discount rate 10% p.a.) ($/ha)

Year	Bulldozer	Preparation	Tractor	Establishment	Wire	Additional Sales	Net cashflow
0	188.00	85.00	0.00	0.00	75.00	0.00	(348.00)
1			90.91	90.91			(182.82)
2				27.27		94.21	66.94
3				24.79		85.65	60.86
4				22.54		77.86	55.32
5				20.49		70.78	50.29
6				18.63		64.35	45.72
7				16.94		58.50	41.57
8				15.39		53.18	37.79
9				14.00		48.35	34.35
Totals	188.00	85.00	90.91	250.96	75.00	552.89	(137.98)

2.4 Bush utilisation (charcoal production)

The Bush Utilisation Association for Namibia was founded in 1988 to organise the producers of products derived from bush for the purpose of clearing fields for grazing and deriving income from the process. Some possible uses of bush timber include (Ministry of Trade and Industry, 1993):

- sawn wood;
- pulp for paper and panel board production;
- chipboard, particle board and fibre board;
- charcoal;
- woodgas;
- wood fibre;
- animal feed;
- wood/cement composite bricks and panels.

To date only charcoal production has been adopted by commercial farmers. The production of timber for other uses awaits further research and development and assessment of the potential market. It is estimated that 60,000 tonnes of wood were harvested from 6,000 ha of land during 1993 (Reitfontein Farmers Association, 1993). From this harvest 12,000 tonnes of charcoal were produced and marketed at a gross domestic price of $355.00/ton. The major producers are found in Grootfontein and Tsumeb districts, the copper smelter at Tsumeb (Tsumeb Corporation Limited) burning 450 tonnes of charcoal per month.

Harvesting of the bush is generally carried out by hand and involves total deforestation, or selective removal where desirable species are found. Wood is chopped into 50cm pieces in the field or transported to a saw in long lengths. Transport to the kiln is usually performed by tractor and trailer. After burning charcoal is sifted and lengths longer than 20cm are marketed as barbecue charcoal in Europe and RSA. The smaller coals are sold to the Tsumeb copper mine for smelting ore.

Before embarking on charcoal production capital investment is required in the following equipment (Reitfontein Farmers Association, 1993):

EQUIPMENT	COST ($)
Harvesting equipment	2,400.00
Kiln, sieves and tables	12,000.00
Stitching machine	2,000.00
Installation costs	4,000.00
TOTAL	20,400.00

It is assumed that this equipment has the capacity to handle harvested wood from 100 hectares/annum and the machinery has a working life of 15 years.

One ha harvested produces 10 tonnes of wood which produces 2 tonnes of charcoal. These 50% of coals are smaller than 20mm, and fetch a producer's price of $140/ton. The 50% of coals larger than 20mm realise $300/ton. Total income per hectare is therefore $440.

Costs of production/ha are as follows (Reitfontein Farmers Association, 1993):

	$
wood harvesting	120.00
wood transport	30.00
charcoal burning	70.00
charcoal sieving and packing	50.00
total	350.00

Charcoal production produces a net income of $90.00/ha. However, in addition increased production can be expected from livestock due to the re-establishment of grasses. This increase can be expected to be similar to that for chemical and mechanical treatments undertaken to improve the production of climax grasses i.e. $24.00/ha (these benefits will only accrue to the farmer on his own land but at a rate of 100 hectares/year most farmers will require 50 years to convert all farm bush to charcoal). To ensure that regrowth of bush does not occur will require an annual chemical treatment costing $7.00/ha. A discounted cashflow is presented in Table 3.4. This assumes that a farmer already owns a tractor and trailer for transporting wood from field to kiln. This analysis suggests that if markets can be found for charcoal the enterprise represents the only profitable mechanical or chemical means of clearing bush-encroached land.

Table 2.5 Discounted cash flow for charcoal production from 100 hectares.

Present values of charcoal production for the purpose of bush clearing (100ha/annum)(discount rate 10% p.a.) ($)						
Year	Equipment	Production costs	Bush treatment	Charcoal sales	Livestock sales	Net cashflow
0	20,400.00					(20,400.00)
1		31,818.50	636.37	40,000.40	2,181.84	9,727.37
2		28,924.00	578.48	36,361.60	1,983.36	8,842.48
3		26,295.50	525.91	33,057.20	1,803.12	8,038.91
4		23,905.00	478.10	30,052.00	1,639.20	7,308.10
5		21,731.50	434.63	27,319.60	1,490.16	6,643.63
6		19,757.50	395.15	24,838.00	1,354.80	6,040.15
7		17,962.00	359.24	22,580.80	1,231.68	5,491.24
8		16,327.50	326.55	20,526.00	1,119.60	4,991.55
9		14,843.50	296.87	18,660.40	1,017.84	4,537.87
10		13,492.50	269.85	16,962.00	925.20	4,124.85
11		12,267.50	245.35	15,422.00	841.20	3,750.35
12		11,151.00	223.02	14,018.40	764.64	3,409.02
13		10,139.50	202.79	12,746.80	695.28	3,099.79
14		9,215.50	184.31	11,585.20	631.92	2,817.31
Totals	20,400.00	257,831.00	5,156.62	324,130.40	17,679.84	58,422.62

The major constraints to further utilisation of bush are the availability of domestic and foreign markets, a shortage of capital, the problems posed by the need to manage large labour forces, the absence of large processing facilities in Namibia and the lack of a formal marketing body. It is estimated that there are at present 50 farm producers of charcoal. This number is unlikely to increase rapidly unless additional markets can be found and thus the technique is unlikely to have a major impact on bush encroachment nationwide in the near future. If deforestation continues in the northern communal areas a market for charcoal may develop in these areas in the future. Whether the population in these areas at present has sufficient purchasing power to switch from wood to charcoal must be in serious doubt.

2.5 Biological control (game farming)

Game farming has been adopted by a number of farmers in the northern commercial area. It is not clear whether this was an attempt to remove bush and improve grazing or simply a response to falling incomes from beef production, but it seems more likely that the latter cause is responsible. It seems that rarely have game been combined with cattle in mixed grazing systems in an attempt to improve the quality of the grazing (in reality these conditions exist on many farms which have wild game, although their numbers are significantly less than those of cattle).

Game farms provide facilities for tourists to view and hunt game, and some specialise in trophy hunting for foreigners. Although game are better adapted than cattle to the environmental conditions in the northern commercial areas, game farmers have a tendency to overstock their farms to ensure that tourists are guaranteed to see or shoot game. Therefore, to date they have not necessarily contributed to an improvement of range conditions. There is therefore a risk of range degradation if game stocking rates do not match the capacity of the farm. Fenced in game are equally likely to degrade pasture as cattle.

The market for tourism and hunting is obviously limited, and farmers consulted during fieldwork expressed the opinion that there is little prospect for further development of this industry. It is said that those that established themselves 10 years ago are now showing a healthy profit. However, current costs of establishing these types of enterprise may prove prohibitive for many farmers. The cost of game-proofing a 5,000 ha farm is in the region of $100,000. Further investment will be required in livestock and then a period must be set aside for them to breed before the farm can be opened to visitors. Without considerable reserves of capital these types of projects will not be a realistic alternative for the majority of landowners.

2.6 Rotational grazing

Although rotational grazing features as part of the management strategy on the majority of commercial cattle farms in Namibia, some farmers are practising a more sophisticated form of management than others. The origins of this strategy are to be found in Holistic Resource Management, a rotational grazing system developed by Alan Savory in Zimbabwe. The objectives of this strategy are to ensure that paddocks or camps receive sufficient rest during the growing season to allow the development of perennial grass species. It is therefore important that each herd has access to 21 paddocks which will allow 3 days grazing per paddock during the growing season and 60 days rest. If only three days grazing is allowed in any one paddock (assuming this paddock is of the optimum size for the size of the herd) this will ensure that climax and other desirable perennial species of grass will not be overgrazed. As these species are the most palatable they tend to be eaten first by cattle and the objective of this grazing management system is to ensure that the cattle do not have sufficient time to return to these grasses for a second bite.

After the growing season the herd can be split if required and 6 paddocks allocated to each herd which will allow 20 days grazing per paddock, the animals being rotated twice around the available grazing. Several of the farms visited during the course of fieldwork claimed that this system of grazing resulted in an increase in climax perennial grasses on their farms. The establishment of these grasses in turn tends to suppress the germination and establishment of unwanted bush. How this occurs is not immediately clear although this process is in line with current ecological understanding. It is not clear why this should be the case under this system of management when chemically or mechanically cleared bush does not respond in a similar way. It may be the case that those farmers clearing bush by these methods do not follow up clearance with a management system that benefits the perennial grass portion of the pasture.

It is impossible to establish with certainty whether this grazing management is responsible for the healthy state of grazing on these farms or whether the environmental conditions on these holdings are particularly favourable for cattle production. In addition to the direct influence of grazing animals on the vegetation it is claimed that the close herding of livestock has a beneficial effect upon soil conditions in the paddocks, which in turn results in improved germination of perennial grass species. In some cases it is argued that the cause of range degradation is not the result of overgrazing as such, but is rather the consequence of too few animals. If small numbers of animals are left in a large paddock they will tend to concentrate their grazing on the most palatable perennial species while ignoring the sub-climax and annual species. This leads to overgrazing of the most valuable portion of the range, suppresses the growth of these species and reduces the range's ability to suppress the growth of bush. Therefore, it is argued, the objective should be to have high densities of animals on the range for short periods of time.

There is insufficient data to prove with certainty that these methods of management are superior to those of more traditional range management. However, the signs are such that the technique deserves further consideration and investigation.

In the absence of any more systematic and comprehensive data, Table 2.6 compares the Biomass per hectare and hectare/LU of a farm in Okahandja district practising this form of management with 19 other farms pursuing a more traditional approach in the district. It must be emphasised that this evidence is only suggestive. There are great variations between farms in terms of resources available, both natural and financial, and in the management skills of farmers. Furthermore, the data for the 19 farms only cover two years, whereas those for the intensive rotational grazing farm cover an eight-year period.

Table 2.6 Comparison of stocking rates of a farm practising intensive rotational grazing with other farms practising traditional livestock management.

	Intensive rotational grazing farm	19 other farms
Biomass/ha (kg)	37.3 (mean 1986-94)	27.8 (1992-93) 28.2 (1993-94)
Ha/LU	12.3 (mean 1986-94)	17.1 (1993-94)

If the technique is successful there remains the question why has it not been adopted by more than the estimated 60-70 farmers throughout the commercial farming area? Although some investment is required in additional fencing, and probably also in additional livestock, the major reason why the technique has been ignored by the majority of farmers is that it requires a high degree of commitment to management, record keeping, attention to detail and possibly more labour. Many farmers may simply not be willing to devote this much time and attention to agricultural production.

3.0 CONCLUSIONS

There is little precise data on the nature and extent of bush encroachment in the northern commercial farmlands of Namibia. It is estimated that the area affected is between 10 and 15 million hectares. National cattle population statistics do not indicate a declining trend in production, having remained relatively constant between 1981 and 1992. Several factors affect the cattle population, making it difficult to draw any conclusions from these statistics, but they could be interpreted as indicating that the problem of bush encroachment may have stabilised.

Bush encroachment in the northern commercial farming areas of Namibia has a serious detrimental effect on the output of beef from individual farms and consequently on farm incomes. These effects can also be assumed to have an effect on those sectors of the economy dependent upon agriculture, including those involved in input supply, the farm labour force and the meat processing and export industries. Although the precise cause of encroachment is unclear it is widely accepted that mismanagement of the grazing resource is a major factor in the deterioration of grazing lands. There is little data on the contribution made to this deterioration by the effects of soil erosion.

The chemical and mechanical methods of controlling bush encroachment do not provide adequate returns at current beef prices to justify investment in the application of these techniques. The longer term outlook for beef prices is not favourable, with the GATT agreement taking effect from July 1995. It is estimated by Low (1994) that this will depress beef export prices by 17-20%, although GATT may allow penetration of other markets in the Middle East which may compensate to a degree for this loss of export revenue. If the beef price declines farmers may attempt to compensate by increasing herd size. Without appropriate management this will lead to further bush encroachment and ultimately a further loss of income and the collapse of some businesses.

Despite the negative financial returns to chemical and mechanical treatment small numbers of farmers are using these techniques in the absence of what they consider to be viable alternatives. Charcoal production is one alternative which can be economically viable but is heavily dependent upon the development of markets for this product and the development of processing capacity on a scale suitable for the processing of large quantities of wood to take advantage of the European market for high quality charcoal.

Game farming, while possibly contributing directly to range improvement, cannot be sufficiently well integrated into cattle production systems to benefit these systems directly, beyond the general encouragement of game on commercial farms. The investment required in this form of production precludes most farmers from undertakings of this kind.

The positive effects of intensive systems of grazing management look promising, but a shortage of available farm level data precludes a firm conclusion concerning its applicability to the commercial farming area as a whole.

There is concern among farmers in this region that a lack of definitive policy on agriculture and land reform is leading to over-exploitation of rangeland by some farmers. There is an unwillingness to invest in improvements to farms while the threat of land reform remains. This may also be a symptom of poor returns to livestock production but cannot be ignored as a potential cause of further deterioration of farmland.

Given these constraints to the future control of bush encroachment it appears safe to conclude that the problem will become more serious in the future, threatening the viability of the smaller farms. Production is likely to fall with a consequent effect upon those parts of the economy dependent upon a healthy beef sector. Smaller farmers may be forced to seek alternative sources of income or keep more stock, which may, with inappropriate management, lead to further bush encroachment and land degradation.

Appendix A. Cattle and rainfall data for a 5,000ha farm 1932-1992 (Grootfontein)

Year	Cattle numbers	Rainfall (mm)
1932	320	200
1933	315	210
1934	290	860
1935	390	290
1939	410	480
1940	470	215
1941	460	
1942	390	
1943	400	
1944	460	
1945	520	
1946	510	
1947	480	410
1948	490	
1955	460	390
1956	520	610
1957	530	350
1958	580	540
1959	600	450
1960	580	410
1961	590	260
1962	690	250
1963	650	560
1964	580	210
1965	560	330
1966	480	380
1967	570	350
1968	600	510
1969	610	360

1970	570	310
1971	490	500
1972	430	380
1973	400	250
1974	400	800
1975	440	400
1976	440	690
1977	500	550
1978	400	810
1979	380	450
1980	370	380
1981	320	400
1982	250	430
1983	290	340
1984		590
1985		220
1986		350
1987	300	340
1988	205	390
1989	200	490
1990	210	450
1991	205	310
1992	200	300

Source: Reitfontein Farmers Association, 1993

COMMERCIAL AREAS CASE STUDY
NO. IV: SOUTHERN AREAS (KEETMANSHOOP, KARAS REGION)

1.0 INTRODUCTION

The main agricultural activity in this region is smallstock ranching. Degradation of the vegetation appears to have been taking place on a wide scale, in which case there will have been a reduction in the incomes of the farmers affected. The land-use practice associated with this degradation is overstocking. A variety of factors are causing farmers to overstock, and to give priority to short-term financial gains at the expense of the long-term quality of the range and sustainability of their businesses. Many of them are struggling to make a living from their smallstock businesses and have financial problems caused by a variety of factors, including the effect of drought on incomes and adverse trends in the prices of smallstock and their products. Certain government measures, including elements of the drought relief programme, have also reportedly encouraged degradation of the range.

1.1 Description of the case study area

Karas is the southernmost region of Namibia. Its southern boundary is the border with the Republic of South Africa (RSA), its western boundary is the coast and its eastern boundary is the Kalahari. Its northern boundary cuts across Namaland, and is marked by the settlement of Asab on the main road from Windhoek to RSA. Thus, the central and southern parts of Namaland are in Karas regions whereas the more northerly parts, such as Gibeon town, are located in Hardap.

The annual average rainfall is lower in the Karas Region than in regions further north. It ranges from 100 to 250mm per annum on average, the lower end of the range pertaining in the south and west, and the higher end to the north and east. The vegetation consists of dwarf shrubs and grasses (see Namaland case study for further details).

The low level of rainfall means that the region is only suitable for smallstock farming. Karas and Hardap are Namibia's two main regions for smallstock production. In 1988/89, the commercial smallstock sector, most of which is in the south of Namibia, accounted for about a quarter of the commercial agricultural sector's gross farm income (GFI). It produced products (excluding pelts) worth $80.1 million (16.5% of GFI); and the value of pelts was $44 million, accounting for a further 9% of GFI.

1.2 Livestock Numbers

Karas contains both commercial districts and communal areas (including most of Namaland/Soromaas). Two of the major commercial ranching districts of the Karas region are Keetmanshoop and Karasburg. The main types of smallstock in the southern commercial sector are, in order of importance: Dorper sheep, Boerbok goats and Karakul sheep. The statistics on

livestock numbers given below are from MAWRD's six-monthly veterinary stock census reports.

1.2.1 Dorpers

In June 1993, there were 336,948 Dorper sheep in the Keetmanshoop district and 159,877 in Karasburg district, giving a total of about 500,000 in Karas's commercial sector. The Karas Dorpers constituted about a third of the total Dorper population of Namibia, which at that time was 1,582,311. (There were also 725,279 Dorper in Mariental, which is in the Hardap region, north of Karas.)

1.2.2 Boerbok goats

In June 1993, there were 51,890 Boerbok in Keetmanshoop district, 25,741 in Karasburg and 39,735 in Bethanie. In Hardap there were 97,170, giving a total of around 215,000.

1.2.3 Karakul

In June 1993, there were 451,495 Karakul sheep in the whole of Namibia. Of these, 75,537 were in Keetmanshoop, 52,382 in Karasburg, 25,060 in Bethanie, and 58,355 in the Hardap region.

2.0 SOCIO-ECONOMIC ASPECTS OF SMALLSTOCK RANCHING

A combination of external economic and physical factors affects the livelihoods of these commercial ranchers from year to year, and their farming practices. Farming practices that may be affected are stocking rates, and the types of smallstock owned, both of which may have implications for the long-term quality of the range and whether or not degradation takes place. The two main factors are probably:

- the prices they can get for the livestock (or livestock products); and
- the level of rainfall - and hence the level of livestock production.

2.1 Changes in the Commercial Smallstock Sector

2.1.1 Pelt Production

In the past the main form of smallstock was the Karakul sheep, which was reared for the pelts of its lambs. The majority of the pelts are exported to Europe, where they are used to make fur coats etc. Between 1943 and 1981, annual production of Karakul pelts exceeded two million in all years; and between 1969 and 1973 more than five million pelts were exported (pers comm, The Karakul Board). However, since around 1980 the number of pelts produced

annually has fallen dramatically, and in 1993 it was just 158,780 (ibid).

The reason for the fall in pelt production is that there was a decline in the price of the pelts. The price in 1976 was $18.00, which is equivalent to about $120.00 today, and by 1983 it had fallen to $9.00 (pers comm, Mr von Kuehne, The Karakul Board). There appear to be have been two reasons for this. First, there was a change in fashion towards long-haired furs rather than short ones. Second, fur has become less popular as a form of clothing/decoration as a result of campaigning by environmental and animal rights organisations.

During the last couple of years pelt prices have risen slightly, from about $35.00 two years ago, to about $60.00 in 1994 (ibid). Nevertheless, prices are still well below what they used to be in the 1970s, and the prospects for further substantial price increases are poor.

2.1.2 Mutton Production

Around the time when Karakul prices were falling to exceptionally low levels, mutton prices were increasing. The main market for mutton is in RSA. The Karakul has not been bred for meat production, and is not well-suited to it. Therefore, farmers gradually replaced their Karakul with another kind of sheep, the Dorper. The Dorper is a cross between a Dorset Horn and a Persian. To a lesser extent, commercial ranchers have also increased goat production, utilising the Boerbok, which is larger than the traditional goat of the region.

The current pattern of ownership of different types of livestock is illustrated by the six commercial farmers (referred to hereafter as Farmer 1, 2, 3 etc) in Keetmanshoop district who were interviewed as part of this study. Some information about their farms and livestock is given in Table 1 below. (Further information about farmers' production systems is given in the Appendix A).

For most of them the majority of their smallstock units are accounted for by Dorper sheep. Goats (Boerbok) are the second most important type of livestock, and for one of the farmers they are the most important. Two farmers still own some Karakul, although they acknowledged that this is largely for sentimental reasons. Farmer 6 said that he obtains a higher income from his Dorper than from his Karakul.

Table 1 Basic Data about Respondents' Farms and Livestock

	Farm Size (Ha)	Karakul	Dorper	Goats	Cattle	Range Quality (H=high L=low)
F1	23,000	-	3,500	350	50-60	H
F2	6,000	-	1,500	250	-	H
F3	12,500	-	500	-	-	L
F4	14,300	600	-	800	70	L
F5	15,000	-	1,000	60	-	L
F6	6,800	800	400	120		H

Notes: 1. Livestock numbers exclude lambs and kids, except for the kids (c500) on F4, which are included because they are not sold until 12-14 months old. 2. High quality range = CC of 4ha/SSU; Low quality range = CC of 5ha/SSU.

2.1.3 Drought

There has been a lower than average rainfall in this region since about 1979 (Mr Snyman, pers comm). It has been a drought-stricken area since 1991/92. Generally speaking, Keetmanshoop district experienced low rainfall in 1991 and 1992, although rainfall variability is high within the region. In 1994 there has been good rainfall in some areas, but not in others.
Table 2 below shows smallstock numbers in Keetmanshoop district (as defined in the veterinary stock census reports) during the last four years. Surprisingly, numbers did not decline in 1992, but reached a peak. They declined dramatically in 1993, however. One possible interpretation of the data is that, instead of destocking in 1991, farmers retained more animals than usual in anticipation of receiving a destocking subsidy from the Government, as part of its drought relief programme. The effect of this component of the drought-relief programme is discussed later.

Table 2. Smallstock Numbers in Keetmanshoop District, 1990-1993

	1990	1991	1992	1993
Karakul	203,818	164,689	227,726	75,537
Dorper	371,902	401,117	413,642	336,948
Boerbok	62,301	57,373	61,662	51,890
TOTAL (incl. other)	701,403	680,346	765,152	512,017

2.3 Marketing of Smallstock

Smallstock and their products are produced almost entirely for export, as the markets for them in Namibia are small. Karakul pelts are exported to Europe, whereas Dorpers and goats produced by commercial farmers are nearly all exported to the RSA. In 1992, 1.346 million sheep were marketed, and in 1993 1.038 million (mostly Dorper) (Meat Board of Namibia, 1994). (Further information about marketing is given in the Appendix A).

The drought in southern Africa at the beginning of the 1990s also prompted farmers in other parts of the region to sell off many of their sheep to reduce the size of their herds, and this led to a fall in the price of mutton. About two years ago the price was about $6.00/kg. During the last few weeks, however, the price of mutton has increased considerably, and has been $9.00-16.00/kg (depending on quality), and Dorper farmers are very happy with current prices (pers comm, interviewees, Snyman and Meat Board of Namibia). Apparently, the main reason for the high prices is that farmers are rebuilding their flocks after the drought, and so marketed sheep are in short supply. Goat prices are also good at present.

2.4 The Profitability of Smallstock Ranching

It appears that many commercial farmers in Keetmanshoop district and elsewhere in Karas region are struggling to make a living. This is not surprising given the prolonged period of predominantly low-rainfall years, the dramatic decline in the price of Karakul pelts during the 1980s and the low price of mutton during the recent drought. If farmers are making a loss on their livestock business this could contribute to degradation of the range. This is because they may decide that they have to overgraze in the short-term, in order to break even or pay off debts, even if they know that this is at the expense of the quality and carrying capacity of the range in the longer term.

The Ministry of Agriculture's regional office in Keetmanshoop has a computerised data base of the monthly income and expenditure of a substantial number of farmers in the region. According to the data supplied by participating farmers to the Ministry, average income and expenditure during the last three years were as shown in the Table 3 below (pers comm, B Snyman).

Table 3. Farmers' Income and Expenditure (N$), 1991-93

Year	Average income/ha	Average expenditure/ha
1991	7.48	7.75
1992	7.98	6.71
1993	7.26	7.63

The data show that, on average, farmers are roughly breaking even but producing little income to cover living expenses. However, the figures on expenses/ha do not include long-term repayments to the Agricultural Bank of Namibia for the purchase of farms. According to people interviewed, the amount of capital required to establish oneself in the smallstock business is about $ 1-1.5 million. On average, farmers pay $5,641.00 per annum to the Bank on their loans. In 1992/93 the average debt of farmers with an estimated carrying capacity of 1 SSU/5 ha was $8.57/ha.

These average figures conceal wide variations, however. Some farmers do not have any outstanding loan repayments on their land. One such farmer who was interviewed described smallstock ranching as making a profit of 7-8% pa, which he described as low in comparison to other types of business.

Mutton prices have risen during the last few months, and the price of goat meat is also picking up. However, when the GATT agreement comes into effect, it is expected that there will be an increase of Australasian mutton imports into RSA and Namibia, whose prices are considerably lower than locally produced mutton. This could increase the extent of indebtedness in the commercial sector, and could lead to more widespread or severe overstocking and to some farmers being forced out of business.

Since Namibian mutton is of a very high quality, people involved in Namibia's smallstock industry are hoping that they can market the meat to high-income groups in RSA. Consideration is being given to establishing an abattoir and a deboning and vacuum-packing plant in Keetmanshoop (Mr B Snyman, pers comm).

3.0 LAND DEGRADATION

The six farmers interviewed said that they themselves were not experiencing any serious land degradation. However, most of them were of the opinion that many other farmers in the region were experiencing degradation of the veld. The "Chain of Explanation" concept described earlier in this report (Section 2) will be used in this section and the following one to describe the nature of the degradation and its causes.

A Physical Changes in Soil and Vegetation. This land degradation primarily takes the form of vegetation degradation. There may also be an increase in soil erosion - either wind or water erosion - although the farmers interviewed generally said that erosion was not a problem.

It was not possible to observe the degradation at close hand, since it was not present on the farms visited, but it comprises a reduction in vegetative cover and perhaps also a change in the composition of grasses towards less palatable species, and hence less forage for the livestock. One of the farmers visited showed us the poor state of the range on his neighbour's farm, which contrasted visibly with that on his own farm.

B Economic Symptoms of Degradation. The overall economic effect of the degradation of the range should be a reduction in the carrying capacity of the land and farmers' incomes from livestock sales. One of the farmers interviewed, Dr Corrie Visser, said that there had been a reduction in the carrying capacity of the land during the last couple of decades.

Dr Visser has been living in southern Namibia since 1970, and was Deputy Director of Agriculture for the Rehoboth region, prior to Independence. He argued that the Ministry of Agriculture's estimates of carrying capacity are too high, and that they should be 7 ha/SSU at most, rather than 4 or 5 ha/SSU. He also suggested that further degradation of the range over the next 10 years could lead to a carrying capacity of 10 ha/SSU. (In principle, reductions in carrying capacity could be used to quantify the economic cost of degradation. This has not been attempted here, however, because of the lack of hard information on the area affected by degradation and the severity of that degradation.)

4.0 CAUSES OF RANGELAND DEGRADATION

C Land-use Practices Leading to Degradation. The main proximate cause of land degradation in the region (ie the specific land use practice that results in it) is overstocking. Mr Snyman, MARD's agricultural extension officer for the region, thought that about 60% of farmers might be overstocking and causing degradation.

A variety of reasons were provided by farmers and government officials to explain why overstocking takes place. These were:

- financial pressures, particularly for smaller farms;
- ignorance;
- drought;
- the Government's drought-relief programme;
- types of livestock (especially the switch from Karakul to Dorpers);
- the taxation system;
- the politics of land ownership.

Applying the chain of causation concept, these causal factors can be grouped in the following way.

D Land-Users' Resources: insufficient land to sustain a reasonable number of animals; insufficient income at sustainable stocking rates to pay off debts; poor financial management, resulting in lower profits than could be obtained with the land and livestock resources available.

E The Nature of Agrarian Society: none of the factors mentioned appear to fall into this category.

F State Policies, Laws and Administration: aspects of the Government's drought relief programme; the relationship between livestock income and the rate at which farmers are taxed; taxes on livestock; the politics of land ownership.

G The International Economy: the impact of changing fashions on the price of Karakul pelts, and hence the switch from Karakul to Dorper sheep; the (prospective) impact of the GATT agreement on Dorper prices.

Each of these categories of causal factors will now be discussed.

4.1 Land-Users' Resources

In the opinion of Mr Snyman, the agricultural extension officer for the Karas region, overstocking (and hence degradation) mainly takes place where farms are too small or where farmers are in debt.

Most farmers said that farms had to be above a certain size in order to be financially viable. Firstly, there is a minimum level of profit that farmers will require, and this requires a minimum farm size or number of livestock. Secondly, there are certain fixed costs that will have to be incurred whether the farm is 5,000 or 10,000 ha. It was suggested that farms should ideally be at least 10,000 ha in area. For example, one of the farmers interviewed had a farm of 6,800 ha which he had farmed full-time for 2-3 years after buying it. Subsequently, however, he had obtained a government job, and become a part-time farmer, since it was difficult, if not impossible, to make a living from the farm alone.

Since about 1981 there has been an unusually high incidence of low rainfall years, which has reduced the carrying capacity of the farms. This can lead to reduced livestock sales and incomes, which can in turn lead to farmers becoming indebted, and then overstocking to pay off those debts.

Other factors that have made some farmers seriously indebted, and hence under pressure to take a short-term view and overstock, are as follows. Firstly, credit used to be available at low interest rates, but these are much higher now than they used to be. Secondly, during the drought a lot of farmers, especially in the south west, borrowed money to buy fodder, and were then unable to repay the loan (Mr van Wick, pers comm).

Another of the farmers visited commented on the poor level of financial management skills among many farmers, and recommended that they be given training.

4.2 State Policies, Laws and Administration

4.2.1 The Drought Relief Programme

This programme contained two components that, according to the farmers interviewed, have a detrimental effect on the range. One was the provision of feed for livestock during the drought. This can encourage farmers to retain livestock, and farmers said that this stimulates animals' appetites, thus leading them to increase their food intake from the range.

The second is a payment of $20.00 for each breeding ewe that the farmer sells. The objective of this measure is to encourage farmers to destock: unfortunately, however, it can have the opposite effect, by encouraging farmers to retain their stock so that they can receive the payment. The better farmers, who destock early, do not receive the payment, and hence are penalised.

There was a general consensus among the people interviewed that the above measures should be abolished. A MAWRD report also concluded that drought relief in the form of fodder can reward bad management if it is based on pasture conditions (Bayer et al, 1991). The report noted that:

"on one farm visited, where the stocking rate was four times that of a neighbouring farm, the farmer complained about lack of forage on his farm and was feeding drought-relief supplements. The animals and pastures of his neighbour were in much better condition, and the neighbour did not have to feed his animals. Without drought relief, a poor manager would have to pay higher prices for the supplementary feed, he would probably feed less, he would have to sell more animals and probably more animals would die. In the long run, he would probably reduce the stocking rate and 'drought' would occur less often".

4.2.2 Income tax

Destocking of livestock during drought periods may result in an unusually high income for that year. As a result, some of the larger farmers would find themselves in the top income bracket, and would be taxed at 42% of their income. This can act as a deterrent to destocking and lead to overstocking. Alternatively, if farmers do de-stock substantially, and are taxed accordingly,

they will have to restock with only 60% of the money they received when they destocked.

We were informed that the government has recently increased its taxes on livestock owners. According to one of the farmers interviewed, these have risen from about $6.00/SSU owned to $70.00/SSU, and from $25.00 to $650.00/LSU. Although some forms of financial allowance or support have also been introduced, it was predicted that the extra tax will cause some farmers to go out of business. By putting greater financial pressure on farmers, the higher taxes could also encourage overgrazing.

4.2.3 The politics of land ownership

One senior government official and part-time farmer said that he thought a large proportion of commercial farmers are over-exploiting their land, because they are afraid that they may lose some of it as a result of land reform. He said that they are exploiting as much of it as they can, while they can.

4.3 The International Economy

The fall in Karakul pelt prices reduced farmers' profitability and put them under greater financial pressures. The majority of Karakul farmers in the very dry south-western regions, particularly Maltahohe, have gone out of business. Farmers in the central and eastern parts of southern Namibia, which receive a somewhat higher rainfall, have been able to switch to Dorper sheep, as was noted earlier. However, this move caused considerable land degradation, because farmers did not allow for two important differences between Karakul and Dorper when determining their stocking rates for Dorpers.

Many, if not most, farmers apparently replaced a given number of Karakul (say 1,000) with the same number of Dorper; whereas they should have replaced 1,000 Karakul with 600 Dorper. This is because, firstly, mature Dorper ewes are bigger (60-70 kg), and hence eat more, than the smaller (40-45 Kg) Karakul ewes. Secondly, whereas Karakul lambs are slaughtered within 24 hours of birth, and hence do not put any pressure on the range, Dorper lambs feed on the range until they are 4-6 months old.

4.3.1 The prospective impact of GATT

If the increased imports of Australasian mutton (discussed earlier) lead to a reduction in the prices of Namibian smallstock meat, this will increase financial pressures on farmers. It could either cause farmers to go out of business or lead to overgrazing, or (most likely) a combination of the two.

5.0 IMPLICATIONS FOR RESEARCH AND POLICY

5.1 Research

The information about the nature and extent of degradation gained in this study has been qualitative and based almost entirely on the judgements of knowledgeable officials and farmers. It would be highly desirable, therefore, if further research were undertaken to verify and quantify this information.

In addition, the reasons why certain farmers overgraze have been elicited from the same sources, and not from these farmers themselves. It is recommended, therefore, that further interviews be carried out with farmers with high stocking rates. The stocking rates should be checked, and the reasons for high stocking rates ascertained. In particular, the relationship between financial pressures on farmers and stocking rates needs to be investigated. This analysis has assumed, on the basis of the views given by farmers and officials, that financial pressures lead to overgrazing. This assumption needs to be verified, however. In some circumstances, financial pressures might cause farmers to abandon agriculture, or diversify their sources of income, and thereby reduce
grazing pressures on the range.

5.2 Policy Implications

The farmers interviewed were of the opinion that the provision of fodder during drought periods should be abandoned, because it would reduce land degradation, for the reasons discussed earlier. Dr Visser argued that, instead of taking a short-term view related to the maintenance of livestock numbers, the government should take a longer-term view and give priority to improving the quality of the veld. The farmers' views appear to be valid, and should be given serious consideration by the government as far as the commercial smallstock sector is concerned.

Farmers also argued that the de-stocking subsidy should be abolished. In this case, however, it may be the administration of the measure that is the problem, rather than the measure itself, since its objective is a desirable one. Thus, either its administration should be improved so that farmers de-stock sooner, or it should be abolished.

5.3 Farm size

Farms below a certain size may not be financially viable units, and apparently these are the farms on which most of the degradation tends to take place. Whether they are financially viable or not depends, however, on various factors, including: whether there are any long-term debts associated with the farm; whether the farm is in a high potential or low potential area, regarding the quality of the range; and what level of income the owner regards as acceptable. It is not possible, therefore, to say what the minimum farm size should be; and, in any case, it

would be difficult for the government to force the amalgamation of small farms with other farms. One suggestion, however, was that small farmers should be given some sort of compensation, or subsidy, if they reduced their stocking densities so that they were in line with the long-term carrying capacity of the land.

5.4 Income tax

One of the farmers made a proposal for circumventing the potentially deterrent effect of the income tax structure on destocking at the beginning of drought periods. He suggested that the high income tax rate of 42% should only apply if the farmer spends his income from livestock sales on consumption goods. Otherwise he should be able to place it in a special account for a few years, and if it were withdrawn for the purpose of restocking it should not be taxed. This is an interesting proposal that appears to merit further consideration by the Government.

5.5 The profitability of smallstock production

Ultimately, this is an important factor in determining whether or not farmers overstock. Insofar as government policies and measures have a bearing on profitability the government should seek to ensure that they are conducive to the long-term profitability of this important sector of the Namibian economy.

APPENDIX A LIVESTOCK PRODUCTION AND MARKETING SYSTEMS

Production Systems

All farmers have a large number of paddocks or camps (of the order of 30-60 per farm), which they use for rotational grazing for their Dorpers. The length of time a group of Dorpers is kept in one camp varies considerably according to the state of the range in that part of the farm, the time of the year etc. One farmer said that he uses three or four camps per herd (he divides his 3,500 sheep into a number of herds), and that he rotates them every 4-6 weeks. During the rainy season it is often possible to rotate every 2-3 weeks. During the lambing season the ewes and their lambs must be kept in one place, so the pregnant ewes are moved into a new camp just before the season begins. One farmer pointed out that it is sometimes necessary to 'overgraze' a camp: if the sheep only consume their preferred plant species other species will replace them, so overgrazing is required to control these less valuable species.

Predation of lambs by jackals has been a serious problem in the past. These farmers have erected 'jackal-proof' fencing around the perimeters of their farms and have also put up some of this fencing within their farms to create four or five jackal-proof 'blocks'. As a result, jackals are no longer a serious problem, but wild cats/lynxes, which can climb over the fencing have become a bigger predation problem than they were previously.

The Dorper farmers interviewed aim to produce about 120 lambs per 100 breeding does per annum. Farmers' breeding systems for Dorpers varies. If lambs are born in each month through the year this has the advantage of providing a steady income. One of the farmers interviewed practised this kind of system.

On the other hand, it is advantageous if lambs are born at the start of the rainy season, in December or January, since fodder is going to be most plentiful during the following few months and the lambs will grow faster. However, fertility is at its highest during the rainy season, in February/March, so if mating takes place then there is a higher twinning rate for the lambs that are born five months later in June/July. For these reasons another farmer had two lambing seasons, December/January and June/July, and two corresponding 'marketing seasons' (see below).

Goat production is more difficult in some ways than Dorper production. Firstly, goats cannot be rotated from camp to camp. They like to go where the fodder is of the highest quality, and can break through camp fences to escape from one camp to another. (Two of the farmers interviewed overcome the paddock rotation problem by rotating their goats from block to block instead. Apparently, the jackal-proof fencing is strong enough to prevent them breaking through it and escaping from one block to another.)

Secondly, goat production is more labour-intensive, particularly during the kidding season. Farmers said that goats are not so good at looking after their young - they do not have a good

mother's instinct. Consequently, they have to be brought home every day during the kidding season and when the kids are young, or kept in pens close to the farm. The labour-intensity of goat production can be a particular problem at weekends, when labourers may not be present. These factors appear to deter some farmers from owning goats, or at least from owning large numbers of them.

The farmer whose main enterprise was goat production had one breeding season per annum. His kidding rate was 175%, ie 175 kids per 100 breeding does. Since each doe conceives only once a year this means that approximately 75 out of a hundred does have a twins. (A few does have triplets, and some lambs will be born dead.) Out of 175 kids born, 170 are weaned successfully and 165 are still alive when the goats are about a year old and ready to be sold. During the kidding season the goats are kept in pens near the farmhouse, and the kids are not released onto the range until they are 2-3 months old.

Marketing Dorpers and Goats

Smallstock and their products are produced almost entirely for export, as the markets for them in Namibia are small. Karakul pelts are exported to Europe, whereas Dorpers and goats produced by commercial farmers are nearly all exported to the RSA. In 1992, 1.346 million sheep were marketed, and in 1993 1.038 million (mostly Dorper) (Meat Board of Namibia, 1994).

The reason for the reduction in smallstock marketed in 1993 was that there was "continuous wavering in the market" (ibid). (Two farmers mentioned that goat marketing had recently been hampered by political unrest in RSA.) Namibia's Meat Board negotiates quotas annually with the South African Meat Board, which are set according to the supply/demand situation in the RSA. There is a controlled market and an open market. In 1993, of all the Namibian smallstock that were marketed, 42.4% and 36.7% went to the South African open and controlled markets respectively.

In the controlled market prices are controlled to ensure stability for both producers and consumers. In order to sell their animals on the controlled market producers must obtain a permit each year from the Meat Board. The controlled market operates in the main centres in the RSA - Cape Town, Johannesburg, Durban and Kimberley.

The open market is in RSA's smaller towns and rural areas. There is no control of prices in the open market, so prices fluctuate according to the supply/demand situation. Producers said that this made selling to the open market a riskier business, but, on the other hand, there is also the possibility of higher prices.

The average weight of lamb and sheep carcasses in 1993 was 16.4 kg (Meat Board of Namibia, 1994). Generally speaking, Dorper lambs are sold when they are about 40 kg live weight. Those born at the start of the rainy season will reach this weight faster than those born after

the rainy season, so the age at which they are sold varies from 4-6 months.

Some commercial farmers sell their smallstock at local auctions, or arrange for buyers to come to their farm at a certain time. Others arrange for the animals to be sold in RSA. Prices in RSA are higher. Although it costs $30-35.00/head (transport costs, insurance and meat board fees) to get them marketed there, farmers can receive $1-2.00/kg more for their meat after these costs have been deducted.

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