A Retrospective Assessment of the Environmental Impacts of Emergency Borehole Supply

in the Gam and Khorixas Areas of Namibia

Prepared for the Namibian Programme to Combat Desertification (NAPCOD) represented by the Directorate of Environment and Tourism, Ministry of Environment and Tourism, Namibia

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Executive Summary

This report presents the findings of a retrospective study of the environmental impacts of emergency borehole supply in the Gam and Khorixas areas of Namibia. The study was undertaken by the 1996/97 Masters group of the Department of Environmental and Geographical Science at the University of Cape Town, South Africa. Supervision throughout the process was provided by the Environmental Evaluation Unit at the University of Cape Town.

The report was commissioned by the Namibian Programme to Combat Desertification (NAPCOD), through the Ministry of Environment and Tourism in Namibia (MET). It was conducted during the period from November 1996 to April 1997.

Background

Namibia's climate may be termed arid to semi-arid, with low and variable rainfall, high evaporation rates and frequent dry periods being the norm. The majority of Namibia's population, especially the rural population, are dependent on the environment for their livelihoods. In addition, a significant proportion of both formal and informal economic activity depends on the ecological production and integrity of the environment (NPC, 1995).

Thus, Namibia needs to take cognisance of the dynamics, unique properties, fragility, risk of desertification, and limitations of such an environment. This is especially relevant in the planning, management and implementation of development in the rural areas. It is in these areas where people are particularly vulnerable to the effects of environmental degradation.

The provision of boreholes may be a significant determinant of the characteristics of the environment in communal areas. They may affect or impact on the whole range of interacting physical, ecological, social and economic aspects that may be considered under the broad term of 'environment'. The environmental implications of borehole provision thus need to be assessed and managed appropriately.

Boreholes in Namibia are provided under a wide variety of circumstances. Other than the provision of boreholes as ongoing rural water supply development, boreholes have been provided under the label of 'emergency boreholes'. In 1992 and 1993 emergency boreholes were provided as part of the Drought Relief Programme. In this programme approximately 300 emergency boreholes were drilled and installed and another 50 non-functioning boreholes were rehabilitated (National Drought Task Force, 1993). The repatriation of Herero people, from Botswana to Namibia in 1994, also required the urgent provision of boreholes to meet the water needs of returnees and their livestock in an area where there was no permanent surface water (Simmonds, pers. comm.). Re-settlement schemes may also, therefore, require the provision of emergency boreholes.
Concern has been raised, that in the past the environmental impacts of emergency borehole provision programmes have not been adequately addressed and considered during the planning and decision-making process (Tarr, pers. comm.). This is because there is a deficiency of documented knowledge regarding environmental impacts of boreholes and, therefore, little clarity on environmental criteria by which to assess and guide such programmes (Tarr, pers. comm.).

Consequently, this study was commissioned to begin to address this situation.

**Approach to Study**

Two case study areas were selected for this study. These case study areas formed the focus for the research into the environmental impacts of boreholes, and were able to direct the investigation into the relevant policies and processes which informed and guided borehole implementation.

The first case study was in the Khorixas area. The Khorixas regional constituency covers the communal land in the southern part of the Kunene Region, along the north west side of Namibia, in part of what was previously known as Damaraland. The region is arid to semi-arid, with localised, highly variable rainfall patterns and frequent dry periods. Groundwater supply is almost the exclusive source of water in the area and consequently, it is highly sensitive to exploitation. There were two emergency water resource development programmes in this area during the 1992/93 Drought Relief Programme. One was funded by the Nigerian government and the other was funded by the United States Agency for International Development (USAID) and implemented by the International Medical Corps (IMC). Both programmes were included in this research.

The second case study was in the Gam area. Gam is located in north eastern Namibia and adjoins Bushmanland. It falls within the Kalahari Geological System. No permanent water exists in the area, while groundwater resources are scarce. Furthermore, because of the deep Kalahari overburden those aquifers which do exist are difficult to locate and present many technical difficulties in the drilling and installation of a borehole. Therefore, there has been very little permanent settlement in the area. However, in 1993 the Ministry of Lands, Resettlement and Rehabilitation initiated a repatriation programme of Herero people from Botswana to the Gam area. Water supplies had to be provided for these returnees, this was through the provision of boreholes, and it is these boreholes which have been assessed in this second case study.

**Terms of Reference**

The main terms of reference of the study were:

- to briefly review, at the national and regional level, the relevant climatic, demographic, political and socio-economic characteristics of Namibia
• to present an overview of Namibian water resources, water supply policy - in particular, rural water supply policy - and land use patterns

• to present a review of emergency borehole supply policy

• to identify and evaluate the ecological, social and economic impacts of emergency boreholes in the two case study areas

• to provide, on the basis of the above, recommendations and guidelines on borehole provision

Methodology
Methods used to gather information included the following:

• Literature review

• Interviews with key stakeholders and informants, including relevant informants from government and non-government organisations, aid agencies and relevant researchers

• Field work in the two study areas included observations, informal interviews with people from communities using boreholes, and the use of Participatory Rural Appraisal techniques (PRA).

Key Findings
Key findings are summarised below. It was found that the direct and indirect impacts of borehole provision are often difficult to separate from the impacts of other events, issues and policies, including land use practices, population growth and movements, resettlement, and land tenure issues.

Borehole provision in the two case study areas, has had both positive and negative impacts. Although the two case studies differ in the rationale behind emergency borehole provision, and will be presented separately, many of the underlying issues and resulting impacts are similar.

Khorixas
• Environmental considerations did not generally appear to have been taken into account in the emergency borehole provision programme and little consideration seems to have been given with regard to the economic sustainability of boreholes in terms of cost effectiveness, efficiency, reliability, and appropriateness of technology.

• The emergency borehole programme appeared to have some deficiencies with regard to quality control during implementation:
  ♦ The Nigerian programme had exceptionally low success rates in providing useful boreholes. It was poorly supervised and there appeared to be minimal accountability, by either donors or
geotechnical consultants, for the quality of work and the keeping of financial records (Hoffman, 1993).

- Although the IMC programme had higher success rates in providing useful boreholes, stepped pump testing of these boreholes did not seem to have taken place (van der Merwe, pers. comm.). Thus the recommended installations and pumping rates were unlikely to have been based on accurately calculated sustainable yields.
- No monitoring was found to have taken place since installation.

- Borehole siting appeared to have been undertaken somewhat haphazardly. There was an apparent absence of procedure and minimal consultation with stakeholders such as government officials, local headmen and user communities. The low level of community involvement regarding borehole siting has resulted, in some cases, in resentment, misunderstandings, and a lack of sense of ownership by the people.

- Furthermore, this absence of community involvement and disregard of local knowledge in the siting of boreholes appears to be impeding efforts by government to create water supply partnerships with the local communities, such as the first phase of the Cost Recovery Policy for operation and maintenance of boreholes.

- Borehole provision has led to an improved quality of life in some respects. Where infrastructure is adequate, health impacts of boreholes were generally positive. In Khorixas most of the IMC installations had adequate infrastructure for a clean and safe water supply. Furthermore, the IMC's educational programme on rural health focusing on hygiene, sanitation, water use patterns, efficiency and sustainable borehole yields, has to some extent raised peoples awareness of these issues (Murowoa, pers. comm.)

- It was not possible to accurately ascertain the extent of soil and vegetation degradation associated with the boreholes. However, vegetation cover around the boreholes has been influenced by heavy grazing and browsing pressure and evidence of soil degradation was observed. This could be exacerbated by intense utilisation associated with heavy grazing, constant animal traffic and reduced vegetative cover.

- Groundwater potential is low in the Khorixas area, with groundwater reserves being restricted to secondary aquifers. Most boreholes were sited along drainage lines, with potentially negative effects downstream. Overuse of vegetation and compaction of soil by livestock may further contribute to decreasing water infiltration and ground water recharge rates.

- Boreholes that were drilled as temporary relief measures in the 1992/93 drought period are now being used on a permanent basis. This has, arguably, resulted in inappropriate farming and land use strategies in an arid area, and has increased stress on natural resources. Drought relief
boreholes appear to be misdirected relief in this case. As regards livestock, grazing shortages and problems are more pressing issues during droughts than water shortages. The drought was, in this sense, a shortage of grazing rather than a shortage of water.

• The provision of permanent water points have enabled people to live where an absence of surface water previously prevented them from doing so. This can have negative environmental effects as inappropriate land use practices, such as permanent settlements of people with their livestock on unsuitable marginal lands, has occurred. However, it did not appear that boreholes have completely eliminated adaptive farming strategies such as movement of livestock in response to drought cycles and grazing availability.

• Influxes of newcomers with their livestock, and lack of control over resources was found to be a problem that needs to be addressed. This is particularly true where there are conflicting land use practices, wealth inequalities and weak leadership structures. There is little control over the number of newcomers and the sizes of their herds. This results in competition over, and pressure on scarce resources, and provides a disincentive to manage these resources sustainably.

• If planning for drought continues to be seen as a short-term emergency measure, inappropriate and unsustainable responses to, and strategies for coping with drought will continue to be implemented.

Gam
• Environmental constraints (social, biophysical and economic) do not appear to have been taken into account in the decision-making process in the resettlement programme. No environmental assessment was undertaken to determine site suitability prior to the resettlement.

• The supply of boreholes in the Gam area has allowed the resettlement of pastoral Hereros into a relatively ‘pristine’ area, previously utilised by a small population of Ju/'hoansi and Herero on a very small scale. The resulting increase in both human and livestock numbers around these permanent water points is changing flexible farming practices which include seasonal movements, to a more sedentary approach.

• The principle symptoms of environmental degradation related to Herero repatriates in Gam include soil degradation, bush encroachment and a severe reduction of quality and quantity of grazing. In the study area, several factors contributing to land degradation were identified:
  ♦ concentration and increased duration of livestock in grazing areas;
  ♦ concentration and increased duration of livestock at water points;
  ♦ lack of herding and rotational grazing;
  ♦ free access to resources promoting a lack of accountability or responsibility for sustainable use of common property;
installation of boreholes with no monitoring of impacts on water tables, vegetation and grazing due to inadequate extension services and awareness raising programmes.

- Inadequate infrastructure for a safe and hygienic water supply has in some cases negatively impacted on the health of people in the Gam area.

- Maintenance of boreholes is often subject to long delays which places pressure on surrounding borehole locations which have to sustain additional herds.

- Not all boreholes recommended for installation have been accurately tested to determine sustainable yields. In addition, the present lack of monitoring of water usage, water table fluctuation, and yields raises concern over the long-term sustainable delivery of water from these boreholes.

- In a marginal area such as Gam, the provision of permanent water points, coupled with the sudden population increase of both livestock and people, could give short term benefits at the expense of long term productivity. Localised environmental degradation which was observed during the study especially around boreholes and homesteads provides an indication of the degradation which is already taking place in Gam. Extensive land degradation and, therefore, a greater susceptibility to droughts will result if sustainable land-use practices are not put into place.

- Resettlement, made possible by borehole provision, has resulted in the imposition of a sedentary and intensive system on an ecologically fragile area. This has lead to a disruption of appropriate coping mechanisms, such as transhumance, which enabled sustainable use of the area.

- A lack of clear ownership rights over resources contributes to major problems in resource management. Without secure tenure, boreholes, like any other natural resource are regarded as government property. This contributes to the farmers’ lack of incentives and opportunities to manage resources in a sustainable manner. Farmers utilising a borehole are unable to deny other people either the right to grazing on surrounding land or to the use of the borehole. In the study area, dependency on the government seemed to frustrate farmers especially with regard to the long delays experienced in borehole maintenance.

- Planning for the Gam resettlement programme was short-sighted and ineffective, generally lacking in guidelines or any indication of a move towards integrated regional development. In addition, no consideration was given to the development of a holistic land-use plan for the region, and no guidelines were provided to contribute to the sustainable use of the natural resources upon which the programme’s success is wholly dependent.
Summary of Findings
The provision of boreholes on an emergency basis without reference to holistic land use planning occurring in co-operation with affected users, has engendered a situation which might be unsustainable in the long term.

Sectoral policies which address the management of natural resources are uncoordinated thereby giving conflicting messages to local communities (Murowoa, pers. comm.). If management of natural resources is to be sustainable, this problem should be addressed.

The provision of artificial water points need not contribute to an unsustainable situation if accompanied by appropriate land use management practices which take environmental limitations and social systems into account. Consideration should be given to all aspects of sustainability and the immediate needs of people should be balanced against needs in the future.

Key Recommendations
From the study it is clear that boreholes can be significant determinants of and influences on the social, economic and biophysical environment. Therefore, considering the range of possible environmental impacts and implications of borehole provision, the primary recommendation arising from this study is that borehole provision must be subject to a process of environmental assessment and holistic environmental planning and management.

To this end key recommendations are presented at national, regional and local levels.

Key National Level Recommendations
- Every development plan, policy and programme should be assessed at a strategic level in terms of its impact on the environment. This is of particular importance in addressing the cumulative effects of boreholes in communal areas.

- A national strategy should be developed to reduce the country’s vulnerability to drought, thereby reducing the social, economic and environmental impacts resulting from drought.

- Effective co-ordination is required for government policies at national, regional and local levels. The establishment of LUEB chaired by the NPC at a national level and the appointment of an Environmental Commissioner in the NPC will promote this co-ordination and ensure that environmental considerations are taken into account during a project's appraisal.

- A flexible approach to land tenure needs to be adopted that will enable constituted communities and groups to exercise joint ownership rights over land. Community tenure will be central to the success of the policy for
community ownership of boreholes and other natural resources which need to be managed collectively.

- In conjunction with a flexible approach to land tenure, holistic land-use planning is required to address sustainable resource management in Namibia. The provision of all water points in rural areas should be subject to this planning.

- Land-use planning needs to take cognisance of the necessity of flexible farming strategies to cope with Namibia's arid environment.

- To alleviate the pressure of livestock farming on natural resources, alternative land use and livelihood options need to be explored and developed where possible. These could include tourism, use of wildlife to benefit communities and the development of alternative markets and skills. The concept of Community Based Natural Resource Management (CBNRM) may serve as a useful framework for achieving this economic diversification.

- Any foreign donor assistance needs to be subject to a process that ensures that these projects, plans and programmes are appropriate to the particular ecological, social and economic characteristics and needs of the Namibian environment.

**Key Programme Level Recommendations**

It is imperative that borehole provision programmes, whether under emergency conditions or as ongoing rural water supply, be submitted to a full process of environmental appraisal.

The following are highlighted as important features of the environmental assessment of a borehole provision programme:

- Commitment to transparency and accountability
- Needs assessment (including the need for water or grazing)
- Consideration of alternatives to borehole provision
- Assessment of environmental impacts including the following:
  - **Social impacts**
    - effect on settlement patterns
    - influx of people into the area
    - effect on indigenous sustainable land use practices
    - quality and standard of infrastructure with respect to the provision of safe water
  
  - **Economic impacts**
    - costs to the community of maintaining boreholes
    - application of appropriate technology
  
  - **Ecological impacts**
    - cumulative effects of boreholes on ecology
    - spacing of boreholes
Key Recommendations at Individual Borehole Level

Pre-requisites and Conditionalities of borehole provision

- Full community participation is required at all stages of decision-making and planning.

- Before a borehole is provided to a community there must be a well defined and documented need for it.

- Boreholes should not be installed unless there is a clear understanding of the need for management of natural resources and a strong community structure to do this. This will require capacity building within communities and the creation or strengthening of community based organisations, possibly including CBNRM principles.

Siting of Boreholes

- Conflicts between geohydrologists and local community knowledge and requirements with respect to siting need to be recognised and negotiated openly.

- Areas of low groundwater potential need to be recognised, and a moratorium on further drilling placed on those areas.

- Available groundwater resources need to be taken into account to prevent unsustainable drawdown of water tables.

- Boreholes need to be sited such that their zone of impact does not overlap zones of impact of surrounding water points.

- Boreholes should not be sited in areas of high biodiversity or ecological sensitivity such as wetlands. Instead boreholes should be sited such that they attract settlement and human activity away from such areas. Consideration of the sensitivity of soil and vegetation to degradation is needed in siting of boreholes.

Appropriate Technology - pumps and infrastructure

- The pump capacity should not be able to exceed the sustainable yield of the borehole. Recommendations regarding sustainable borehole yields need to be based on stepped pump test results, not simply on inaccurate blow testing results.

- The most appropriate pump mechanism should be installed. It is suggested that in most cases solar powered pumps are the most appropriate given the local economic and environmental considerations.
• Water storage and water outlet points should be planned and designed in such a way as to ensure a safe user environment. To provide high quality water, water storage should be in closed plastic tanks and reticulated through a closed system.

**Operation and Management**

• Although CBNRM currently only applies to rights over wildlife, the concept of community based natural resource management should arguably be extended in the future to include rights over, or ownership of, other natural resources such as water.

• Attention needs to be given to developing appropriate monitoring and management plans, in conjunction with communities, to reduce the impacts on sensitive soil and vegetation.

• Water point provision in conjunction with land use planning, could incorporate seasonal or occasional use of boreholes in emergencies. Thus seasonal grazing areas would remain and sedentarisation in these areas would be dissuaded.

**Record Keeping and Monitoring**

• Accurate, regularly updated records of borehole data must be kept which include information about rock strata, water tables, depth drilled and results of stepped pumped tests.

• Regular monitoring of pumping volumes needs to be implemented. This data could be incorporated into a regional data base indicating seasonal changes in borehole yields and water tables, and provide information towards determining longer term sustainable yields.

• Water quality in terms of bacterial contamination and salt content should be monitored on a routine basis as well as at the time of installation. Where there are abnormal findings or indications of a potential problem this should be fully investigated.
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<tr>
<td>CBNRM</td>
<td>Community Based Natural Resource Management</td>
</tr>
<tr>
<td>CCN</td>
<td>Council of Churches in Namibia</td>
</tr>
<tr>
<td>CSIR</td>
<td>Committee for Scientific and Industrial Research</td>
</tr>
<tr>
<td>CCO</td>
<td>Chief Control Officers</td>
</tr>
<tr>
<td>CSO</td>
<td>Central Statistics Office</td>
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<tr>
<td>DESA</td>
<td>Drought Emergency for Southern Africa Appeal</td>
</tr>
<tr>
<td>DET</td>
<td>Directorate of Environmental Affairs</td>
</tr>
<tr>
<td>DPMP</td>
<td>Disaster Preparedness and Management Project</td>
</tr>
<tr>
<td>DRFN</td>
<td>Desert Research Foundation</td>
</tr>
<tr>
<td>DRMP</td>
<td>Drought Relief Management Programme</td>
</tr>
<tr>
<td>DRP</td>
<td>Drought Relief Programme</td>
</tr>
<tr>
<td>DRWS</td>
<td>Directorate of Rural Water Supply</td>
</tr>
<tr>
<td>DWA</td>
<td>Department of Water Affairs</td>
</tr>
<tr>
<td>EEAN</td>
<td>Environmental Evaluation Associates of Namibia</td>
</tr>
<tr>
<td>EEZ</td>
<td>Exclusive Economic Zone</td>
</tr>
<tr>
<td>ELCIN</td>
<td>Evangelical Lutheran Church in Namibia</td>
</tr>
<tr>
<td>ELCRN</td>
<td>Evangelical Lutheran Church in the Republic of Namibia</td>
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<tr>
<td>EMU</td>
<td>Emergency Management Unit</td>
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<tr>
<td>FAO</td>
<td>Food Agricultural Organisation</td>
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<tr>
<td>FMLU</td>
<td>Food and Management Logistics Unit</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GNP</td>
<td>Gross National Product</td>
</tr>
<tr>
<td>HRRRC</td>
<td>Herero Repatriation and Resettlement Committee</td>
</tr>
<tr>
<td>IMC</td>
<td>International Medical Corps</td>
</tr>
<tr>
<td>IMR</td>
<td>Infant Mortality Rate</td>
</tr>
<tr>
<td>IMSCLUP</td>
<td>Inter-Ministerial Standing Committee for Land Use Planning</td>
</tr>
<tr>
<td>LUEB</td>
<td>Land Use and Environmental Board</td>
</tr>
<tr>
<td>MAWRD</td>
<td>Ministry of Agriculture, Water and Rural Development</td>
</tr>
<tr>
<td>MET</td>
<td>Ministry of Environment and Tourism</td>
</tr>
<tr>
<td>MLRR</td>
<td>Ministry of Lands, Resettlement and Rehabilitation</td>
</tr>
<tr>
<td>MRLGH</td>
<td>Ministry of Regional and Local Government and Housing</td>
</tr>
<tr>
<td>MWCT</td>
<td>Ministry of Wildlife, Conservation and Tourism</td>
</tr>
<tr>
<td>NAPCOD</td>
<td>Namibian Programme to Combat Desertification</td>
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<tr>
<td>NDP</td>
<td>National Development Plan</td>
</tr>
<tr>
<td>NDTF</td>
<td>National Drought Task Force</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organisation</td>
</tr>
<tr>
<td>NNDFN</td>
<td>Nyae-Nyae Development Foundation of Namibia</td>
</tr>
<tr>
<td>NNFN</td>
<td>Nyae-Nyae Farmers Co-operative</td>
</tr>
<tr>
<td>NPC</td>
<td>National Planning Commission</td>
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<tr>
<td>OFDA</td>
<td>Office of United States Foreign Disaster Assistance</td>
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<tr>
<td>OPD</td>
<td>Out-Patient Department</td>
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<tr>
<td>PRA</td>
<td>Participatory Rural Appraisal</td>
</tr>
<tr>
<td>RWEO</td>
<td>Rural Water Extension Officer</td>
</tr>
<tr>
<td>SADC</td>
<td>Southern Africa Development Community</td>
</tr>
<tr>
<td>SARDEP</td>
<td>Sustainable Animal and Range Development Programme</td>
</tr>
<tr>
<td>SSD</td>
<td>Social Science Division</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>SWAPO</td>
<td>South West African People's Organisation Liberation Movement</td>
</tr>
<tr>
<td>TB</td>
<td>Tuberculosis</td>
</tr>
<tr>
<td>TDS</td>
<td>Total Dissolved Solids</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>UNEP</td>
<td>United Nations Environmental Programme</td>
</tr>
<tr>
<td>UNICEF</td>
<td>United Nations Children's Fund</td>
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<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
</tr>
<tr>
<td>WASCO</td>
<td>Water and Sanitation Committee</td>
</tr>
<tr>
<td>WASP</td>
<td>Water and Sanitation Policy</td>
</tr>
<tr>
<td>WFP</td>
<td>World Food Programme</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
<tr>
<td>WWF</td>
<td>World Wildlife Fund</td>
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<td><strong>List of Definitions</strong></td>
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<tr>
<td><strong>Annual grass</strong></td>
<td>a grass plant that can only grow from seed every rainy season (contrast with perennial grass).</td>
</tr>
<tr>
<td><strong>Arid</strong></td>
<td>an area where mean annual rainfall is less than 250 mm; rainfall is seasonal, highly variable from year to year, and evaporation is high.</td>
</tr>
<tr>
<td><strong>Biodiversity</strong></td>
<td>the variety of living organisms considered at all levels, from genetic through species, to higher taxonomic levels, and including a variety of habitats and ecosystems.</td>
</tr>
<tr>
<td><strong>Bush encroachment</strong></td>
<td>is a process involving gradual replacement of grasses by shrub species, less palatable or inedible to cattle and sheep.</td>
</tr>
<tr>
<td><strong>Carrying capacity</strong></td>
<td>the upper limit to the total number (or biomass) of any species that can be supported in a given habitat.</td>
</tr>
<tr>
<td><strong>Communal land</strong></td>
<td>land available for common use; in Namibia this land is currently owned by the State.</td>
</tr>
<tr>
<td><strong>Conservancy</strong></td>
<td>an area of land shared by multiple owners or users who jointly pool their land and/or financial resources to make available a larger unit for management.</td>
</tr>
<tr>
<td><strong>Degradation</strong></td>
<td>to diminish the productivity of land through mismanagement</td>
</tr>
<tr>
<td><strong>Desertification</strong></td>
<td>land and degradation in arid, semi-arid and sub-humid areas resulting from various factors, including climatic variations and human activities.</td>
</tr>
<tr>
<td><strong>Endemic</strong></td>
<td>species which are highly localised or restricted in geographical distribution.</td>
</tr>
<tr>
<td><strong>Ephemeral</strong></td>
<td>a stream which flows at the surface only periodically, for instance during periods of heavy rains in an arid or semi-arid environment.</td>
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<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>Habitat</td>
<td>the normal abode or locality in which an organism or population lives, characterised by its biotic or physical characteristics.</td>
</tr>
<tr>
<td>Infant Mortality Rate</td>
<td>the number of deaths in the age group of one month to one year per 1000 live births</td>
</tr>
<tr>
<td>Land degradation</td>
<td>describes a decline in natural, biological productivity that is either irreversible or which may not be recovered for at least one human generation.</td>
</tr>
<tr>
<td>Nomadism</td>
<td>the way of life which involves constant movement in search of water, food and livestock forage.</td>
</tr>
<tr>
<td>Non-equilibrium system</td>
<td>a system that drops the duality between biotic and abiotic dynamic phenomena, and recognises unpredictable abiotic events as part of healthy ecosystem behavior.</td>
</tr>
<tr>
<td>Perennial grass</td>
<td>a grass plant that grows from seed one year and continues to grow in following years (contrast with annual grass).</td>
</tr>
<tr>
<td>Rangeland</td>
<td>open country (usually grassland) used by grazing livestock.</td>
</tr>
<tr>
<td>Sedentarism</td>
<td>the permanent settlement of humans and livestock in an area (contrast with transhumance).</td>
</tr>
<tr>
<td>Sustainable development</td>
<td>development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs.</td>
</tr>
<tr>
<td>Transhumance</td>
<td>seasonal movement of livestock between specific areas (for example, high and low pastures on the Brandberg) driven by fodder and water needs.</td>
</tr>
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* Note that many of these definitions have been sourced from Jacobson P.J., Jacobson K.M & Seely M.K. 1995.
Acknowledgements

This study was initiated by Mr. Peter Tarr of the Directorate of Environmental Affairs in Namibia, under the auspices of the Namibian Programme to Combat Desertification. The study was funded by GTZ. A sincere thank is extended to GTZ for affording us an opportunity to work on such an important project.

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- Mr. H. Koch, Directorate of Rural Water Supply
- Dr. A. Simmonds, Inter-Consult
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1. Introduction

1.1 Namibia - an Arid Country

Rainfall, is arguably the most important single variable shaping the ecological, social and economic environment in Namibia. Namibia is the driest country in southern Africa, with rainfall ranging from less than 20mm per annum on the west coast to just over 600mm in the Caprivi in the north-east (see figure 3.2) (DWA, 1991). Rainfall is not only low but also extremely variable. This, combined with high evaporation rates and frequent droughts often results in significant water deficits in the country (ibid.).

Most areas in Namibia may be termed arid or semi-arid environments. Thus Namibia needs to be cognisant of the dynamics, unique properties, fragility, risk of desertification and limitations of such environments in planning, managing and implementing development and economic activities. This is particularly important in Namibia as most of the population, especially the rural population are dependent on the environment for their livelihoods. Furthermore, a significant proportion of both formal and informal economic activity depends on the ecological production and integrity of the environment (NPC, 1995). Namibia is therefore, not only an arid country but one that is dependent on a healthy environment for the health of its people and economy.

Design, planning and implementation of policies, programmes and projects should therefore protect and enhance this sensitive environment. Ill-advised development and economic activity may cause or contribute to environmental degradation, initiate and promote desertification and lead to an overall loss to the quality of life of Namibians. Namibia as a developing country, largely dependent on its own environment and ecological production, has a special imperative to achieve environmentally sound and sustainable land use and economic activities (MET, n.d.). This is of particular importance in rural and communal areas where communities are particularly vulnerable to the effects of environmental degradation.

1.2 Providing Boreholes in Communal Areas

The provision of boreholes in communal areas, like rainfall, is a significant determinant of the characteristics of the environment. Boreholes arguably affect the whole range of components that may be included under the broad term of ‘environment’ - that is, the physical, ecological, social and economic components that interact and determine the integrity of the environment and the quality of human life. The environmental impact of borehole provision should therefore be assessed and managed appropriately.

Boreholes are provided in Namibia under a wide variety of circumstances. They form a large component of ongoing routine rural water supply
development as well as integral components of emergency schemes to provide water in rural areas (DWA, 1991).

Approximately 300 emergency boreholes were drilled and installed throughout Namibia during the Drought Relief Programme of 1992/1993 (National Drought Task Force, 1993). Another 50 non-functioning boreholes were rehabilitated in this programme. Re-settlement schemes since Namibian independence have also prompted the provision of boreholes in areas where there is no surface water (Simmonds, pers. comm.).

1.3 Motivation for this Study

Although the authorities responsible for borehole planning are developing guidelines and criteria to inform the planning and decision-making process, it appears that little or no environmental assessment is undertaken in the planning of borehole provision (Koch and Tarr, pers. comm.). Consequently it may be argued that the environmental impacts of boreholes have not been adequately considered in the planning or decision-making process. This may relate to those which were drilled and installed as emergency boreholes in the drought of 1992/3, those supplied as 'emergency boreholes' in re-settlement schemes as well as those supplied as part of ongoing rural water supply development programmes.

Furthermore, concern has been expressed by several government and non-government institutions (including The Ministry of Environment and Tourism and the Namibian Programme to Combat Desertification) that insufficient knowledge exists regarding the impact of boreholes on the environment. This undoubtedly contributes to the low priority given to environmental considerations in the planning and provision of boreholes.

There is, therefore, a need for focused research into the environmental impact of boreholes. This needs to facilitate the establishment of a scientific basis from which the planning process for emergency boreholes and other boreholes may be informed. This is particularly true for Namibia where boreholes are a significant component of rural water supply and as such have a significant impact on Namibia's ability to benefit, in a sustainable manner, from its natural resources.

As a result of this situation the Namibian Programme to Combat Desertification (NAPCOD), through the Ministry of Environment and Tourism in Namibia (MET), commissioned this report, with the goal of starting to fulfil the objectives mentioned above.

1.4 Background to Study Team

The study was undertaken by a team of eight students enrolled for the Environmental Science Masters Course in the Department of Environmental and Geographical Science at the University of Cape Town, South Africa. The study was undertaken as a self-contained investigation, commissioned by
NAPCOD. Although the completion of this study forms part of the academic requirements of this course, it was approached as an independent professional project for the client. After this report has been submitted to the client, each student will complete an individual dissertation which is based partly on information collected during the compilation of the report. These dissertations will also be made available to the client.

Appendix 8 outlines the qualifications and experience of the students involved.

The Environmental Evaluation Unit (EEU) of the University of Cape Town was also involved in this study. As a professional environmental consultancy within UCT, the EEU supervised the project and contributed towards field work and internal review of the report.

1.5 Nature and Scope of Study

Boreholes in communal areas in Namibia may be classed as 'emergency boreholes' or those supplied as 'routine' in ongoing rural water supply development. Emergency boreholes may be further classified as those supplied as emergency drought relief boreholes (such as those provided or rehabilitated in the 1992/93 drought relief programme) or as those supplied as a matter of urgency in re-settlement programmes (such as during the re-settlement of Herero people from Botswana).

The research set out to investigate the environmental impacts of emergency borehole supply in Namibia. This was originally to be focused on the 1992/93 Drought Relief Programme. However, through discussions with the client (NAPCOD) and initial investigations it was decided by the research team not to limit the definition of the research topic strictly to the boreholes provided during the 1992/93 drought relief scheme but to also include boreholes provided as 'emergency' water supply in other situations such as re-settlement programmes. By widening the scope of the study it was felt that a more holistic picture could be obtained, especially with regard to the impact of boreholes on a previously relatively 'pristine' environment, as was expected to be found in some of the resettlement programmes.

The research team, in conjunction with representatives from NAPCOD, felt that the best approach to the investigation would be to select two case study areas on which to base the research. Although those topics which relate to the whole of Namibia were researched on a national level, the two case study areas formed a focus for detailed research into the environmental impacts of boreholes. This case study focus also directed the investigation of the policies and processes which informed and guided borehole implementation in these two areas.

The two case study areas identified were:

1. Khorixas Area and the 1992/3 Drought Relief Programme
2. Gam Area and water provision in resettlement programmes
1.6 Rationale for Choosing Case Study Areas

Both case study areas have been subject to programmes of emergency borehole provision. In Khorixas boreholes were provided as emergency drought relief while in Gam boreholes were provided as an emergency when people were resettled from Botswana.

The areas lie approximately on the same latitude across Namibia’s East-West rainfall gradient and for this reason were thought to be a useful comparison of each other and reasonably representative of two different climatic environments of Namibia.

![Map of Namibia showing the locations of Khorixas and Gam](image)

*Figure 1.1. Location of Gam and Khorixas in Namibia*
Khorixas is a low rainfall area with an arid environment. It has been subject to a variety of land uses over many generations. Boreholes have been part of these land use practices for many decades. The boreholes provided as emergency drought relief were yet another addition to the already complex social, economic and environmental picture.

Gam, on the other hand, is less arid and presents a relatively pristine, under-utilised area. A small community of Bushmen and Herero were living in the area prior to 1994. However, the on-going Herero Resettlement Programme of Herero from Botswana into the Gam region, has resulted in population numbers increasing significantly. Provision of boreholes here was subordinate to, and a consequence of, the decision to create a resettlement area. These boreholes were therefore supplied as emergency boreholes - the first being installed in mid 1994 - in a previously unsettled area. These two areas, therefore, presented very different scenarios and circumstances but both were subject to emergency borehole provision.

1.7 Terms of Reference

The terms of reference, drawn up by the research team and approved by NAPCOD, for the project were:

- To briefly review at the national and regional level the relevant climatic, demographic, political and socio-economic characteristics of Namibia.

- To present an overview of Namibian water resources, water supply policy (in particular rural water supply policy) and land use patterns including agriculture and livestock farming.

- To present a review and analysis of emergency borehole supply as regards the:
  - institutional structures and stakeholders relevant to the decision-making process;
  - rationale for the determination of borehole siting;
  - participation of stakeholders in the planning and implementation process;
  - community involvement in the management of boreholes;
  - present monitoring of boreholes and present monitoring of the environmental impacts of boreholes and
  - the environmental sustainability of boreholes.

(Note: The above was focused on the two local case study areas and how they relate to the national and regional level.)
• To identify and evaluate the ecological, social and economic impacts of boreholes in the two case study areas.

• To provide, on the basis of the above, recommendations and guidelines on:
  1. The political and institutional planning process of borehole provision
  2. The siting and commissioning of boreholes
  3. Stakeholder involvement in the planning process and management of boreholes
  4. Conditions and restrictions specified by the authorities relating to borehole use and provision
  5. Sustainability indicators
  6. The monitoring of the use, conditions of use and environmental impacts of boreholes
  7. The decommissioning of boreholes

1.8 Structure of Report

The report is divided into four parts:

Part I contains information about the approach, methodology and limitations of this study. It also provides an overview of relevant biophysical, social and economic characteristics of Namibia. Sections providing a review of water supply in Namibia, land tenure issues and relevant institutional structures are included as well as a section which provides a discussion of some theoretical considerations relating to providing point sources of water in an arid environment.

Part II and Part III deal with the case study areas of Khorixas and Gam respectively. In each case study a regional profile, review of the relevant programme concerned with borehole supply and a presentation and discussion of the research findings is included.

Part IV presents the conclusions and findings of the report. It also presents the recommendations which have arisen from this study.

Eight appendices contain additional information referred to in the body of the report and a compilation of field data.
PART I

APPROACH
NAMIBIA - OVERVIEW
NAMIBIAN WATER SUPPLY
LAND TENURE
INSTITUTIONAL STRUCTURES AND POLICIES
ARID ENVIRONMENT- OVERVIEW
DROUGHT & DROUGHT RELIEF PROGRAMME
2. Approach to Study

2.1 Methodology

Several different methods were used to gather information contributing to this report. These were:

- literature review,
- interviews with key stakeholders and informants,
- field work incorporating observations, informal interviews and information gathering using Participatory Rural Appraisal (PRA) techniques.

2.1.1 Literature Review

A comprehensive review of the relevant literature was undertaken which provided a basic information base from which to proceed.

2.1.2 Interviews

Interviews were conducted with key stakeholders and informants in Windhoek and the two study areas. These included relevant informants from non-governmental organisations, aid agencies, researchers, local communities, government ministries and departments at the national and regional level. A list of the interviews is to be found in Appendix 1. All interviews took place between November 1996 and March 1997.

2.1.3 Field Work

Observations, informal interviews, measurements and PRA were done at the study sites. These activities varied according to the study situation. Translators were used in Khorixas and Gam.

2.1.3.1 Observations, Measurement and Informal Interviews

- Soils
The soil description for the sites is based on field observation and discussion with people at the study sites. Qualitative analysis was carried out within a 500 metre radius of each borehole site as well as around the households. The analysis compared soil components from each site to soils in the surrounding veld/land in terms of their potential to support vegetative growth.

The soil information and components (see Appendix 2) included at each borehole site are: locality name; relief; surface stoniness; form of soil surface; soil texture and signs of erosion.
• Vegetation and Land Use
Qualitative vegetation descriptions for the sites were based on field observations and informal interviews with people living at the study sites. Vegetation was described in the area visible from the borehole (about a 500-800m radius). The type and state of vegetation cover, including whether perennial or annual grass was present, whether bush or grass was dominant and a qualitative assessment of bushes for browse pressure, were noted around the homestead and borehole. Informal transect walks with farmers were also used to ascertain vegetation condition away from the immediate vicinity of the borehole.

Discussions were held with farmers on grazing management.

• Water Quality
To assist information gathering for assessing the health impacts of boreholes, water from the boreholes in the study area was analysed to determine
  • total dissolved solids and
  • coliform and *E. coli* count.

1. **Total Dissolved Solids (TDS)**
   A Perstorp Water Analyser (Model 51500) was used to measure this parameter. This instrument is able to simultaneously measure TDS, temperature, pH and oxygen concentration in a water sample. The TDS is derived from the electrical conductivity of the water. The relationship between electrical conductivity and TDS varies, however, according to the pattern of salt constituents of a particular water body. The analyser should be standardised for a particular water body once its salt profile and TDS have been established by a full analytical method. This was obviously not possible in this study and the results could, therefore, possibly have as much as 10% error but were nevertheless used as a useful guide.

2. **Bacterial Analysis of water samples**
3M Petrifilm™ test plates were used. These culture plates were inoculated with 1ml of the test sample and incubated in a field incubator at 35 - 37°C for 24 hours. Every microbe in the initial sample, which responds to the gel, grows into a colony which is visible to the naked eye and can be counted. Dye and gas indicators within the gel allow identification of four types or classes of organism viz. *E. coli*, 'other coliforms', non-coliforms and pseudomonas aeruginosa.

Sterile techniques were used in the collection and handling of the samples to prevent contamination of samples. The 3M Petrifilm™ plates were inoculated with the sample within a maximum of 6 hours of collection.
Infrastructure
Observations were made as to the borehole infrastructure that was present e.g. pump installation, reservoirs, animal watering points and taps. The relation between animal watering points and where people obtain their water was also noted.

Informal Interviews
Informal interviews were conducted to determine the importance of the borehole to people. The Department of Rural Water Supply’s new cost recovery plan and water point committees were discussed informally and people’s views on them were elicited.
2.1.3.2 Participatory Rural Appraisal
At each of the boreholes visited, people who were living in settlements around the study borehole, who generally utilised water from the borehole were asked to be involved in activities. The following information was elicited using PRA techniques.

- **Demographic details**
  A map depicting homesteads with their occupants and surrounding physical resources was generated by participants to establish population, demography and spatial layout of the settlement.

- **Settlement patterns and livestock variations over time**
  A time trend was drawn, indicating when members of the community arrived at the settlement. Livestock increases or decreases were noted, and these were linked to periods of water and grazing availability.

- **Borehole Networks**
  Respondents were asked to draw their borehole and any others where reciprocal networking of water and other important resources took place. Linking lines were drawn between these with details of what the relationships entailed.

- **Livelihoods and Resource Use**
  Respondents were asked to list resources used for livelihoods, and to prioritise these according to importance and also reliability in times of difficulty, such as drought. Resources were prioritised according to cash value and importance to the community.

- **Expenditure**
  Items that required cash were discussed and prioritised in terms of which ones were the most difficult to meet.

*A summary of data from the PRA sessions is presented in Appendix 7.*

2.1.4 Study Site Selection

2.1.4.1 Khorixas
In Khorixas, boreholes drilled during the 1992/93 drought were selected by the study team for field visits. The selection of boreholes was based on the borehole's proximity to Khorixas and availability of data on the borehole such as its position and yield. A borehole that was not drilled during the 1992/93 drought was also included.
A list of the study boreholes and research activities is presented in table 2.1, and a map of the farms on which the boreholes are located is presented in figure 2.1. PRA and ecological observation was not done at all sites due to time and personnel constraints.

**Table 2.1: Boreholes visited in Khorixas and research activities.**

<table>
<thead>
<tr>
<th>Locality</th>
<th>IMC Borehole Number</th>
<th>Research Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halt post</td>
<td>34106</td>
<td>Observation, informal interview, PRA</td>
</tr>
<tr>
<td>Bergville post</td>
<td>34107</td>
<td>Observation, informal interview, PRA</td>
</tr>
<tr>
<td>Ruimte</td>
<td>34109</td>
<td>Observation, informal interview</td>
</tr>
<tr>
<td>Lofdal post</td>
<td>34110</td>
<td>Observation, informal interview, PRA</td>
</tr>
<tr>
<td>Engelbrecht post</td>
<td>34111</td>
<td>Observation, informal interview, PRA</td>
</tr>
<tr>
<td>Nugas post</td>
<td>34114</td>
<td>Observation, informal interview, PRA</td>
</tr>
<tr>
<td>Freyer</td>
<td>34116</td>
<td>Observation, informal interview, PRA</td>
</tr>
<tr>
<td>Emmanuel post</td>
<td>34122</td>
<td>Observation, informal interview</td>
</tr>
<tr>
<td>Petrusfontein post</td>
<td>34125</td>
<td>Observation, informal interview, PRA</td>
</tr>
<tr>
<td>Post 66</td>
<td>34126</td>
<td>Observation, informal interview</td>
</tr>
<tr>
<td>Potgietersrus</td>
<td>34128</td>
<td>Observation, informal interview, PRA</td>
</tr>
<tr>
<td>Tussenby</td>
<td>34129</td>
<td>Observation, informal interview, PRA</td>
</tr>
<tr>
<td>Renosterkop</td>
<td>34131</td>
<td>Observation, informal interview</td>
</tr>
<tr>
<td>Horison</td>
<td>RWA installation</td>
<td>Observation, informal interview</td>
</tr>
</tbody>
</table>
Figure 2.1: Location of study farms in Khorixas region (not to scale)
2.1.4.2 Gam

Boreholes that had been drilled for the Herero Repatriation Programme were visited. The choice of boreholes that were visited was based on the advice of the translator from Ministry of Lands and Resettlement in Gam and the fact that the boreholes were accessible from the Gam repatriation centre. In addition, one old government borehole at the resettlement camp itself and a privately drilled borehole were visited. Participatory Rural Appraisal was only done at three study boreholes. This was due to time constraints and logistical difficulties.

A list of the boreholes that were visited is presented in table 2.2 and a map of their locations is presented in figure 2.2.

Table 2.2: Boreholes visited in Gam and research activities

<table>
<thead>
<tr>
<th>Locality Name</th>
<th>Borehole Number</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Borehole N5’</td>
<td>WW 34457</td>
<td>Observation, informal interview, PRA</td>
</tr>
<tr>
<td>Otjimihama</td>
<td>WW 34463</td>
<td>Observation, informal interview, PRA</td>
</tr>
<tr>
<td>Otjiserandu</td>
<td>WW 34846</td>
<td>Observation, informal interview, PRA</td>
</tr>
<tr>
<td>Gam</td>
<td>Old government borehole</td>
<td>Observation, informal interview</td>
</tr>
<tr>
<td>Private borehole</td>
<td>Unknown</td>
<td>Observation, informal interview</td>
</tr>
</tbody>
</table>
Figure 2.2: Boreholes installed in Gam district
2.2 Limitations of the Study

Total representation of the full range of social, political and biophysical issues surrounding boreholes in Namibia as a whole was not the intention of this study. The study essentially presents two case studies of borehole provision which are not representative of Namibia as a whole. The results of this study should thus be interpreted in this light.

The borehole sample size in the areas visited was small due to time and logistical constraints. The study team was split up in Khorixas so that more boreholes could be visited in the available time. This inevitably resulted in slightly different approaches and the comprehensiveness of information may not be uniform for all boreholes.

In Gam few boreholes were visited as time was limited and access to the boreholes was difficult because of their remoteness and the poor condition of the roads at the time of year of the study. In addition as petrol was limited and the boreholes were far apart, this limited the distance that could be travelled. Information gained in Gam is, therefore, not as comprehensive as that gained in Khorixas as the sample size was much smaller.

Biases could be present due to the fact that selection techniques for boreholes to be visited were restricted by time and logistical constraints.

It was considered important that the perceptions of community members be elicited. Participatory Rural Appraisal was done with mixed groups and other exercises were undertaken with different gender groups. In the Khorixas region, for example, men tended to dominate group discussions, partly because they spoke more fluent Afrikaans. When women spoke up, priorities tended to differ. In contrast, in Gam, women were better represented than men at PRA activities. Thus the information gained in the field might be biased due to differences in gender representation in information gathering.

The use of translators untrained in PRA techniques may have resulted in a loss of clarity and precision in the information gained during sessions.

As a result of the limited time available in the field much of the information collected for the report is qualitative rather than quantitative in nature. However, perceptions of the people living around the boreholes were gained, which was considered very important.

Time constraints resulted in a need to rely on secondary information from reports. In addition information from other organisations and individuals was relied on to a great extent. The depth of knowledge gained for this report is therefore limited to some extent, and the use of secondary data and information has been based on the assumption that it is accurate and of a reasonable quality.
Overall, not enough non-governmental organisations (NGO) were consulted. For example in Khorixas, Africare, who was involved in the IMC programme, were not available for interview. This has resulted in the fact that information and perceptions gained might not be complete.

Thus the results of this study from PRA, field observation and measurements give an indication of the impact trends of emergency boreholes in Khorixas and Gams, rather than a totally comprehensive analysis thereof. The extent to which this information can be extrapolated to the rest of Namibia is consequently limited.

However, it is intended that the analysis and findings of this study contribute to the development of an information base that will be useful for informing further policy development and decision-making. It is hoped that this research will initiate further studies so that in due course, a comprehensive knowledge base exists on the environmental impacts of emergency boreholes.
3. Namibia - an Overview

In this chapter a brief overview of Namibia is presented in order to provide a background for the study which follows. The chapter is divided into different sections with political, geographical, climatic and hydrological overviews being presented first. These will give a background to the historical and physical characteristics affecting Namibia, and sets the context of the importance of groundwater as a resource for the country. An overview of Namibia’s demography, health, economy, and the country’s reliance on agriculture will then follow. The important point which will be brought out in this final section is the importance of agriculture in Namibia.

3.1 Political History

Namibia, then known as South West Africa, was proclaimed a German protectorate in 1884. During the period 1884 to 1908 the German settlers fought a number of wars with the indigenous peoples, especially the Hereros and Namas—who saw their lands and herds being threatened by the Germans. In these wars it has been estimated that about 75% of the Herero population and 50% of the Nama populations perished (Central Statistics Office, 1994). A great number of the Hereros who survived fled into what is now Botswana. The descendants of these Hereros are now involved in the Namibian repatriation programme from Botswana to Gamm.

The conquest of German South West Africa by South African forces during World War I resulted in its subsequent administration by South Africa under a 1920 League of Nations mandate. When the United Nations succeeded the League of Nations in 1945, South Africa refused to place the territory of South West Africa under UN Trusteeship, and began a systematic policy of introducing the apartheid system of government into the territory. In 1964 the Odendaal Commission recommended the establishment of the so-called “homeland” system for blacks. This resulted in the country being divided into a number of ethnic homelands which made up 40% of the land while 44% was reserved for whites with the remaining 16% consisting of game reserves and mining areas.

In 1978, the UN Security Council adopted Resolution 435 in an attempt to end South Africa’s occupation of Namibia. This eventually culminated in Namibia’s first free and fair elections which were held in November 1989. Dr Sam Nujoma was elected as President of Namibia, and independence formally declared on 21 March 1990 (NPC, 1995).

3.2 Geography

Namibia covers an area of 824 269 km². It is the 12th largest country in Sub-Saharan Africa lying on the south west coast of Africa. It is bordered by Angola and Zambia to the north, Zimbabwe and Botswana to the east, and by South Africa to the south. The country is bounded by two deserts, the Namib,
along the whole of the west coast, and the Kalahari, on the southern and central eastern border with Botswana (UNDP, 1996).

Namibia’s landscape is very varied. The expanses of desert, sand dunes and rock formations found in the south contrast sharply with the savannah and woodlands of the central regions and the forested scenery of the north-east (NPC, 1995).

Figure 3.1 below shows a typical topographical profile of Namibia from Swakopmund on the west coast through Gobabis to the Botswana border in the east. Three prominent zones are clearly visible: a narrow coastal plain (0 - 500m), an eroded escarpment reaching altitudes of 1500 - 2000m, and an extensive interior plateau at altitudes of 1000 - 1500m.

![Figure 3.1: Typical Topographical Profile of Namibia (adapted from Van Der Merwe, 1983)](image)

### 3.3 Climate

General rainfall over Namibia originates from the Indian Ocean and is carried across by easterly trans-continental winds. Rainfall varies from less than 50mm per annum in the west at the coastline to over 700mm in north-east Caprivi as shown in figure 3.2 (DWA, 1991).

It is extremely variable over most of the country, and increasingly unreliable in drier areas. Rainfall in Namibia is low, erratic and spatially variable. This, coupled with potential annual evaporation rates of between 2600mm in the north-west and 3700mm in the south-east, means that large water deficits in dry seasons and periodic droughts are the norm for most of the country (ibid.).

In broad terms, a distinction may be made between the extremely arid coastal zone, the arid southern interior, the semi-arid central and the north-western area, and the small sub-humid north eastern zone (Van Der Merwe, 1983).
Figure 3.2: Mean Rainfall Map of Namibia
3.4 Hydrology

Namibia’s climatic extremes contribute to a unique and extreme hydrological cycle. It is estimated that on average 83% of the total rainfall evaporates shortly after precipitation, 17% is available as surface runoff, of which 1% recharges groundwater sources and 14% is lost through evapotranspiration. Only 2% remains available for surface storage (DWA, 1991).

![Figure 3.3: Namibia's Water Balance (DWA, 1991)](image)

Namibian water resources can be divided into three major categories:
1. Perennial rivers
2. Ephemeral rivers
3. Groundwater

3.4.1 Perennial Rivers

The Zambezi, Okavango, Kunene and Kwando rivers in the north, and the Orange river in the south are Namibia’s only perennial surface waters. These rivers all originate in neighbouring countries where higher rainfall supports year-round flow. Perennial rivers supply 23% of Namibia’s water demand, however, this is mainly to villages and towns close to these sources. The water utilised by Namibia from the perennial rivers which flow past the country is less than 0.1% of their combined annual runoff (DWA, 1991).

3.4.2 Ephemeral Rivers

In contrast to the perennial rivers along its borders, rivers which originate within Namibia are all ephemeral - flowing only after strong rains have fallen over their catchment area. For most of the year these Namibian rivers are dry, sandy channels.

Ephemeral surface water, in the form of large reservoirs which store seasonal flood waters, supply 20% of Namibia’s total water demand. Although the utilisation of surface water close to the point of demand tends to be the
cheapest way of providing water, a number of factors hamper effective planning and management of Namibia’s surface water resources (DWA, 1993):

- the high variability in precipitation patterns, which requires large storage volumes in relation to the mean annual runoff in order to provide carry-over storage for drier years;
- the difficulty in assessing hydrological characteristics of catchments, where evapotranspiration rates are about ten times greater than precipitation rates, and where available streamflow records are relatively short;
- the high evaporation rates in conjunction with unfavourable storage sites (shallow reservoirs with a large surface areas);
- the downstream environmental effects which will result from altering the flooding frequency, discharge and sub-surface flow. Most notable would be the loss of perennial springs and wetlands.

3.4.3 Groundwater

Groundwater resources provide for the bulk of Namibia’s water demand - approximately 57%. It is estimated that Namibia has approximately 32 000 boreholes which deliver water. It must be noted however, that good groundwater sources in Namibia are the exception and not the norm. An unsuccessful borehole is considered to be a borehole with a yield not suitable for the purpose for which it has been drilled, and nearly 80% of all boreholes fall in this category (DWA, 1991). The yields of Namibia’s existing production boreholes varies between as little as 0.5 m$^3$/h for rural communities and farm installations, to as high as 20 m$^3$/h for domestic and industrial water supply schemes (ibid.).

Primary karst and alluvial aquifers are utilised in conjunction with surface reservoirs to provide for bulk water supply to urban centres, mining and irrigation demand. Smaller secondary aquifers (found along joints, bedding planes, shear zones and faults) and hand dug wells provide for the majority of rural agricultural demand (ibid.).

Groundwater recharge in Namibia originates only from rainfall, whether precipitation occurred recently or in prehistoric times. The occurrence and recharge of groundwater therefore depends on a combination of sufficient rainfall and favourable hydrological conditions. To avoid the “mining” of aquifers, water cannot be removed at a rate faster than it is replaced by these natural processes, as this is unsustainable use and will result in the aquifer drying up (Jacobson, et al., 1995).
3.5 Demography

The 1991 Population and Housing Census recorded Namibia's population at 1.4 million people. Growth rates were determined to be about 3% per year (Central Statistics Office, 1994). The projected population for 1995 was 1.61 million, and with an estimated population density of 2.0 people per km² Namibia is one of Africa's three most sparsely populated countries (UNDP, 1996).

According to the 1991 census population densities within the country vary enormously. It is estimated that 60% of Namibia's population live in the northern districts, and population densities in certain of these areas exceed 100 people per km², while only 7% of the population, live in the southern areas where population densities can be as low as 0.5 per km². The urban and rural distribution of the population also show that 33% of the population live in urban areas, with the remaining 67% living in rural areas.

One dominant feature of Namibia's population is its youthfulness: children aged 0 - 14 make up 42% of the population, while older persons aged 65 and over make up less than 5% of the total population.

With about 68% of the population residing in rural areas, Namibia can be described as having a predominantly rural population, but at a growth rate of over 5% per annum in the urban sector, the population is also experiencing a rapid rate of urbanisation. If the trend continues, close to 1 million people - or over 43% of the projected population of the country - may be living in urban areas by the year 2006 (NPC, 1995). As in many other countries, there is a tendency in Namibia towards migrating from rural districts to major urban centres that offer more employment opportunities and more advanced educational and health services. This trend is likely to continue unless both the Government and the private sector intervene to narrow the gap between the flourishing urban centres and the remote rural areas.

3.6 Namibian Health Indicators

Two useful indicators of national health are the Infant Mortality Rate, and the Childhood Mortality information.

3.6.1 The Infant Mortality Rate (IMR)

The IMR is an often used, reliable and sensitive indicator of the health of a nation. It usually correlates well with living conditions, standard of water supply, education and health facilities available (Holland et al, 1991).

The IMR's for Namibia are presented in the graph below (figure 3.4). This shows the National Average IMR as well as the IMR per region. The IMR in an average developed country is likely to be less than 30/1000 (in Europe as
low as 13/1000). The IMR’s in Namibia are very variable by region. The high figures for most regions are definite indicators that all areas could be improved by promoting education and socio-economic upliftment. One key contribution would be to provide reliable clean water supplies - for its primary and higher order potential benefits.

![Graph showing IMR (per thousand live births)](image)

*Figure 3.4: Infant Mortality Rates (Central Statistics Offices, 1991)*

### 3.6.2 Childhood Mortality

The next graph (figure 3.5) presented is that showing the leading causes of death in the under five age group in Namibia. Mortality data in this age group provides a clear picture of the most serious health problems in Namibia. It is worth noting that of the top five, two relate directly to water - diarrhoea and malaria. All five, however, are directly linked to living standards and nutrition. It is clear that development work in Namibia needs to concentrate on these areas and providing clean water is undoubtedly necessary in this process.
Figure 3.5: Leading causes of death in under five year olds in Namibia (Central Statistics Offices, 1991)

Note: The percentages in this table add up to more than 100%. This was because recording allowed for multiple causes as the cause of death. Diseases such as diarrhea, undernutrition, measles and respiratory infections often occur concurrently.
3.7 Economy

Namibia has a resource-based economy which is highly capital-intensive and accounts for much of the GDP, government revenues, and foreign exchange earnings. The pillars of Namibia’s economy all depend on the resource base - mining, agriculture (mainly livestock), fisheries, and wildlife-based tourism (Lange, 1997). Although Namibia has good economic policies and political stability, it’s small, widely dispersed domestic market has proven to be an obstacle to development of industry in the country. Much of the country’s food and manufactured goods are met through exports (CSO, 1996).

Figure 3.6 shows how the Namibian economy is service dominated, with services making up over 60% of the GDP. The largest single contributor to Namibia’s GDP is general government, accounting for 25% of the GDP in 1995.

![GDP by Main Activity Chart]

**Figure 3.6: GDP by Main Activity (UNDP - Development Cooperation Report, 1996)**

As a result of the recommendations of the Odendaal Commission in 1964, Namibia’s agricultural sector is divided between a commercial, mainly “white”, sub-sector of farming and animal husbandry, and a large “black” traditional sub-sector that is subsistence orientated and operates at a low technological level. The overall contribution of the agriculture sector to the GDP is 10.5%, of which less than 3% is derived from subsistence agriculture (UNDP, 1996).

Namibia’s crop production (wheat, maize and pearl millet) is generally limited to the northern part of the country, where water is more readily available. In the central regions agricultural potential is confined to livestock farming while in the more arid south only extensive sheep and goat farming is possible without irrigation. The main environmental constraints confronting the development of agriculture in Namibia are the threat of drought, overgrazing, bush encroachment, soil erosion, and desertification.
3.8 Reliance on Agriculture

Agriculture's contribution to rural livelihoods, particularly in the communal-tenure areas, is much more significant than the GDP suggests. The majority of Namibians derive a substantial part of their livelihood from the land and the resources it supports; livestock, crops, trees and flora. (Desertification News, 1994). As much as 70% of the population is directly or indirectly dependent on agriculture, with the agricultural sector accounting for 27% of private sector employment.

These rural people are dependent on the resource base of their environment and in an arid country such as Namibia it is a particularly variable one. Water is a major limiting resource in many rural areas and around 50% of rural households still lack proper access to a reliable source of safe water (NPC, 1995).

In order to minimise the risk posed by the uncertain climate and the poor physical resource base, communal-tenure area households are having to adapt highly diversified livelihood strategies. Household incomes are being supplemented by non-farm activities such as remittances of both food and cash, pensions and formal sector employment. Agriculture can therefore be seen to play a supplementary, but essential, role in the livelihoods of rural households and particularly for the poorest, who have least access to off-farm incomes (ibid.).
4. Namibian Water Supply

Namibia's general climatic, geological and topographical features make water its single most important resource. Apart from being essential for human survival and welfare in Namibia, a scarcity of water has the potential to constrain the development of virtually all sectors of the economy (NPC, 1995). Consequently, water management policy is a critical component of the country's economic development strategy.

This chapter provides an overview of how Namibia is utilising its water resources at present, including estimated future water demand projections. The rural water supply situation is also presented, with an emphasis on why this sector has high priority in national development.

4.1 Water Demand

There are six main groups of water users in Namibia, each with different demands on available surface and groundwater sources. These categories are presented in figure 4.1 as a percentage of Namibia's total water demand:

- Stock (25.4%)
- Tourism (0.9%)
- Irrigation (42.8%)
- Domestic - Urban (16.9%)
- Domestic - Rural (11.4%)
- Mining (3.1%)

![Figure 4.1: Water Consumption in Namibia (from MET, undated)](image)

A further breakdown of urban and rural water demand is given in Table 4.1. Domestic water demand in the urban environment includes industrial water. Domestic water demand on commercial farms excludes stock water demand. It is interesting to note the difference between the average domestic consumption in the urban environment of the districts, as compared to the urban environment in communal regions. Differences can be attributed to the higher degree of industrialisation and better living standards in the major towns of the districts (DWA, 1991).
Table 4.1: Unit Water Consumption, 1990 (DWA, 1991)

<table>
<thead>
<tr>
<th>Area</th>
<th>Consumer</th>
<th>Water Consumption (litres/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Districts</td>
<td>Domestic urban environment</td>
<td>330</td>
</tr>
<tr>
<td></td>
<td>Domestic rural environment</td>
<td>85</td>
</tr>
<tr>
<td>Communal Regions</td>
<td>Domestic urban environment</td>
<td>165</td>
</tr>
<tr>
<td></td>
<td>Domestic rural environment</td>
<td>85</td>
</tr>
<tr>
<td>Commercial Farms</td>
<td>Domestic average</td>
<td>136</td>
</tr>
<tr>
<td>Country</td>
<td>Large stock</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Small stock</td>
<td>9</td>
</tr>
</tbody>
</table>

As a developing country, Namibia’s water consumption can be expected to increase rapidly due to:

- an ever-increasing population (present growth rate is 3%);
- rapid urbanisation;
- the development of higher standards of living;
- the required upgrading of the rural water supply network to provide greater numbers of people with a reliable source of safe water;
- industrial and mining development;
- increasing agricultural development, especially in terms of irrigation projects which will greatly increase the national water demand (Bethune, 1992).

Estimated future water demand of the various consumers on each of the available water resource categories is illustrated in Table 4.2.

Table 4.2: Estimated future water demand (DWA, 1991).

<table>
<thead>
<tr>
<th>Consumer</th>
<th>Demand on Water Resources (Mm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Perennial Rivers</td>
</tr>
<tr>
<td>Domestic</td>
<td>12.6</td>
</tr>
<tr>
<td>Stock</td>
<td>3.7</td>
</tr>
<tr>
<td>Mining</td>
<td>2</td>
</tr>
<tr>
<td>Tourism</td>
<td>39.7</td>
</tr>
<tr>
<td>Irrigation</td>
<td>Total</td>
</tr>
</tbody>
</table>

Analysis of the figures in Table 4.2 shows an expected increase in the utilisation of perennial rivers of 170%, as compared to 78% for ephemeral rivers and 8% for groundwater. Clearly, the major water sources present in the interior of the country are virtually fully exploited and Namibia will have to rely on long-distance water transfers from perennial rivers to meet future demand.
Studies are presently underway to determine the technical and environmental feasibility of providing water from the Okavango River. Regardless of the outcome of these studies, perennial water will not provide an unlimited supply of water. One of the major challenges facing Namibia will be to implement stricter controls and incentives to ensure more efficient use of water and water efficient production methods, in order that future demand can be met from the country’s limited supplies.

4.2 Rural Water Supply

At independence, Namibia was faced with a situation where there were great disparities between the rural and urban water supplies. Rural areas were not adequately provided with water supplies, while water supply in most urban areas were served by a well resourced bulk water system (NPC, 1995). For example, it was estimated in 1990 that only 50% of the estimated rural population had proper access to a reliable source of safe water (ibid.).

This trend has led the Government to giving greater emphasis to rural water supply. In the financial year 1994/95, the DWA was allocated N$210 million, of which 38% was in support of rural water supply. In excess of 40% of the development expenditure in the Governments Public Sector Investment Sector is dedicated to the rural communities, and it is envisaged that total expenditure on rural water supply over the five year period of the Public Sector Investment Programme will be over 50% of the total expenditure (ibid.).

Rural water supply is mostly dependent on ground water as the only source of water; with estimations showing that in February 1997 there were about 5100 functioning rural water points, mostly boreholes (Koch, pers. comm.).

4.2.1 Sector Targets for 1995-2000

According to the National Development Plan for 1995 - 2000 the following sector targets are relevant regarding rural water supply (NPC, 1995):

- 80% of the rural population is to have access to safe and reliable water supplies by the year 2010. Access is defined at present as within 2.5 km of the home;
- 95% of the rural population is to have representation on water committees at the district level by the year 2000;
- 8 regional water offices are to be established;
- 50 new rural water points are to be created annually, with more effort directed towards rehabilitation and maintenance of existing water points, especially boreholes;

Provision of water, is therefore, a high priority in national development. In rural areas this will involve provision and rehabilitation of boreholes as part of routine rural water supply.
5. Land Tenure

Land tenure and access to and control over resources are important issues for peoples' ability to effectively manage their environment. As boreholes are resources that provide benefits and access to other resources such as grazing, people need to be able to effectively manage them. An understanding of land tenure and land use issues and their history in Namibia is thus necessary.

5.1 Introduction

The distribution, management and tenure of land in Namibia has historically been determined by policies of former colonial administrations and falls into two broad categories. Land formerly utilised by indigenous communities was dispossessed and set aside for European settlement and the original owners were confined to 'native reserves' (Werner, 1994). The South African Government refined this initial division of land and imposed different agricultural policies and levels of support in the two sectors. The result has been the development of "white commercial" farming as distinct from "black communal" farming (figure 5.1).

![Figure 5.1: Different types of land tenure in Namibia (adapted from Harnett (1993)).]
Commercial land is owned by individuals under freehold title and comprises some 44% of the country (362,000km²), supporting 6,300 farms belonging to 4,200 farmers. In contrast communal land comprises 41% of the country (335,400km²) and is home to 138,000 households (Dewdney, 1996; Sullivan, 1996a).

Prior to independence, allocation of land in communal areas was regulated by a series of 'traditional authorities' or second tier authorities set up by the South African government (Rohde, 1994). With independence the laws regulating these authorities were repealed, their powers removed, and ownership of all land set aside for 'native' populations was vested in the State (Sullivan, 1996a). The legal status of land allocation and management in the communal areas is problematic as there are no regulating laws, and traditional authorities no longer have the power or ability to effectively administer land tenure and administration. As a result, rural communities do not have secure, exclusive tenure over land and natural resources (Dewdney, 1996).

In 1991, the National Land Conference reached consensus about a number of issues and made a number of recommendations (Harnett, 1993). These have not yet been accepted by the government and thus there is currently no clear or comprehensive Government policy on land allocation or natural resource management in the communal areas. It has however, been accepted that there is an urgent need for communal land tenure reform and the development of a national land policy (Dewdney, 1996). To this end, a green paper is currently available on national land policy (Tjipueja, H. pers. comm.; Outline of a National Land Policy, 1997).

The Agricultural (Commercial) Land Reform Act (No 53 of 1995) is an attempt to address the grievances of those without land. The redistribution of farms fenced for freehold tenure and commercial production by European farmers, to farmers from the communal areas features prominently, through acquisition of these farms on a willing seller, willing buyer basis (Dewdney, 1996). However, progress on reform in the Communal lands themselves has been slow. A draft Communal Land Bill is at present being circulated which proposes that the allocation and management in communal area be vested in Regional Boards comprised of representatives of the Ministry of Lands Resettlement and Rehabilitation, local authorities and traditional leaders, community members and government extension workers (Sullivan, 1996a; Tjipueja, H. pers. comm.). In addition, the views of various stakeholders are being compiled to assist and inform decisions about what types of tenure should be extant in the communal areas.

5.2 Land Use

5.2.1 Commercial Farms

Under the two broad forms of tenure two different types of land use are practised: "commercial" farming and "communal" farming. Commercial farming is characterised by the production of crops and livestock for sale. Farms are
fenced and herd sizes restricted to ensure minimal disruption to production in years of drought. In addition, many farmers have started game farming and tourist lodges in recent years.

5.2.2 Communal Farms
Land use in communal areas is a result of a history of colonial rule. In pre-colonial times, settlement was confined to areas of reliable water, while transhumance was practised elsewhere. Traditionally, in the southern and central areas, people followed scarce water and grazing resources. In the north, communities were more settled, but at the end of the wet season, as accessible surface water and grass diminished, livestock were herded to more distant grazing areas (Ashley, 1994).

With the dispossession of land and the creation of native reserves, these traditional land use practises came under increasing pressure and changed. In the northern higher rainfall areas, mixed dryland farming on a subsistence level is the predominant system, whilst in the remainder of the communal areas grazing systems still predominate (Seely et al, 1995). In many areas, forms of migratory pastoralism are still practised, though much restricted compared to pre-colonial systems. Land enclosure, forced relocation under colonialism and the erection of fences since independence have reduced people's ability to respond flexibly to a semi-arid environment. These systems of subsistence agriculture are maintained by a variety of supplementary activities that supply other income (Rohde, 1994).

5.3 A Brief Discussion of Tenure Issues
In communal areas, even though people lack ownership rights over basic infrastructure (such as boreholes) and natural resources they are actively involved in day-to-day management and maintenance as well as with negotiations in relation to who has rights of use of these resources (Sullivan, 1996). Yet, at present, the lack of clear tenure arrangements is a 'disincentive to long-term planning and the sustainable use and management of resources' (Jones, 1993).

The Outline of a National Land Policy (1997) proposes several different forms of tenure arrangements. Freehold tenure is not deemed to be advisable in communal areas. Leasehold and customary grants are mentioned as two types of land rights. Long term leases would be issued for 30 to 50 years and would be secure, registrable, transferable, inheritable, renewable and mortgageable. For customary grants, a certificate of rights which is secure, inheritable and not limited in time would be introduced for customary uses. This would not be transferable without the permission of a Regional Land Board.

However, the question of community tenure has not been addressed. Fears have been expressed in government that if community tenure is allowed, people will exclude others from ownership on ethnic grounds (Shumba, pers. comm.). This need not happen.
Communal land tenure implies that there is a group of people who have defined guidelines for resource use, and members have security that they can gain access to future use of the resource and that there is an enforcement mechanism for deviant behaviour. Equally important for communal tenure to operate effectively, is the right of group members to exclude outsiders from the use of the resource (Jones, 1993). Thus communities need to be defined and this definition of a community should exclude ethnicity. The definition of community can however, be problematic and needs to be undertaken in conjunction with the affected people.

The lack of secure communal tenure is a major contributing factor to land degradation as people seek to maximise, individually, their own benefit. This is at the cost of the long term sustainability of resource use and leads to competition amongst users (Dewdney, 1996).

Although land tenure in communal areas is seen as ‘communal’, it is more in the way of being ‘open access’. Recent initiatives by the Ministry of Environment and Tourism will result in communities in communal areas being given rights to utilise and manage wildlife once they have formed a conservancy. This is step toward community ownership of natural resources. In order for natural resource management to be effective, however, the nature of tenure over natural resources has to be more holistic (Shumba, pers. comm.; Dewdney, 1996).

Whatever form of tenure is decided upon, questions of secure access and control over natural resources need to be clarified.
6. Relevant Institutional Structures and Policies

Namibia is dependent on its ecological production (NPC, 1995). With a rapidly growing population (3% p/a), it is important that the country safeguards its fragile ecology for the benefit of present and future generations.

This responsibility rests with government structures and institutions and takes shape and form through different policies and principles.

At independence, Namibia’s public administration was restructured, and a number of Government institutions were established for the functioning of the newly independent Namibia within the framework of the new Constitution. Simultaneously, new policies were formulated which were aimed at making a break with the pre-independence policies and meeting the challenges of Namibia (NPC, 1995).

In a study of this nature, it is thus necessary to examine the institutions, structures and policies in order to understand how they articulate their responsibilities and the consequences thereof.

Some of the key institutions and structures relevant to this study include the following:

- National Planning Commission (NPC)
- Department of Water Affairs (DWA)
- Ministry of Environment and Tourism (MET)
- Ministry of Lands, Resettlement and Rehabilitation (MLRR)
- Emergency Management Unit (EMU)
- Land Use and Environmental Board (LUEB)

This chapter comprises a description and brief discussion of each of these structures’ function and role. Relevant policies and principles are also outlined. This is important as these structures and their policies directly or indirectly influence the use and management of natural resources. As such they are inextricably linked and thus an important component of a study concerned with rural water supply.

6.1 Institutional Structures

6.1.1 National Planning Commission (NPC)

The National Planning Commission (NPC) in the office of the President was established with the mandate to “...plan the priorities and direction of national development...”. The Director General of the Commission is to advise the President on all matters pertaining to economic planning (NPC, 1995). The National Planning Secretariat which is attached to the Ministry of Finance has the responsibility to co-ordinate the National Development Plan, external aid, the Development Budget and for monitoring the progress of national policies,
programmes and projects. In essence, the NPC is the supreme body for decision making in terms of the overall co-ordination and appraisal of the activities of all the different line ministries; including appraisal of the environmental implications of development projects (Tjipueja, S., pers. comm.). Thus, the NPC has to ensure that different sectoral policies and programmes are implemented in accordance with national objectives.

The NPC currently has serious problems in fulfilling its mandate, due to factors such as high staff turnover, inappropriate appointments and lack of qualified staff (Confidential, pers. comm.). This has hampered the co-ordinating function of the NPC resulting in duplication of and contradictions in various sectoral policies.

6.1.2 Department of Water Affairs (DWA)

With the restructuring of governmental services after independence, it was recognised that there was a need to investigate the water and sanitation sector with the purpose of defining its future overall objectives and policies (DWA, 1993). This led to establishment of an inter-ministerial committee which ultimately formulated the Water and Sanitation Policy (WASP). WASP defines the scope of services expected to be rendered by different sectors, and provides long term principles and guidelines for provision of water supply in Namibia. The WASP was deliberated by Cabinet and finally adopted on 21st September 1993 (ibid.).

With the adoption of WASP, the DWA was restructured, and new institutions with different responsibilities were created. The restructured DWA is to concentrate on resource management and rural water supply, and the Directorate of Rural Water Supply (DRWS) has been given the responsibility for rural water supply. A commercially oriented corporation, Namibia Water Corporation Ltd. is to be established for provision of bulk water. A national Water Supply and Sanitation Committee (WASCO) was established for overall co-ordination of the water sector. Its other key functions are to identify major problems in the water and sanitation sector; establish priorities; propose actions and assign responsibilities and formulate a national policy (DWA, 1993). In order to give WASCO the requisite decision making powers and authority, the committee was established at a Permanent Secretary level (Koch, pers. comm.). (See figure 6.1 on proposed structure).
Figure 6.1: The restructured Department of Water Affairs (Adapted from DWA, 1993)

The following principles form the foundation of the WASP:

- Essential water supply and sanitation services should become available to all Namibians, and should be accessible at a cost which is affordable to the country as a whole.

- This equitable improvement should be achieved by the combined efforts of the government and the beneficiaries, based on community participation and the acceptance of a mutual responsibility.

- Communities should have the right, with due regard for environmental needs and the resources available, to determine which solutions and service levels are acceptable to them. Beneficiaries should contribute towards the cost of the services at increasing rates for standards of living exceeding the levels required for providing the basic services.
• An environmentally sustainable development and utilisation of the water resources of the country should be pursued in addressing the various needs (DWA, 1993).

6.1.3 Ministry of Environment and Tourism (MET)

Environmental co-ordination is the responsibility of the Directorate of Environmental Affairs (DEA) in the Ministry of Environment and Tourism (MET). The fragility of Namibia’s natural ecology and dependence of Namibia on its ecological production is fully recognised by the DEA (Tarr, pers. comm.). This awareness is clearly reflected in the Mission Statement of the DEA:

“To maintain and rehabilitate essential ecological processes and life-support systems, to conserve biological diversity and to ensure that the utilisation of natural resources is sustainable for the benefit of all Namibians, both present and future, as well as for the international community” (MET, 1994).

Based on this commitment, the DEA has formulated an Environmental Assessment Policy which was approved by Cabinet in 1994. The policy aims to promote sustainable development and economic growth while protecting the environment in the long term. It seeks further to ensure that environmental consequences of development projects and policies are considered, understood and incorporated in the planning process (DEA, 1995).

Recognising that previous conservation attempts have had limited success because they did not address the needs of the human and social dimensions of natural resource management, the DEA is promoting the concept of Community Based Natural resource Management (CBNRM) (Jones, 1996). The new approach puts more emphasis on sustainable utilisation of resources such as wildlife and the involvement of local people and other stakeholders directly in conservation and decision making. The CBNRM programme is also aimed at providing incentives to rural people to sustainably manage the natural resources (ibid.). Presently, community management of resources is limited to that which falls within the mandate of the DEA - that is, the right to manage and use wildlife sustainably. It is envisaged that rights over other resources could be devolved by other line ministries to communities to widen the scope of CBNRM (ibid.).

The Directorate of Environmental Affairs has taken measures to create an enabling policy and legislative framework to support the communities. In March 1995, Cabinet approved a policy which provides for people in communal areas to gain rights over wildlife and tourism through forming conservancies, and in June 1996 Parliament passed legislation which put this policy into effect (ibid.). (See Appendix 3)
The DEA has therefore been pivotal in empowering local communities by providing institutional support through relevant organisations, building awareness concerning environmental issues and offering technical advice through governmental and non-governmental organisations (ibid.).

**6.1.4 Ministry of Lands, Resettlement and Rehabilitation (MLRR)**

The Ministry of Lands, Resettlement and Rehabilitation (MLRR) was established soon after independence with the mandate to initiate, facilitate and co-ordinate the land reform process in Namibia, including the development of sustainable resettlement programmes. As the custodian of all land held under communal land tenure and unproclaimed Government land in the rural areas, the MLRR has to co-ordinate its activities with other government institutions, NGOs and local communities. This co-ordination is done through the Inter-Ministerial Standing Committee for Land Use planning (IMSCCLUP) established by the Ministry (Shumba, pers. comm.).

Since most of the land administered by MLRR is communal land (41% of the country), the policy on communal land is of crucial importance to management of natural resources such as water, wildlife and others. The absence of a clear policy framework to address the tenure situation in Namibia has made it difficult for Government and those working with them to devise a clear strategy for these areas (Corbett and Daniels, 1996). It was only in May 1996 that a draft Outline of a National Land Policy was released as a Green Paper for wider consultation (Tjipueja, H., pers. comm.).

While the draft policy vests authority over communal land in Regional Land Boards on behalf of the inhabitants of the communal areas, and proposes various tenure arrangements, ownership of such land still remains State property (Sections 63 and 78-83). This reluctance by Government to give secure tenure to local communities, despite strong views for it from different sectors of the Namibian society still remains an outstanding issue. Although the Policy does not appear to exclude group or community tenure, it does not explicitly provide for it. Within the MLRR, there are still strong feelings from some of the senior decision makers that all natural resources should remain as State property. Exclusive tenure to local communities is seen as socially and politically undesirable because it would strengthen ethnic differences and promote ethnic conflict (Tjipueja, H. and Shumba, pers. comm.).

**6.1.5 Land Use and Environmental Board (LUEB)**

For a long time, Namibia has been characterised by sectoral planning in the rural areas leading to a lot of duplication and the dissemination of conflicting messages to rural communities. This has in turn led to unsustainable resource exploitation patterns. Efforts are therefore underway to establish an independent body which will provide a platform for integrated land use planning, and to act as an advisory body to the NPC and Cabinet. The
proposed Land Use and Environmental Board (LU EB) would be a multi-sectoral forum that would ensure such integration (Shumba, pers. comm.).

The LUEB will be a statutory institution providing an umbrella framework for all sectoral policies, plans and programmes on natural resource management and all land based development. Giving the LUEB statutory authority implies that its decisions will have more weight. All relevant ministries, parastatals, local government, the private sector, NGOs and local communities would have representation on the LUEB which will be chaired by the NPC, and will report to the President. The advantage of the NPC chairing the LUEB is that it is non sectoral, it has a broader view of developmental issues in the country, and co-ordinates the budget (Shumba, pers. comm.).

The LUEB will have two sub-committees for land use planning, one rural and one urban, which together with the Environmental Commissioner form a joint Secretariat. The two committees will appraise all development work for social and environmental soundness, and will advise the respective sectors accordingly. Because there will be a high degree of co-operation between the IMSCLUP rural and the IMSCLUP urban, through the joint Secretariat, it is envisaged that there will be an opportunity for co-ordination. The LUEB will also have some representation at the regional level, although this would have to be co-ordinated with other structures that are already in place or are to be established such as the Regional Land Boards (MLRR, 1996).

The LUEB would consist of twenty-two (22) members who would be appointed by the President. The following ministries and organisations would be represented: Ministry of Lands; Rehabilitation and Resettlement; Ministry of Regional, Local Government and Housing; Ministry of Environment and Tourism; Ministry of Agriculture, Water Affairs and Rural Development; Ministry of Works and Transport and Communications; Ministry of Fisheries and Marine resources; Ministry of Mines and Energy; Ministry of Trade and Industry; Ministry of Finance; National Planning Commission; a member of the association of local authorities; a member of the association of regional authorities; two members nominated by an association representative of NGOs; and a member nominated by the National Development Corporation; two members whom in the opinion of the President are by virtue of their knowledge and active involvement in land planning and environmental issues fit to serve on the Board, and a member nominated by the Council of Traditional Leaders (ibid.).

The LUEB was approved by Cabinet in October 1995, and several drafts of the legislation have already been prepared for discussion. However, correspondence within the MLRR and with other ministries such as DEA shows that NPC has not been very keen in participating in LUEB. This can partly be explained by their lack of capacity to run such an institution (Confidential Memorandum, 1996). As a result there has been some delay in LUEB taking off the ground (Shumba, pers. comm.).
6.1.6 Emergency Management Unit

After the 1992/93 drought experience, the Emergency Management Unit (EMU) was established to co-ordinate emergency management such as drought. The EMU committee is composed of all senior officers from relevant ministries, UN agencies and national NGOs dealing with emergency operations such as food distribution, transport, labour and others. The EMU is directly responsible to the President and/or the Prime Minister. Thus, the EMU is a conversion of the former National Drought Task Force (NDTF) with representation from all the relevant government and non-governmental organisations. The EMU has representation at the regional and constituency levels. In addition, Emergency Operational Units are being created at all levels in the various governmental agencies, regional offices, constituencies and villages. These will be given specialised training in various aspects of managing emergencies, and will be activated whenever there is an emergency (Dumeni, and Giorgis, 1995).

In fulfilling its mandate of co-ordination, the EMU will be involved in three specific areas: training; operations and logistics; resource mobilisation (national and international), information and administration.

6.1.7 Other Main Actors

Other main actors in the water sector include the Ministry of Regional and Local Government and Housing, The Department of Works in the Ministry of Works, and Communications, Ministry of Health and Social Services, Regional and Local authorities, Ministry of Basic Education and Culture, Non-governmental Organisations (local and international) and Donors.

6.2 Water Policy

The Government of Namibia recognises that water is a basic human need, and therefore is committed to providing safe water for the whole population. However, the increasing pressure to extend water to the rural areas, while also meeting the increasing urban demands in a way that is sustainable in the long term presents a continuous challenge for Government (NPC, 1995).

To meet this challenge, the rural water supply policy was therefore formulated within the framework of the WASP, based on the following principles:

- An agreement between the community and the authorities setting out the respective responsibilities and commitments should be a prerequisite for government support.
- Payment by the community should, as a general rule, cover operation and maintenance costs although there may be cases where a subsidy may apply.
- Because of the great variation in conditions in general throughout Namibia, a system should be worked out whereby the ability of each
community to pay for services rendered can be evaluated, and the need
for subsidisation quantified.

- Government support should be reconsidered if stipulated conditions of
  agreement are not complied with (DWA, 1993).

The general objective of this policy is to accomplish user ownership and
responsibility for operation and maintenance by the local communities. The
Policy is accompanied by Strategy papers which were developed and
approved for implementation in 1994. These Strategy papers form a basis
from which policy objectives can be achieved by DRWS, and community
participation could be initiated. These are being implemented on a trial basis
and are to be reviewed every two years (DWA, 1993). The Strategy papers
have been distributed for wide circulation in order to give an opportunity for
feedback from interested parties, and are being amended where necessary.

6.2.1 Status of the Water Policy

The implementation of WASP will be in different phases. Currently, the
DRWS is undertaking measures to facilitate community ownership and
management of the water points as a priority. To achieve this, elected water
committees are being established countrywide to take overall responsibility
for their water points (Koch, pers. comm.). The water committees will operate at
different levels. The central water committees will be responsible for co-
ordinating activities in each region; the local water committees will be in
charge for a number of individual water points, and water point committees for
individual water points.

Members of a water point committee are elected by the community that uses
a particular water point. Water point committees are also to operate and
maintain their water point and collect contributions from the users. Currently,
the emphasis of DRWS is on the establishment of water point committees,
while central water committees and local water committees have not yet been
established in some regions. In Khorixas for example, there is a central water
committee which was established during the 1992/93 drought, and a new
committee will be elected (Samupofu, pers. comm.).

The DRWS recognises that human resource development is a cornerstone to
sustainable community based rural water supply. To attain this goal, there is
an ongoing training programme for water point committees, with emphasis on
community based operation and maintenance of water points and community
based financial management. The DRWS takes cognisance of the fact that
the Rural Water Extension Officers (RWEO) should have the necessary skills
to be able to advise the communities (DWA, 1993 and Koch, pers. comm.). A
training programme for Rural Water Extension Officers has already started in
some regions such as Khorixas.

In order to ensure financial sustainability, the DRWS is introducing a cost
recovery policy for the water points. In the next five years, the communities
will be paying for operation and maintenance of their boreholes. Thereafter,
they should take up the capital cost in the next fifteen years. This policy is to
be implemented from 1st April 1997 (Koch, pers. comm.). It is envisaged that in the long term, the DRWS should play the role of a facilitator rather than a provider of water supply, while day to day maintenance and operation of water points is the responsibility of the communities themselves (DWA, 1993). To date, rural water supply is still the full responsibility of the DRWS, and is largely subsidised.

6.3 Water Act

The Water Act No. 54 1956, which is administered by the Department of Water Affairs is the principal legislative tool for water management in Namibia. The Act covers a wide range of issues relating to the protection of surface and subsurface waters from pollution and misappropriation (Jacobson et al., 1995). These include protection of river catchments, controls of effluent discharge into rivers and the control of aquatic alien plants. Regulations which govern optimal use of water resources are also outlined.

The Act (Water Act) strictly regulates the drilling of boreholes. It states that any person drilling a borehole must notify the Department of Water Affairs. Moreover, a journal must be kept with the details regarding the date of drilling, final depth, geology, water strikes, pump test data and any other information about the borehole. Any contractor hired by a private landowner or government must submit the journal upon completion of drilling work. The penalty for failure to submit the journal is a fine of only $1500 or three months imprisonment (ibid.).

Provision is also made in the Act for the State to ensure equitable distribution of water by requiring the measurement and regulation of the water abstracted from boreholes. If necessary, it may require the boreholes to be sealed. Although no specific recognition is given to the protection of the environment's water needs, the State may "limit or prohibit the abstraction and use of subterranean water for any purpose..." (Mphil. Environmental and Geographical Science, 1996).

The drafting of the new Water Bill is underway to replace the 1956 Water Act. It is envisaged that the new Bill will take cognisance of the principles of WASP, and thus provide a broad framework for sustainable management of water resources in Namibia.
7. Theoretical Overview of Arid Environments

Namibia as a semi-arid and arid environment is characterised by climatic variability through both time and space. Rainfall levels are low and highly variable and aridity, as distinct from drought\(^1\), is a permanent feature of the climate (Drought Task Force, 1996). The environment determines and contributes to the development of a range of traditional agricultural, pastoral and other economic practices as well as to social structures and dynamics in Namibia (Rohde, 1994).

The marginal habitat associated with the arid landscape calls for a tremendous amount of flexibility and resourcefulness to survive economically (ibid.). Throughout Namibia, water is the ultimate constraint to land use and economic growth. Water availability in particular regulates the way people and their livestock, as well as wildlife, live, move and settle in an arid country (Jacobson et al., 1995).

This section provides a theoretical insight on the ecology and land use of communal areas in an arid environment. Survival or coping mechanisms in such a variable climatic environment are described. The section also elaborates on the biophysical, social and economic implications of providing a permanent point source of water in an arid environment. In addition, the importance of the provision of a safe, clean water supply is discussed.

The theoretical concepts in this section provide an understanding of the findings of the case studies, contributing to useful and relevant interpretation of results.

7.1 Ecology and Land use

A wealth of literature pertaining to arid land ecology indicates that the productivity of a dryland ecosystem is better described by its variability through time and space, than by its average values (Westoby et al., 1993; Sullivan, 1996). Thus, the production potential of both grassland and livestock in arid lands is dominated by rainfall. One of the key technical elements of indigenous range management and water use in arid lands is the principle of mobility or transhumance. Livestock is moved in accordance with the unpredictable nature of rainfall and ecology, as well as the unpredictable nature of water points. This trend implies that livestock population is kept low through the impact of drought or other episodic events (Scoones, 1995a).

This is in contrast to theories of equilibrium systems where vegetation changes are perceived to be gradual and livestock populations are limited by available forage in a density dependent manner in the sense that excessive animal numbers cause negative effects (Scoones, 1995a). In equilibrium systems, stock numbers (carrying capacity) can be determined and maintained from year

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\(^1\) Drought is a relative phenomenon, variably defined, but commonly a period of exceptionally low rainfall and differs from aridity in that it can occur in any climatic zone.
to year. Whereas in arid and semi-arid areas, where primary productivity is largely determined by extremely variable stochastic rainfall events, there is little opportunity for the population to reach a ceiling of ecological carrying capacity (Scoones, 1995b). While signs of equilibrium grassland degradation are frequently seen in arid and semi-arid rangelands, they do not always indicate degradation and may in fact reflect the naturally low rainfall. Such arid and semi-arid systems are termed non-equilibrium systems.

These non-equilibrium systems have important implications for farming and rangeland management. Farming practices are required that place emphasis on flexible responses to uncertain events, and on mobility to allow the optimal use of a heterogeneous environment (Scoones, 1995a). Management systems have to cope with large quantitative fluctuations in resource availability. A variety of coping mechanisms have evolved that enable people to track these fluctuations (Scoones, 1995b):

- increasing the amount of locally available fodder,
- reducing the amount of feed that animals need,
- moving animals to areas of available fodder and
- destocking and restocking in response to drought cycles.

Because climate is so variable, adhering to a single conservative stocking rate is rarely applicable from year to year. The objective of effective arid rangeland management is to 'seize opportunities and evade hazards' (Westoby et al., 1989). This implies that rangeland management practices in arid lands should accommodate and adapt to variable abiotic parameters.

However, dominant thinking about arid and semi-arid systems remains largely focused on exactly the opposite:

- on the means of imposing stability by reducing rather than 'tracking' variation in productivity;
- on proclaiming situations of irreversible vegetation degradation whenever successive dry years eliminate herbaceous cover and leave large tracts of bare ground;
- on declaring as irrational and destructive locally evolved resource management strategies designed to capitalise on good years in order to survive drought years;
- on introducing livestock quotas and off-take levels based on concepts of constant carrying capacity (Sullivan, 1996b).

This has resulted in numerous policies that have constrained peoples ability to cope with aridity. In addition, various other factors such as shortages of skilled labour, changing ownership patterns, absentee owners, lack of secure tenure and population increases are also reducing the chances of successful tracking of environmental variability (Jacobson et al., 1995). These changes may contribute to the process of environmental degradation.
7.2 Local Economic and Social Perspectives in Communal Areas

7.2.1 Local Economy
As previously mentioned, water is the ultimate constraint to livelihood and economic growth throughout Namibia. Before the colonial era, people in Namibia tended to move and settle in response to changes in availability of water, food and grazing that typify a highly variable environment (Jacobson et al., 1995). ‘The vagaries of nature cause disaster to the poor people leading to frequent insecurity. This contributes to increasing pressure on the land and perceived shortage of alternatives to subsistence agriculture in many rural areas. Poverty causes people to be vulnerable to conditions of water or grazing shortages while the rich are affected by variation in their income’ (Giorgis, 1993: 288).

Risk minimisation has been cited as the overriding concern for most farmers in the communal areas where reciprocity and risk spreading strategy is reflected in the way people live (Rohde, 1994). Risk spreading as a survival strategy takes place through extended family and exchange relations. Survival strategies used by people living in communal areas are complex (ibid.). “Flexibility, resilience, mobility, adaptation and mutual accommodation ...” describe the means “... with which communal farmers are able to overcome some of the major hazards which affect farming in a productively marginal environment in an unpredictable climate” (Rohde, 1994: 1).

These survival strategies have led to evolution and operation of different security or support systems both formal and informal (Rohde, 1994; Devereaux and Tapscott, 1995).

7.2.2 Formal and Informal and Support Systems
Formal social security systems include food aid supplied as drought relief and pensions. Pensions, which are paid in monthly sums of N$135, contribute significantly to the cash incomes of many poor households, and provide a ‘safety net’ (Devereaux and Tapscott 1993).

‘Informal social security systems’, including food sharing arrangements, labour exchanges, gifts, and zero-interest loans, are well developed in rural Namibia (ibid.). Although sometimes reciprocated as a two way flow, a more common pattern is where one family member secures a job and diverts some income towards supporting poorer relatives with donations or ‘soft loans’ of food, cash or assets. Many poor households in communal areas are sustained by their better-off relatives, in good years as well as bad, through these ‘informal transfers’ (ibid.).

A ‘moral economy’ also operates in communal areas (ibid.). Neighbours and kin share and assist one another with food or cash from sale of livestock,
when necessary, such as when school fees need to be paid. Thus inputs
from people elsewhere provide another element of income among rural
communities, rather than dependence on agricultural performance alone.
 Marketable surpluses and cash crops do not appear to play an important role
(See Table 7-1).

These socio-economic factors need to be acknowledged in addressing issues
in communal area. "Policy and programme designers should recognise that
they face neither ignorance nor anarchy in communal areas..."(Fuller and
Turner, 1996). This applies equally well to water point planning, access and
range management.

7.2.3 Settlements: Patterns and Mobility

Historical evidence has been found of people centred around natural surface
water, for example at Brandberg and Twyelfontein (Jacobson et al., 1995). If
the water dried up, the site was no longer used. This includes dry boreholes
found on abandoned farm posts throughout the western catchments.

Accessible surface water or shallow groundwater has played an important
factor in determining where people settled. At sites with reliable springs, such
as Sesfontein, or along river courses with shallow groundwater tables,
permanent settlements have developed. Recently, demand for water
supplies has increased as a result of population increases and development
in some areas (Jacobson et al., 1995).

7.3 Providing a Point Source of Water in an Arid
Environment

The communal areas in Namibia present a unique environment. These
areas, which are mostly arid, are not only unique with respect to climate,
geomorphology, ecology and hydrology but with respect to the type of land
use practices employed. Though the immediate benefits can not be
overemphasized, placing a fixed water point in such an environment
undoubtedly has many consequences for all these features of the
environment and the people who rely on it.

7.3.1 Ecological and Land Use Perspectives

Provision of water in an arid environment is one of the major factors which
can enhance promotion of various interrelated factors such as
sedentarisation, overstocking and loss of seasonal grazing. These are factors
which lower the resilience of the environment to drought leading to
desertification (see Appendix 4 for a broad discussion of desertification). By
providing a non-natural point water source, more people and livestock can live
in an area, but at the expense of negative impact on the environment (Brown,
1993).
In areas where annual rainfall dictated the manner in which arid and semi-arid grasslands were used prior to provision of boreholes, wild animals and domestic stock were forced to move when surface water was no longer available. This resulted in a natural nomadism, dependent on rainfall. However, the provision of potable water allows continued occupation and use of areas where water is normally limited. This has uncoupled the link between water for drinking and water for plant growth (Jacobson et al., 1995). This can have both positive and negative impacts on rangeland management.

On the positive side, access to areas that were previously minimally used due to the distance from natural water points is made more accessible. This encourages the movement of animals from areas of low or no grass cover (which is allowed to rest) (Jacobson et al., 1995). The provision of water points in this case allows for increased flexibility in rangeland management.

The impacts of these artificial water points are often negative, however. The provision of water in arid areas allows livestock numbers to increase resulting in additional pressure on pastures. This often results in the concentration of livestock and settlement in particular locations and has numerous impacts. The most important of these being the increase in the potential for degradation of rangeland (figure 7.1).

Too many livestock in one place for too long a period, reduces the vegetation cover. Perennial grasses may be replaced by annual grasses. While perennial grasses respond to small amounts of rainfall, annual grasses require a certain minimum before they germinate. Thus in some years, in parts of Namibia no germination may take place and if perennial grasses have been eliminated, no green grass will be available for livestock. The prolonged presence of grazing animals means that the more nutritious perennial plants, especially grass, may be trampled and new growth, from small amounts of rain, may be eaten before it can become established (Seely et al., 1995).

Loss of vegetation cover leads to soil loss or degradation through processes such as trampling. Trampling hand renders soils more susceptible to wind and water erosion and to desiccation and oxidation. Moreover, persistent overtrampling and wind erosion will lead to the reduction and ultimate eradication of the seed bank that sustains the grasses (Seely et al., 1994).
Figure 7.1: Cycle of Rangeland Degradation (adapted from Ashley, 1994).

Most of the human activities exacerbating the effects of drought operate by disturbing the water-soil-vegetation relationship rather than affecting availability of drinking water. Provision of drinking water during times of low rainfall, particularly to livestock, is a major factor enhancing the susceptibility of people and their livestock to future droughts (Seely, et al., 1994).

People and livestock often settle permanently at water points regardless of current rains (sedentarisation) (Jacobson et al., 1995). Farmers no longer respond flexibly to uncertain events and do not follow the natural seasonal variations in pasture and water availability. Thus land is not given a chance to recover from heavy grazing (Seely et al., 1994). As accessible grazing areas become crowded or degraded, marginal or seasonal grazing areas are opened up to year round grazing which further leads to degradation. Chances for opportunistic management are reduced as former seasonal grazing areas are no longer available.

The provision of water points in an arid environment during drought can, therefore, enhance susceptibility to future droughts, with stock maintained on land which should be rested to avoid degradation, and land users developing an expectation of the arid land which exceeds the realities of its naturally low and highly variable productivity.
7.3.2 Socio-economic Perspectives

The installation of poorly planned water points in arid landscapes in response to periodic droughts 'without proper consideration of their spacing, the capacity of surrounding land, and the changing patterns of grazing demand' (Quan et al., 1994: 6) has a number of negative socio-economic implications.

Permanent water points, particularly in marginal lands, generally lead to increased and sedentary settlement with attendant increasing human and livestock populations. This may lead to competition and conflicts over resources, particularly where control over access to resources is weak or absent. Communal areas generally depend on subsistence farming thus, pasture degradation surrounding borehole settlements would result in livelihood and subsistence losses to the communities. This would place increased pressure on other sectors and on working relatives (Quan et al., 1994).

Possible increased urban migration would result in a further absence of able-bodied adults, particularly men, which would lead to a further decline in agricultural labour and affect management decisions, thus further undermining farm production and negatively affecting livelihoods and subsistence.

7.4 Health Perspectives

Notwithstanding the above, access to clean water is undoubtedly one of the most basic human needs. As a basic necessity to life its value is clear, however, less obvious is the extent to which a clean and adequate water supply can benefit human health.

7.4.1 The benefits of safe water provision

The importance of a healthy water supply to public health perhaps first became apparent to modern medicine due to pioneering work by John Snow, in 1855. This work gave rise to the understanding that health and water supply are intimately related and also created an awareness of the links between health and the environment. The correlation between a good clean water supply and public health is now widely known. It has often been stated that the outstanding improvement in health in the late nineteenth and early twentieth century in Europe and North America, as reflected by health indicators and mortality data, is attributable more to improvements in water supply and nutrition than to advances in medical science (Hardoy et al., 1990).

The health status of countries as reflected by standard indicators such as the infant mortality rate (IMR) often correlates strongly with the accessibility of water and level of female education (Holland et al., 1991). A good example of this is Burkina Faso which in 1984 had an IMR of more than 200 per
thousand at a time when only 31% of the country had access to clean water. The IMR in Namibia is approximately 67/1000 on average (see fig 3.4) (Central Statistics Office, 1994) and it was estimated in 1990 that only 50% of the estimated rural population had proper access to a reliable source of safe water supply (NPC, 1995). The IMR in Europe is approximately 13/1000 (Holland et al., 1991) which is an indicator of its development and useful comparison.

There are obviously a number of associated factors in a country with poor water supply to the public which will strengthen this correlation. However it is well recognised by development agencies and the World Health Organisation (WHO) that a basic and most effective way of improving health in developing countries is to secure a safe and adequate water supply. This was specifically stated by the International Conference on primary health care in Alma Alta in Russia in 1978. The Alma Alta declaration states (section VII, no. 3) that government has a responsibility to provide adequate primary health care for all, which includes "an adequate supply of safe water and sanitation." WHO has been actively promoting the Alma Alta declaration as fundamental to policy on primary health care development and health.

Therefore providing a access to a safe and adequate clean water supply in a rural community will have significant positive effects on the health of that community and water supply is therefore a development priority.

7.4.2 Water related diseases

To broaden this picture of the benefits of clean water it is necessary to review water related diseases.

Water related diseases are commonly classified as:

- Infectious waterborne diseases
- Water washed diseases
- Water based diseases
- Water related insect vector diseases

**Infectious waterborne diseases** are those diseases transmitted when a pathogen found in water is ingested. These will include the common diarrhoeal diseases, the enteric fevers and gastro-enteritides. In developing countries waterborne diarrhoeal diseases affect children in particular and account for up to 30% of fatalities in the under five age group with one child dying from diarrhoeal disease every twenty seconds world-wide (Hardoy et al., 1990). Morbidity and mortality from diarrhoeal disease are greatly increased where malnutrition is a problem.

**Water washed diseases** also primarily affect children. These are those diseases which could be decreased if there was more water available for personal hygiene and sanitation. They include skin infections and eye infections.
Water based diseases are those where the infectious agent requires aquatic organisms as hosts for at least one stage of its life cycle. The prime example of this is schistosomiasis (bilharziasis).

Water related insect vector diseases, like malaria, are diseases where the vector (animal carrier) of the disease (e.g., the mosquito in the case of malaria) requires an aquatic or wet environment for part of its lifecycle.

A profile of water-related disease in the world is presented in Appendix 5.

7.4.3 Providing a safe and adequate supply of water
Providing a supply of water can have significant health benefits in reducing disease and promoting health. This is provided that certain criteria are met in the quantity, quality and manner of provision. Failure to meet these criteria may create new health impacts or hazards.

These criteria would include, inter alia:

1. **Quantity**
   WHO recommends at least 50 litres of water per person per day. (Hammond and Gear, 1984)

2. **Quality**
   Water must be of adequate quality with respect to chemical content, microbial content and pollution. There are very comprehensive guidelines for acceptable levels of elements, salts, pesticides and bacteria.

3. **Standard of Equipment/ Infrastructure/ Storage facilities**
   It is important that to supply water to the end user the equipment and infrastructure must be of a reasonable standard and appropriate. In the case of boreholes this would refer to infrastructure such as the reservoir or tank. Providing uncovered reservoirs, for example, could allow contamination of water and a breeding area for malaria-carrying mosquitoes. The separation of water used by animals and that used by people would also be important to prevent contamination of water intended for human consumption.

It is clear that many environmental variables can contribute to the benefits and also possible risks of providing water. This will now be examined more carefully within the context of Namibian communal areas.

7.4.4 Potential positive and negative health effects of providing a safe and adequate supply of water
The provision of clean safe water in a rural community in Namibia is likely to have a range of effects. These could be classed as primary, secondary and cumulative effects. Besides the immediate health gains of providing safe
water there are likely to be secondary social and economic benefits which may contribute to the health benefits. It is also possible that negative environmental impacts of water provision may, in this particular environment, cause negative impacts on health (see table 7.1).

However, in the socio-economic setting and fragile ecology of the arid environments found in the communal areas in Namibia it is possible that the positive picture as presented above could be confounded by environmental limitations discussed in the previous sections on ecological perspectives and socio-economic perspectives. Decreased productivity of the land may be initiated with serious long term effects and possible negative impacts on quality of life, standard of living and health.

The fact that providing a new water supply in an arid environment is beneficial as regards health must, therefore, be viewed in a holistic framework of the social, economic and ecological environment. Providing a safe water supply has many health advantages but many other aspects and effects that arise out of water provision need consideration so that the health benefits may be maximised and any potential negative effects minimised. This is particularly true in a rural environment where people are dependent on the environment and its ecological integrity to maintain their quality of life and health.

Water supply therefore needs to be planned and managed in such a way as to directly promote health as well as to indirectly promote health by maintaining the integrity and productivity of the environment.

These issues relating to water provision and its positive and negative health impacts will be elaborated and illustrated in the two case studies of emergency borehole provision in the Gam and Khorixas areas.
| Primary Health Benefits | Improved hygiene and sanitation leading to a decrease in water washed diseases.  
Safe water leading to a decrease in morbidity and mortality from waterborne diseases. |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Primary Effects and Opportunities | Possibility of maintaining crops or a productive garden for commercial and/or subsistence benefit.  
Possibility of increasing livestock numbers. |
| Consequent Secondary Health Benefits | Better nutrition due to better food supply in terms of quantity, reliability and variety. |
| Secondary Effects | Increased income and financial independence leading to improved standard of living. |
| Tertiary and Cumulative Benefits | Socio-economic upliftment. Means to access education. Food security. Financial and social security. All these have a significant positive impact on community health status. |
8. Drought and the Drought Relief Programme 1992/93

The 1992/93 drought occurred shortly after Namibian Independence and the nation-wide drought relief operation that ensued was the first of its kind in the history of the country (Dumeni and Giorgis, 1995).

Pre-independence administrations comprised a fragmented structure with different tribal authorities delivering different services and programmes. Commercial farmers were assisted in times of drought by established agricultural credit institutions and by the Administration for Whites through subsidy programmes for licks and fodder. Other administrations were not empowered to implement any meaningful form of drought relief such as food distribution, emergency water supply or livestock, and the burden of drought relief in rural areas was primarily born by local NGOs and churches who were sometimes assisted by international NGOs and UN agencies.

Thus, other than the subsidies provided to commercial farmers, not enough was done by pre-independence administrations or political structures to detect, prepare for, mitigate or respond to the effects of drought.

At the onset of the 1992/93 drought, the new government had just inherited the legacy of apartheid and colonialism, namely a large rural population living in marginal communal lands in varying degrees of poverty and vulnerability brought about by a pre-independence policies that resulted in neglect, oppression and inequality.

At the time of the drought, therefore, the new freely-elected Namibian government had no institutional capacity for dealing with drought (or other emergencies), especially in the communal areas where farmers were already under pressure due to deficiencies in the rural water supply system. Neither had the government had the time to build experience in dealing with the social, economic or institutional problems and complexities inherited from the past (Dumeni and Giorgis, 1995).

8.1 Drought

8.1.1 Definition of Drought

Drought is not an absolute concept but is relative to the context of the climatological patterns of the country. Drought has always been part of the history of Namibia. In 1923 a Commission was assembled to investigate drought in Namibia. One of the findings of this Commission was that drought occurs naturally and frequently and as many as 21 drought years were identified in the 44 years between 1879 and 1922 (Jacobson et al., 1995). Almost every second year in this period was classed as a drought year.
It does indeed seem necessary to decide on an appropriate definition of drought in an arid land. The problem occurs when defining whether low rainfall is a drought and whether it is just a dry period within normal variation. It is not logical to class every other year as a drought as has happened in the past. However, it is necessary to be able to recognise the years that do represent a problem and where government or outside assistance may be required.

It is useful to classify drought into three types (Olszewski and Moorsam, 1995):
- Meteorological Drought
- Agricultural Drought
- Hydrological Drought

The following definitions are based on Olszewski and Moorsam (1995) and Drought Task Force (1996):

8.1.1.1 Meteorological Drought
This is a statistical convention which indicates a degree of low rainfall. It may be arbitrarily decided, for example, that mean rainfall below 85% of expected is drought.

More commonly drought is defined relative to the norm. Measures of normal, however, can be a problematic concept in an arid country. Most of Namibia has an arid climate which is characterised by patchy and highly variable rainfall. The variability implies that there are a few years with exceptionally high rainfall which has the effect of raising the mean rainfall. Because of this effect it has been argued that the median rainfall is a better measure of normal, as half the years will have rain above the median and half below, whereas, because of the few very high rainfall years, many more than half the years will fall below the mean. A period of drought, therefore, could be defined as two or more years below the median (Seely, 1991).

A drought year may also be described relative to long term rainfall patterns. For example, a year that is in the lowest 5% of years for rainfall could be called a 1 in 20 drought and in the lowest 10%, a 1 in 10 drought. This is a useful way of presenting the degree of low rainfall and extent of possible drought related problems. It may work as a less arbitrary definition of drought as it describes the degrees of the phenomenon in context, without having to draw a definite line between drought and non-drought.

However, any meteorological definition is merely a comment on the rainfall statistics which do not take into account the actual effects and impacts of the low rainfall in the context of the ecology and community.

8.1.1.2 Agricultural Drought
This is a deficiency of rain which critically affects the normal functions and production of the agricultural year. It describes the situation more accurately than rainfall statistics and averages as it reflects nuances in rainfall such as
its timing and intensity. Drought can be defined then in terms of deviation from normal crop yield or biomass production for a specific area. In an arid climate with patchy rainfall this can be a useful definition as it is region specific and will help promote the understanding of region specific drought rather than the phenomenon of national drought which is rarer.

8.1.1.3 Hydrological Drought

Hydrological drought is also a measure of the effect of low rainfall. Although hydrology refers to the whole water cycle, the term hydrological drought usually refers to the inability of the rains to re-charge groundwater reserves.

Several factors beyond mere low rainfall will play a role in limiting the ability of rains to recharge aquifers. Among these will be natural phenomenon as well as human factors. For example, excessive groundwater extraction above the mean rate of recharge may have the effect of lowering water tables and decreasing the ability of even good rains to recharge aquifers. Boreholes and dams in the headwaters of a river may decrease the ability of run-off to recharge surface aquifers. Lastly, environmental degradation may also affect factors such as vegetation cover, evapotranspiration, soil penetration and run-off resulting in decreased ability of rain to recharge aquifers.

8.1.2 Drought Relief in Arid Lands

From the foregoing discussion it becomes increasingly clear that the definition of drought, and consequently drought relief, in arid lands may be approached and defined from different and possibly conflicting points of view. For example, in the context of this study, one of the possible consequences of sinking a borehole, in response to needs arising out of meteorological and agricultural drought, is that it may in fact contribute to increasing hydrological drought either directly by abstraction or indirectly through associated land-use practices.

The immediate and obvious response to drought, would on first consideration, be to provide water. It is pertinent to note, however, that one of the observations of the Drought Commission in 1923 was that 'it was not from want of water that stock died during the droughts, but from want of veld' (Jacobson et al, 1995). Shortage of rain can manifest itself in a variety of ways depending on many factors in the specific environment concerned. In these arid environments with fragile and non-equilibrium ecologies, in a social and economic environment dependent on the land and with specific land use practices there are indeed several factors which contribute to the experience of drought. Response to drought then has to be appropriate for these unique arid lands and appropriate to the specific experience of drought.

In conclusion then, drought relief in the unique situations found in rural Namibia may include the provision of water but this will need to be done judiciously and be part of an overall drought management plan suitable for the specific area.
8.1.3 Proclamation of Drought

The proclamation of drought in Namibia, notwithstanding the above discussion, is a political decision. In Namibia it is the State President who declares drought, as happened in 1992/3 and again in 1996. The President's decision is presumably informed by scientific advice concerning rainfall and food shortages. However, being a political decision there are always the political and financial factors which contribute to his advisors' perspective on the situation.

In 1992/93 the President declared a national drought which initiated several processes under the banner of drought relief. It attracted millions of Namibian dollars worth of foreign aid from government agencies and NGOs. This aid was provided in the form of financial assistance, material and food aid and personnel resources. The drought relief programme provided aid to rural communities in the form of food aid and water provided by tankers, new pipelines, new borehole construction and provision and borehole rehabilitation (NDTF, 1993). It did, in many ways, provide impetus and a flood of foreign funding to the rural water supply development programme.

Besides the gains to people in a time of need, obvious political gains are implicit in such activities. In addition there are economic benefits in boosting local economies through foreign funded programmes which contribute to GNP and economic growth.

USAID contributed significantly to the drought relief programme in 1992/93. However, when a national drought was declared again in 1996, the Office for Foreign Disaster Assistance (OFDA - an United States government agency) undertook an assessment of their own and found that drought was limited to a few specific areas. It was also noted that Botswana which has experienced similar vagaries of climate has not declared a drought in the last 12 years. The extent of the drought relief from USAID was consequently limited. USAID now adopts a policy of promoting capacity building within Namibian government to prepare for disaster management rather than directly funding relief programmes as they did in 1992/3 (Binding, pers. comm.).

8.2 Involvement of Institutional Structures

8.2.1 Government Departments

In January 1992, SADC's Regional Early Warning System foretold of impending drought in the region, and subsequent reports indicated that the scale and severity of the anticipated drought would be unprecedented. A joint FAO/WFP mission to the region in March and April endorsed these findings. This resulted in the government of Namibia setting up a Cabinet Committee on Drought that was chaired by the Prime Minister and made up of the Ministers of Agriculture, Water and Rural Development, Defence, Works, Transport and Communications, Information and Broadcasting and Lands, Resettlement and Rehabilitation.
On May 15, the President of Namibia announced the appointment of a Deputy Minister to head a national Drought Relief Programme (DRP) with a particular focus on a water supply programme. At the same time, Cabinet requested each ministry to prune its budget to make financial provisions for the drought. The budget was revised under contingency measures and R120 million was allocated to the DRP for food distribution, crop and livestock subsidies and emergency water supply. The President also made a special appeal for international donor support to complement national resources.

A Plan of Operation was formulated with technical assistance from the UNDP and endorsed by Cabinet to manage and co-ordinate the DRP.

An inter-ministerial National Drought Relief Task Force (NDTF) was formed to deal with the more practical, hands-on implementation aspects of relief and to assume overall responsibility for the DRP.

In an attempt to co-ordinate the activities of government and non-government agencies operating in the field, the NDTF created 8 units (plus the NDTF Secretariat), to implement the DRP. A brief description of these follows below (Dumeni and Giorgis, 1995):

8.2.1.1 The Emergency Water Unit - Department of Water Affairs
The responsibilities of this Unit included the rehabilitation of disused/faulty boreholes, provision of new boreholes, extension of pipe-lines, provision of water with water tankers and the design of public awareness programmes for wise use of water during drought.

8.2.1.2 The Vulnerable Group Unit - Primary Health Care
Functions of this Unit included monitoring the nutritional status of children under 5 years old, assessment of drought-related disease, mortality and morbidity, supply of essential drugs and recommendations of appropriate rations for vulnerable groups.

8.2.1.3 Livestock and Crop Unit - Department of Agriculture
This Unit's responsibilities included the administration of schemes to preserve as many livestock as possible whilst pursuing measures to relieve natural resources from the pressures of overstocking, and the provision of seeds for food production during the next rainy season.

8.2.1.4 Design and Management Unit - Ministry of Lands, Resettlement and Rehabilitation
Functions of this Unit included determining the criteria for who should receive drought assistance, the monitoring of regional and local drought relief structures and the designing of a plan for operation and training of people in the DRP.
8.2.1.5 NGO/Donor Liaison Unit - Ministry of Works, Transport and Communication

This Unit was responsible for assisting with the mobilisation of donor aid for the drought, facilitating participation of NGOs in the DRP, and keeping records of donations and pledges.

8.2.1.6 Monitoring and Evaluation Unit - NDTF

The responsibilities of this Unit included monitoring the different elements of the DRP (especially food distribution), as well as identifying and then informing those responsible of any bottlenecks or problems in the DRP. The Unit also provided regular reports on the DRP for the government and donors.

8.2.1.7 Transport and Logistical Unit - Ministry of Works, Transport and Communication

This Unit's responsibilities included organising and co-ordinating the logistics of transport for drought relief.

8.2.1.8 Information Unit - Ministry of Information and Broadcasting

This Unit provided regular reports on the drought, and liaised with the local and international media. They were also responsible for liaising with other units to ensure their inclusion in publications and official communications.

8.2.1.9 The NDTF Secretariat

The Secretariat was responsible for the day-to-day co-ordination of the DRP and for the implementation of NDTF decisions. In an attempt to improve co-ordination amongst the different units (which were composed of staff from different ministries), the chairmanship of the NDTF was transferred to the Office of the Prime Minister. It was also hoped that this would engender a greater degree of commitment, as members of the NDTF would no longer only be accountable to their own ministries, but also to a higher authority.

However, whilst improving as the DRP progressed, co-ordination problems amongst the various ministries at national level, periodic vacuums in leadership and a general lack of experience detracted from the effectiveness of the NDTF (Dumeni and Giorgis, 1995).

At the regional level, in the absence of elected regional leaders, regional commissioners were put in charge of the regions and made responsible for chairing Regional Drought Committees. They were assisted in these tasks by Chief Control Officers (CCO) who were appointed to oversee the progress of the DRP as well as to take charge of the day to day activities of the DRP.

Each region was encouraged to maintain active regional and local drought committees in an attempt to establish capacity at these levels as well as with a view of enabling people to help themselves.
No special staff were deployed to the regions and the bulk of the work, including identification of beneficiaries of aid, the transport and distribution of food and all reporting was undertaken by local and regional committees (ibid.).

8.2.2 The Involvement of International Aid Agencies

In response to the SADC Regional Early Warning Systems forecast of impending regional drought of unprecedented scale and severity, A SADC ministerial meeting was held in Lusaka, Zambia on April 16, 1992.

A regional task force was formed and 6 regional transport corridor groups were established to provide free movement of emergency commodities. On June 1, 1992, a joint SADC/UN appeal, the Drought Emergency for Southern Africa Appeal (DESA), was presented to donors and the international community, requesting food and non-food aid for the southern African region.

Just prior to this, on May 15, the President of Namibia had launched a special appeal for donor support to complement national resources.

The UNDP, in collaboration with the SADC/UN appeal, responded by providing leadership for the preparation of a drought document appealing to the donor community for international assistance for Namibia. The UNDP undertook to provide expertise to help Namibia with the establishment of the NDTF, and with the preparation of a Plan of Operation for Drought Relief Management and co-ordination, as well as approving a two-phase US$500 000 Disaster Preparedness and Management Project (DPMP).

The first phase of the UNDP’s DPMP was aimed at supporting the Namibian government in the co-ordination and management of the drought and to this end, they provided manpower in the form of an expert to advise on decision-making. They also provided a press and information co-ordinator to assist in gathering and disseminating information on the drought and its effects to the donor community. In line with the UN General Assembly resolution 46/182 which states that “emergency assistance must be supportive of recovery and long-term development”, the DPMP provided training and workshop programmes aimed at strengthening the Namibian Government’s emergency structures.

The second phase of the project focused on drought preparedness, policy formulation for disaster mitigation, establishment of institutional capacity for contingency planning and the implementation of development strategies to combat any form of disaster. To strengthen this second phase, and to enhance the UN’s supportive role in mitigation strategies and contingency planning through monitoring and acquisition of baseline data, the UNDP approved the use of US$50 000 from its Special Programme Resources fund. This was intended to complement the Namibian disaster relief project phase throughout the provision of administrative and logistical support to the UN.
Lastly, UNDP provided US$700 000 worth of funding to the FAO’s Early Warning Food and Information System project which is now linked to the SADC regional Early Warning System for Food Security. This system was established to provide early warning of impending food crisis and to disseminate timely information and advice to policy decision-makers, national and international agencies as well as to rural communities.

UNICEF was also involved in the Namibian 1992/93 drought relief operation, providing four areas of support, including support for the development of water relief. The other areas were concerned with providing support to the NDTF for programme planning, support for nutrition and health care for vulnerable groups and involvement in the Food for Work Programme. In total, UNICEF support for the 1992/93 drought relief programme amounted to US$3.25 million.

The World Health Organisation (WHO), provided technical assistance to monitor vulnerable groups and to conduct environmental surveillance of communicable diseases. Their contribution amounted to US$25 000 (Dumeni and Giorgis, 1995).

WFP contributed approximately US$ 11 million in food to support both the Food for Work programme and the Vulnerable Group Feeding Programme.

FAO primarily provided technical input for rural water supply, a crop assessment mission, consultation on range management, livestock production and livestock marketing.

USAID funded IMC drilling operations as well as providing N$150 000 for the purchase of rural water reservoirs. USAID funding was provided in the form of a “gift” and as such no follow-up has been done on the effects and consequences of these drilling operations (Binding, pers. comm.). A study undertaken by Africare states that the IMC drilled and equipped 26 boreholes as part of their 1992/93 drought relief contribution to Namibia (ibid.).

Once a borehole had been drilled and equipped, one community member was appointed to be responsible for its maintenance, and it was handed over to the community for their use. IMC employees held health education talks at each borehole, and Africare distributed pamphlets on water hygiene, use, conservation and management (Mhone, 1994).

The Nigerian government pledged approximately N$1 500 000 for borehole drilling.

Numerous other foreign governments and their representatives provided donations and aid to the Namibian DRP, in the form of financial or technical assistance, food aid and funding for water projects and water tankers.
8.2.3 Non-Governmental Organisations (NGOs)
Most Namibian NGOs did not participate in the DRP and preferred to concentrate on long-term development activities rather than on short-term drought relief programmes.

However, some Namibian NGOs did get involved in activities such as transport, storage and distribution of food, food for work and training on matters related to the distribution of drought emergency relief aid.

Red Cross operated in the Kunene region and was also involved in water rehabilitation and protection. It also participated in the training of field officers, store keepers and regional co-ordinators in relief and disaster management.

The following are some of the NGOs that participated in the drought relief programme:
• The Council of Churches in Namibia (CCN)
• The Evangelical Lutheran Church in Namibia (ELCIN)
• The Evangelical Lutheran Church in the Republic of Namibia (ELCRN)
• The Red Cross and
• The Rosving Foundation.

8.2.4 Conclusion
From the foregoing, it is clear that the 1992/93 drought period provided aid to rural communities in many ways. It also provided an impetus and flow of foreign aid funding to the rural water supply development programme in the form of construction of boreholes, new pipelines etc. However, will be highlighted later in this report, some of these responses were short term and inappropriate.

In some regions, for example Kunene South, drought was more of a shortage of grazing land than a shortage of water. Inappropriate relief responses can have severe negative implications and may in fact increase the vulnerability of an already vulnerable segment of the population to future droughts.
PART II
KHORIXAS CASE STUDY
9. Regional Profile - Khorixas

This chapter provides an overview of the Khorixas area to provide information for the discussion that follows. A brief history of the Khorixas area is presented and a biophysical profile. A social profile is also presented which covers for example settlement patterns, leadership structures and a local economic systems. A health profile of the region is also presented.

9.1 History

The Kunene Region, located along the north-western side of Namibia, covers an area of 144 km\(^2\). It stretches from the Kunene River in the north to the Ugab River in the south. The region is bordered by the Atlantic Ocean to the west, the Erongo region to the south, and the Oshikoto, Oshana and Omusutu Regions to the east.

The Khorixas regional constituency covers the communal land in the southern part of the Kunene Region (figure 9.1). This area was formerly known as the northern part of Damaraland. Damaraland was created as a result of the recommendations made by the Odendaal commission in 1964 (Mhone, 1994). Historically, the eastern areas of Damaraland were extensively settled by white commercial farmers, while the more marginal western areas were declared communal areas. All white farmers living in this area had their farms expropriated due to the recommendations of the Odendaal Commission, and during the early 1970’s people were forced to move into this area from various southern areas of Namibia.

The people were not settled into communal villages, rather individual families were settled at existing water points, usually expropriated farms. Normally each farm has a main settlement (the old homestead), and a number of livestock posts (generally up to a maximum of four). The old, pre-Odendaal, farm names have been retained, and resettlement has occurred at both the homesteads and the posts. Generally the old homesteads support a larger number of families, while the posts support a smaller number of people.

Following Namibia’s independence, a ‘Delimitation Commission’ was appointed. The Commission recommended new administrative regional boundaries for Namibia, which would not be based on ethnic or tribal lines. The former Damaraland now encompasses the southern part of the new Kunene Region, and the northern part of the new Erongo Region (Mhone, 1994).
9.2 Biophysical Profile

9.2.1 Climate

This area is classified as arid to semi-arid. Rainfall is often localised, precipitating in the form of thundershowers, and generally ranges from less than 50 mm along the coast to about 400 mm per annum around Khorixas (Mhone, 1994). The wet season during the summer months ranges from November through to May, however, the main period of rainfall is usually during the months of February and March. Rainfall is highly variable and is often erratic, both seasonally and spatially. The region falls within the 50-70% variable isohyet for precipitation (see figure 9.2). This means that an area receiving a long term mean of 240 mm of rainfall per annum has a 95% probability of getting between 80 and 400 mm in a season (Jones, 1993). These conditions give rise to droughts and floods occurring in the region with no apparent regularity. The dramatic changes in yearly rainfall in this area is graphically displayed by data from the Khorixas weather station (see figure 9.3).

Figure 9.2 Average Deviations of Annual Rainfall across Namibia (after Van Der Merwe 1983)
9.2.2 Topography
Topographically southern Kunene is characterised by undulating plains and dune fields in the west, which slope gently towards the coastal plain. This is in sharp contrast to the elevated mountainous area in the centre and eastern regions. These mountainous areas are deeply incised by the drainage courses and flood plains of the main western draining ephemeral rivers (Simmonds and Forbes Irving, 1995).

9.2.3 Hydrology
As Khorixas falls within the arid climate of Namibia's western region, ephemeral rivers are of special significance to the region. Floods resulting from heavier rains in the eastern part of these river catchment areas recharge aquifers and maintain riparian vegetation in the drier western regions (Jacobson et al, 1995). These rivers, however, are very sporadic in nature. Owing to the very high evaporation rates of western Namibia no major dams have been constructed in any of the major ephemeral rivers of the region. Small farm dams are generally not relied upon as a source of water.

9.2.4 Geology
Geologically the area is underlain by Pre-Damara Basement, Damara Sequence, Karoo sediments and volcanics and recent surficial deposits. The basement comprises of metasediments, metavolcanics and gneisses. Damaran lithologies, which overly basement, include arkosic clastic units at the base followed by largely carbonate rock types interrupted by extensive
mixtites. Due to the low rainfall karstification is generally poorly developed. In the south-east region granites of Damaran age give rise to very characteristic undulating topography with dome shaped hills and large boulders (Simmonds and Forbes Irving, 1995).

9.2.5 Geohydrology
A relatively low groundwater potential exists for the Kunene South region. Groundwater is restricted to secondary aquifers, with an increase in groundwater potential in zones of fracturing, faulting and shearing (EEAN, 1994a). Historically borehole sites have been restricted to areas of better grazing and easy access, rather than to areas of greater groundwater potential. This has resulted in low rates of successful borehole drilling and these successful boreholes generally producing low yields (DWA, 1994).

The recharge of groundwater through most parts of the Kunene South Region is only 1% or less of the rainfall in a catchment area (DWA, 1991). All groundwater in this region is, therefore, extremely sensitive to exploitation. Groundwater supply is almost the exclusive source of water in this region, and a continued increase in its utilisation could increase the risk of water shortages (EEAN, 1994a).

9.2.6 Soils
Most of the region is covered by red soils derived from decomposed granite, or whiter clayey soils with scattered calcrete. The soils are calcareous, weakly developed and shallow in the west (Jones, 1993). Many are very rocky and sometimes even give way to bare rock. Soils in the Khorixas area are generally thin and poorly developed.

9.2.7 Vegetation
The primary determinant of vegetation is rainfall. The eastern part of the region falls within the transition of mopane scrub woodland to Karoo-Namib scrubland, while the western part of the region falls within the Bushy Karoo-Namib scrubland (Jones, 1993).

Most of the highlands are covered by open xeric savannah, often dominated by the mopane, Colophospermum mopane. Mopane and the aca tree Faidherbia albida along with the camelthorn, Acacia erioloba and Acacia nebrownii are found along the dry water courses. The ana tree is of particular importance to wild animals and livestock for the fodder its pods provide. It is also an important nitrogen fixing tree (ibid.).

Acacia mellifera is common on the clayey-calcrete soils. Sterculia africana and Sterculia quinqueloba are common on the larger granite koppies in the east (ibid.).
The basaltic rocks of the Grootberg and the pro-Namib have a more arid adapted flora with numerous succulent species such as *Pachypodium leali*, and *Moringa ovalifolia*. *Euphorbia damarana* is the dominant plant in the rocky basalt plains (ibid.).

The red sandy plains are dominated by two climax species of grass, *Stipogrostis uniplumis* and *Stipogrostis hirtigluma*. *Cenchrus ciliaris* is the climax species in dry river beds and climax grass on the granite outcrops is *Antephora ramosa* (ibid.).

### 9.2.8 Wildlife

In 1992 an aerial game count was completed for the Kunene Region. Table 9.1 shows the results for seven species of large animals for the Huab catchment area (Khorixas falls within the southern region of this catchment area).

<table>
<thead>
<tr>
<th>Springbok</th>
<th>Hartmann's mountain zebra</th>
<th>Gemsbok</th>
<th>Ostrich</th>
<th>Giraffe</th>
<th>Elephant</th>
<th>Kudu</th>
</tr>
</thead>
<tbody>
<tr>
<td>99</td>
<td>119</td>
<td>97</td>
<td>68</td>
<td>22</td>
<td>184</td>
<td>61</td>
</tr>
</tbody>
</table>

At least 82 species of mammal are known to exist in the Huab Catchment and surrounding area. The only endangered species is the black rhinoceros, which only occurs in very low numbers on the western fringes of the Huab catchment. Ten species found in this area are classified as being vulnerable in Namibia. These include the spotted and brown hyenas, lion, cheetah, elephant and pangolin (Jones, 1993).
9.3 Social Profile

9.3.1 Population and Ethnic Groups

Between 1971 and 1981, the population of Damaraland doubled, as a result of resettlement into the newly created homeland. The 1991 Damaraland population represents a 40% increase over the 1981 census figure, as a result of declining mortality and increased fertility rates (Rohde, 1994). With an annual growth rate of 3.34%, the population of Damaraland is expected to double within the next 25 years. This is an important issue to bear in mind when considering development and resource use, especially water.

The majority of people live in the north-east, in the Grootberg area. A high population density is also found around Anixab near the Ugab river. The climatic conditions of the western regions results in low population densities.

The population of the Huab Catchment area around Khorixas in which the study took place was estimated to be 4,000 in 1992 (Jones, 1995).

The Damara speaking population comprises the majority of the total population of Damaraland (66%) (Rohde, 1994). The OvaHereros and the Ovambos represent the two other largest groups, comprising 18% and 7% respectively (Central Statistics Office, 1991).

9.3.2 Settlements

On the former commercial farms, boreholes were located at what became the site of primary habitation, and at farm-posts established for providing water to livestock being herded in remote areas of the farm (Jacobson et al, 1995, and PRA study findings). Thus, human settlement and the kraaling of livestock is determined largely by the location of functioning boreholes.

Rather than being settled into communal villages, individual Damara families were settled at existing water points. The typical pattern today is that of a farm settlement around the original farmhouse, closer to communication routes, with fewer households at the more remote farm-posts (Sullivan, 1996a).

These settlement patterns are scattered, with people living on farms around water points in predominantly family groups, while larger concentrations occur around towns such as Khorixas, Fransfontein, Bergsig, Anker and Grootberg, where there are schools, clinics or other government offices and services (Jacobson et al, 1995).

The study findings confirmed that ongoing human migration into the area continues. This puts increasing pressure on existing natural resources including water, soil and vegetation. Movement into the area was found to have taken place in response to periods of drought (see PRA time trend in Appendix 7).
People settled in an *ad hoc* basis. There was an absence of clear legislative control or regulation of settlement and there was no ‘traditional’ land allocation in place (Rohde, 1994).

Evidence was found from interviews and PRA findings for a great deal of movement of people between settlements, with members leaving and returning at different times in response to factors such as employment, visiting of family members, water shortages and grazing. Thus the number and composition of people at a settlement varies over time and forms part of the flexible systems that operate in Damaraland.

### 9.3.3 Family and Community Network Systems

A flexible system of reciprocal exchange and risk spreading operates in Damara culture, particularly among kin (Rohde, 1994; Devereaux and Tapscott, 1995). However, unrelated neighbours also share resources and assist one another when necessary. Grazing is also reciprocated between these networks with transhumance continuing to some extent. In addition, visiting and borrowing of items of foodstuff and tobacco takes place. Thus each household cannot be viewed as a completely separately functioning entity. These findings were confirmed by the study results. For more details see PRA resources and network charts in Appendix 7.

Family members generally manage and look after resources communally. Livestock belonging to different individuals will be grazed together. Herds of cattle, goats or sheep can generally be divided into sub-herds to various relatives claiming ownership of his keep, and are grazed together. Furthermore, keeping herds in different places when this is required due to grazing needs, requires much labour, which is traditionally drawn from the family, although more recently, also from hired labourers.

As described by Rohde, survival strategies used by people living in communal areas are complex “Flexibility, resilience, mobility, adaptation and mutual accommodation ...” (describe the means) “... with which communal farmers are able to over-come some of the major hazards which affect farming in a productively marginal environment in an unpredictable climate” (Rohde, 1994).

Thus the flexibility of social and property organisation that appears to continue to exist among the Damaras in the Khorixas area, as manifested in these farming systems as well as kinship and exchange networks, and political organisation, gives strength and resilience. Any developments and policies need to take this into account in order to ensure that these are not disrupted.
9.3.4 Leadership Structures and Resource Control

The development of the Damaras as an ethnic group resulted after the formation of the Damara homeland. Prior to this they had been scattered around Namibia. Traditional leadership was formed through apartheid policies in Damaraland, and these were given a degree of informal autonomy in their decision-making (Fuller and Turner, 1996).

In 1980 the Damara Council, led by the new Paramount Chief, Justus Garoeb, received a massive majority in elections, heralding the emergence of a regional power based on Damara identity (Fuller, 1993 in Sullivan, 1996a). In 1985 the Damara Council began codifying the structure of ‘tribal authority’. A form of traditional leadership was created through the establishment of twelve wards, each with ward heads and councillors. Both the Kings Council and the Damara Council are headed by Paramount Chief Justus Garoeb (Jones, 1993). The Kings council combines elements of traditional leadership with elements of the political Damara Council.

Until independence the communal areas created by the Odendaal Commission were administered separately by the Statutory Legislative Council, by ‘second tier authorities’ consisting of both recognised and State appointed traditional leaders. These became defunct after new administrative boundaries were drawn along non-ethnic lines.

At independence, the laws which maintained the ‘second tier authorities’ were repealed (Rohde, 1994). All property under the control of the Damara Authority reverted to the Government of Namibia. This included water installations. Customary law and tradition regarding rights to resources, are not recognised in Damaraland (Rohde, 1994). In 1992 the Kunene region elected a Regional Council made up by councillors elected from each district. This introduced a new level of leadership that was absent since independence due to the abolition of ethnic administrations created under South African rule, and which resulted in the undermining of traditional powers.

The current situation in Damaraland is that all property held by regional authorities has reverted to central government, the former regional administration in Khorixas is now headed by appointees made by central government, and the position of tribal leaders is seen as largely symbolic (Sullivan, 1996a). Tribal leaders and the Agricultural Extension Officers of the previous regional office do however continue to fulfil important roles in land allocation and the mediation of conflicts. Community members interviewed by the study team reported that traditional leaders are consulted by them in regard to these issues.

Thus although the role of traditional leaders has been downgraded to that of an advisory role, acting as intermediaries between communal dwellers and government officials, in practice they still have an important influence in communities.
9.3.5 Economic Overview

Livestock farming is the major economic activity of the area. Although traditionally hunter-gatherers, virtually all Damara rural families now practice livestock farming, particularly with goats and cattle, as a form of subsistence and livelihood. Wildlife and veld-food sources have become inadequate to sustain a living (Malan, 1993).

Although the large majority of Damaras are very dependent on the physical environment for their livelihoods, it is not able to meet all of their survival needs. These then have to be supplemented by other means.

Risk spreading as a survival strategy is reflected in the variety of sources of livelihoods. In addition, reciprocity and risk spreading takes place through extended family and exchange relations. These exchange networks mean that households depend on a network of others for mutual assistance that is usually, but not always, kin related. Although sometimes reciprocated as a two way flow, one family member often secures a job and diverts some earned income towards supporting poorer relatives with donations or ‘soft loans’ of food, cash or assets. Devereaux and Tappscott (1995) found that many poor households in communal areas are sustained by their better-off relatives, in good years as well as bad, by these ‘informal transfers’.

This ‘exchange relationship’ is one of the most significant factors of the pastoral economy which ensures a ‘safety net’ for individuals or in times of difficulty (Devereaux and Tappscott, 1995). The challenge would appear to be to produce surplus to allow for these exchanges to continue take place.

In addition to income earned from agriculture, cash income is generated from remittances and from salaries earned by family members in nearby towns, from old age pensions and from informal sector activity. Pensions form an important source of reliable income in the rural areas.

A reliance on livestock, an absence of diversification in the local economy and a shortage of alternative skills characterise the communal areas in much of Damaraland. For example, tourism is underdeveloped in the area, and neither are arts and crafts produced due to a lack of skills and distance to markets. There is little agricultural diversity and alternative economic activities such as ostrich or wildlife farming or aloe cultivation are limited.

Employment opportunities are limited. However, some Damara have entered the formal economy in the towns as government employees such as teachers, civil servants and health workers. Labour on commercial farms and the local mines provide further employment opportunities. Casual labour consists of minor jobs such as repairing kraals and fences, and looking after livestock. Private enterprises such as selling wood, repairing donkey carts and retail shopping make a significant contribution to the local economy. Alternative forms of income are limited.
Many wage earners invest in livestock, and comprise the 'weekend farmers', returning to their farms periodically. They enhance the security of extended rural families and provide a subsistence wage to herders.

9.3.6 Health Profile

The discussion presented in this section is structured on the outline of health impacts reviewed in section 7.

The Khorixas area has a health profile fairly typical of a rural area in Namibia.

Data obtained from the state hospital in Khorixas provides a useful indication of the health conditions and problems experienced locally. Key features of this data - as indicators of the health of the region - are presented in the tables 9.2 and 9.3.

(Data derived from Khorixas State Hospital records, Khorixas).

<table>
<thead>
<tr>
<th>Disease</th>
<th>Rank</th>
<th>Number</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Upper Respiratory Tract Infection</td>
<td>1</td>
<td>1823</td>
<td>38.9</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>2</td>
<td>911</td>
<td>19.5</td>
</tr>
<tr>
<td>Ear, nose, throat infections</td>
<td>3</td>
<td>726</td>
<td>15.5</td>
</tr>
<tr>
<td>Skin infection/disease</td>
<td>4</td>
<td>444</td>
<td>9.5</td>
</tr>
<tr>
<td>Lower Respiratory Tract Infection</td>
<td>5</td>
<td>214</td>
<td>4.6</td>
</tr>
<tr>
<td>Eye infection/disease</td>
<td>6</td>
<td>178</td>
<td>3.8</td>
</tr>
<tr>
<td>Trauma</td>
<td>7</td>
<td>132</td>
<td>2.8</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>18</td>
<td>9</td>
<td>0.2</td>
</tr>
<tr>
<td>Malaria</td>
<td>19</td>
<td>6</td>
<td>0.1</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>240</td>
<td>5.1</td>
</tr>
</tbody>
</table>

It is interesting to note that many of these consultations are for diseases that may relate to water, poor sanitation and poor living conditions (see Appendix 5).
Table 9.3: Disease Profile in the over five year old to adult age group
(Khorixas Hospital OPD)

<table>
<thead>
<tr>
<th>Disease</th>
<th>Rank</th>
<th>Number</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Upper Respiratory Tract Infection</td>
<td>1</td>
<td>2824</td>
<td>16.7</td>
</tr>
<tr>
<td>Musculo-skeletal and neurological disease</td>
<td>2</td>
<td>2435</td>
<td>14.4</td>
</tr>
<tr>
<td>Ear, nose, throat infections</td>
<td>3</td>
<td>2023</td>
<td>11.9</td>
</tr>
<tr>
<td>Skin infection/ disease</td>
<td>4</td>
<td>1317</td>
<td>7.8</td>
</tr>
<tr>
<td>Gastrological/ Endocrine</td>
<td>5</td>
<td>1163</td>
<td>6.9</td>
</tr>
<tr>
<td>Trauma</td>
<td>6</td>
<td>1150</td>
<td>6.8</td>
</tr>
<tr>
<td>Eye Infection/ Disease</td>
<td>7</td>
<td>889</td>
<td>5.2</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>8</td>
<td>693</td>
<td>4.1</td>
</tr>
<tr>
<td>Malaria</td>
<td>27</td>
<td>39</td>
<td>0.2</td>
</tr>
</tbody>
</table>

It is apparent from this data that the older population suffers from a different range of illness form the under five age group. However, there are still reasonably high incidences of possible water related disease.

From the above information, it is possible to argue that providing a safe and reliable supply of water to local communities would have a significant positive impact on the health of the communities. As many of the common diseases in Khorixas seem to be 'waterborne' or 'water-washed' diseases (see Appendix 5), provision of more safe and reliable water points would undoubtedly directly decrease the incidence of these diseases. It may also decrease the incidence of diseases related to poor socio-economic circumstance, such as malnutrition, by providing agricultural and other economic opportunities for communities.
10. An Overview of the Emergency Borehole Supply in the Khorixas Area

During the 92/93 drought in the Kunene Region, two emergency water resource development programmes were undertaken through foreign donor assistance. The institutions involved in these two programmes were the Government of Nigeria, and the International Medical Corps (IMC) funded by the United States Office of Foreign Disaster Assistance (OFDA) through USAID. The implementation of these two programmes will be reviewed in the following two sub-sections.

10.1 Nigerian Involvement in the Drought Relief Programme in Kunene

[It was difficult obtaining information on this programme as no records were kept. Almost all the information presented here is derived from the report of Mr J. Hoffman (1993).]

According to the National Drought Task Force Publication, ‘Drought Once Again’ (1993) the Government of Nigeria contributed to the drought relief programme by drilling 25 boreholes in Kunene, this program valued at R1.5 million. This was seen as a great boost to rural water supply development and lauded as a significant contribution to the drought relief project.

Three consultants were involved in the Nigerian Borehole Programme. These were Namibia Groundwater Exploration, HHO and Geotec. Namibia Groundwater Exploration sited two boreholes successfully. HHO and Geotec were responsible for 23 of the boreholes and have been severely criticised by Namibia Groundwater Exploration for the quality of work produced. The drilling contract went to Scanwater and Tradelinks.

An investigation conducted by Hoffman of Namibia Groundwater Exploration in 1993, after the drought relief programme was completed, investigated the actual results, process and funding of the Nigerian Programme (Hoffman, 1993). Some of Hoffman’s key findings and criticisms of the work of Geotec and HHO are summarised below:

10.1.1 Responsibilities of Consultants

The companies HHO and Geotec were appointed as consultants to the programme and they failed in the expected and normal areas of duty of consultants viz:

- Consultation with Government, Nature Conservation, local chiefs and headmen
  There were 23 sites originally requested and proposed and only 10 of these were drilled. The other 13 were cancelled and re-sited by the consultant without any consultation with relevant stakeholders.
• Hydrogeological and geophysical surveys
The geological description at all the sites was incorrect, site selection by hydrogeological survey was poor and many boreholes were incorrectly plotted.

• Supervision of drilling and logging of rock formation
No pump testing or measurement of water yield was done. No logging of rock strata was recorded. This was confirmed by the local DRWS office (van der Merwe, pers. comm.).

10.1.2 Results of HHO and Geotec Work
These results were astoundingly poor. There were 23 boreholes which by the end of the programme had been sited and drilled under Geotec and HHO. Of these only 14 were installed and 9 were dry. This represents a 61% reported success rate. However of the 14 installed 10 ran dry, some within a matter of days and the rest within several weeks. Only 4 boreholes were drilled and installed successfully (17% success rate). There was also one rehabilitation attempted which was successful.

The following tables outline the functional boreholes gained in the entire Nigerian programme.

Table 10.1: Boreholes sited by Geotec and HHO

<table>
<thead>
<tr>
<th>Borehole</th>
<th>Yield</th>
<th>Water Quality</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sited by Geotec and HHO</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(23 sited, 4 not dry)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aub</td>
<td>1.5 m³/hour</td>
<td>Good</td>
<td>Successful. Twenty people use borehole</td>
</tr>
<tr>
<td>Bergsig Post</td>
<td>0.3 m³/hour</td>
<td>Good</td>
<td>No grazing in the area and consequently no people use the borehole</td>
</tr>
<tr>
<td>Arikana</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gao-</td>
<td>0.5 m³/hour</td>
<td>Salt concentration too high for human consumption</td>
<td>Three people live here and use the borehole for stock</td>
</tr>
<tr>
<td>Khaoseb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nai-Gab</td>
<td>0.5 m³/hour</td>
<td>Salt concentration too high for human consumption</td>
<td>No people live here or use the borehole</td>
</tr>
</tbody>
</table>

The above table shows only one borehole which can be declared successful and useful - out of the whole Geotec and HHO programme.
Table 10.2: Boreholes sited by Namibia Groundwater Exploration

<table>
<thead>
<tr>
<th>Borehole</th>
<th>Yield</th>
<th>Water Quality</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duurwater Post</td>
<td>1.5 m³/hour</td>
<td>Good</td>
<td>Successful. 50 people gain benefit.</td>
</tr>
<tr>
<td>Omborondo</td>
<td>1.5 m³/hour</td>
<td>Good</td>
<td>250 people use borehole. But only 1 m³ pumped daily by windmill.</td>
</tr>
</tbody>
</table>

10.1.3 Appropriateness of siting and environmental consideration

Hoffman also points out that HHO and Geotec did not consult with the relevant offices of the Department of Nature Conservation and Tourism in the area. This was despite the Nigerian Government's request to take environmental considerations into account during siting. At least three of the boreholes were drilled in environmentally sensitive areas and two were drilled in very dry areas where there were no inhabitants. Relevant stakeholders were not consulted in this regard. One borehole was even drilled into a permanent spring on the farm 'Palm' and the result was a "dry" borehole (it only yields 100 litres per day).

10.1.4 Money

The Nigerian Government made available at least R1.5 million for this programme. Only three boreholes can be classed as successful:

Table 10.3: Summary of Nigerian programme

<table>
<thead>
<tr>
<th>Consultants</th>
<th>Sited</th>
<th>Successful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geotec and HHO</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>Namibia Groundwater Exploration</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Hoffman also calculates that the programme is unlikely to have cost more than R600 000. He states that 'considerable funds should still be available' from the original sum provided. According to the available literature this amount seems unaccounted for.

In conclusion then, it is fair to comment that the Nigerian programme had a number of deficiencies and shortfalls. This was in the form of improper process, technical deficiencies, results and accountability. The beneficiaries of the programme are few. The rural residents who were the beneficiaries...
intended by the Nigerian Government derived little benefit. Their long awaited and requested boreholes were not successfully sited or drilled. The rural water supply development programme gained little from these activities. The other obvious beneficiaries are the consultants and drilling contractors involved. While these were mostly Namibian companies it is interesting to note that Scanwater is owned and managed by a Swedish citizen.

In this study the Nigerian programme was not assessed in detail on the ground due to its failure to produce functional boreholes. It was not deemed relevant in the assessment of emergency boreholes to study the local environmental impacts of non-functional boreholes in any more detail.

10.2 International Medical Corps Involvement in the Drought Relief Programme in Kunene.

In July 1992 the International Medical Corps (IMC) initiated its Emergency Water Development Program in Namibia with a grant from the United States Office of Foreign Disaster Assistance (OFDA). The aim of the programme was to provide potable water to established and existing communities in drought-affected areas of north western Namibia.

The IMC, in collaboration with the Ministry of Agriculture, Water and Rural Development (MAWRD) and with the approval of the Interministerial Drought Emergency Task Force, implemented the programme after a feasibility study which found significant water resources in rock formations of between 50 - 100m depth in the Kunene Region.

10.2.1 Drilling and Installation

The project, which ran from July 1992 to July 1994, was divided into 3 phases (Manzella, 1994):

<table>
<thead>
<tr>
<th>Phase</th>
<th>Dates</th>
<th>Area</th>
<th>Number of boreholes drilled</th>
<th>Number of boreholes installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>July 92 - Jan 93</td>
<td>Northern Erongo and Southern Kunene</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>II</td>
<td>Jan 93 - Oct 93</td>
<td>Southern Kunene</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td>III</td>
<td>Oct 93 - July 94</td>
<td>Northern Kunene</td>
<td>15</td>
<td>10</td>
</tr>
</tbody>
</table>

Boreholes were drilled to depths of 40 - 120 metres, at sites that were selected and agreed upon by the IMC, geologists from the Department of Water Affairs and local communities. Drilling was done by an IMC owned drilling rig, and installation of pumping structures by three independent contractors over the life of the project.
Table 10.5: Types of Installations on IMC Drought Relief Boreholes.

<table>
<thead>
<tr>
<th>Type of Installation</th>
<th>Number Installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windmill</td>
<td>17</td>
</tr>
<tr>
<td>Diesel Engines</td>
<td>8</td>
</tr>
<tr>
<td>Hand Pumps</td>
<td>10</td>
</tr>
<tr>
<td>Solar Pumps</td>
<td>2</td>
</tr>
</tbody>
</table>

10.2.2 Results

During our visit to the Khorixas area 12 of the installed IMC drought relief boreholes were visited and assessed. In Table 10.6 a comparison is presented on borehole yields and numbers of people served by each borehole. The "Reported" figures were obtained from the IMC’s final report on the programme “Emergency Water Resource Development Programme, Erongo and Kunene Regions, Northwest Namibia” (Manzella, 1994). "Observed" figures were obtained from information gathered at each of these boreholes visited.

In the case of borehole yields accurate testing was beyond the scope of this study, and no independent records exist with the DRWS. The results presented are from direct observation, and from information collected from the people utilising the borehole. It must be stressed that this information is very qualitative, and does not take seasonal fluctuations, or fluctuations over time, into account. A “good” yield generally meaning that the borehole presently provides sufficient water for the communities needs, while “poor” reflected a borehole which was unable to meet the settlements needs. "Dry” boreholes were generally boreholes which had either no yield at all, or such a low yield that the borehole was unreliable as a water source. In the case of the borehole installed at Engelbrecht (34111), “not utilised” represents the fact that the community do not utilise this borehole, except in times of emergency when the borehole which they do utilise has a breakdown. The figures which are presented for the number of people observed are derived from PRA exercises which were done at each community.

Some interesting observations can be made from Table 10.6. The general trend is that the IMC figures for both borehole yields and the number of people the borehole served are higher than those which were observed during this study.

One possible reason for the discrepancy in borehole yields is that the IMC report did not mention what tests were done on boreholes to determine whether the borehole yield was sufficient for pump installation, and if a pump was installed what the recommended sustainable pumping rate should be. It would appear that no proper Stepped Pump Tests were done during the IMC
programme and that yield estimates were made using blow tests (van der Merwe, pers. comm.). Determining recommended yield using a blow test is a very unreliable estimate of the boreholes sustainable yield and is based on very short term results (Hartley, pers. comm.). The fact that some of the IMC boreholes seem to be delivering lower yields, or have dried up completely may be a result of them not being properly pump tested. Although proper pump testing adds to the expense of drilling and installing a borehole, it minimises the number of boreholes installed which later pump dry and, therefore, reduces the costs incurred in developing these non-functional boreholes.

Although the IMC states that boreholes were sited in a process which involved the IMC, geologists from the DWA, water committees, community leaders and local authorities (Manzella, 1996), observations in the Khorixas area seem to refute this. In many instances the people who are utilising the IMC boreholes say they were never involved in the process of siting the borehole, and are generally unable to point to the borehole and say “that was a drought relief borehole” or comment on any of the conditions under which the borehole was installed. It was not possible to investigate this point further to determine how or why this apparent lack of communication existed. In addition, there seemed to have been no liaison between the IMC and the Regional Rural Water Supply Offices in Khorixas during the process (van der Merwe, pers. comm.). No records exist in this office of the work the IMC did in the area, although maintenance of these boreholes is now the responsibility of this office (ibid.).

The IMC played a major role in providing boreholes in the Kunene Region during the 92/93 drought. However, it was difficult to validate some of the claims which were made about the process, as few substantial records seem to exist.
Table 10.6: IMC Boreholes Visited During Study

<table>
<thead>
<tr>
<th>Borehole</th>
<th>Borehole Number</th>
<th>Type of Installation</th>
<th>Yield (litres/hour)</th>
<th>People served</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reported</td>
<td>Reported</td>
</tr>
<tr>
<td>Halt post</td>
<td>34106</td>
<td>Windmill</td>
<td>1 000</td>
<td>Poor</td>
</tr>
<tr>
<td>Bergville post</td>
<td>34107</td>
<td>Windmill</td>
<td>1 000</td>
<td>Poor</td>
</tr>
<tr>
<td>Lofdal post</td>
<td>34110</td>
<td>Diesel engine</td>
<td>6 000</td>
<td>Good</td>
</tr>
<tr>
<td>Engelbrecht post</td>
<td>34111</td>
<td>Windmill</td>
<td>1 500</td>
<td>not utilised</td>
</tr>
<tr>
<td>Nugas post</td>
<td>34114</td>
<td>Windmill</td>
<td>2 000</td>
<td>Poor</td>
</tr>
<tr>
<td>Freyer</td>
<td>34116</td>
<td>Diesel engine</td>
<td>6 000</td>
<td>Dry</td>
</tr>
<tr>
<td>Emmanuel post</td>
<td>34122</td>
<td>Windmill</td>
<td>1 000</td>
<td>Dry</td>
</tr>
<tr>
<td>Petrusfontein post</td>
<td>34125</td>
<td>Solar panel</td>
<td>7 200</td>
<td>Good</td>
</tr>
<tr>
<td>Post 66</td>
<td>34126</td>
<td>Windmill</td>
<td>1 800</td>
<td>Good</td>
</tr>
<tr>
<td>Polgrietersrus</td>
<td>34128</td>
<td>Solar panel</td>
<td>34 000</td>
<td>Good</td>
</tr>
<tr>
<td>Tussenby</td>
<td>34129</td>
<td>Diesel engine</td>
<td>300</td>
<td>Dry</td>
</tr>
<tr>
<td>Renosterkop</td>
<td>34131</td>
<td>Diesel engine</td>
<td>9 180</td>
<td>Good</td>
</tr>
</tbody>
</table>
10.2.3 Education

The IMC developed a rural health information service programme as part of the borehole development project. The programme focused on sanitation and hygiene, basic health measures to be taken in a rural setting, water use patterns, and water use efficiency. Other principle topics included safe and sustainable borehole yields, reducing water waste and evaporation, appropriate stocking levels and better planning for droughts. The programme was led by the IMC’s Community Liaison Officer, educational pamphlets were printed in five languages, and these pamphlets distributed and discussed in community forums (IMC Report, 1994).

10.2.4 Environmental Considerations

Environmental clearances, issued by the Ministry of Wildlife, Conservation and Tourism (MWCT), were obtained for all 55 borehole sites where potential new water points were drilled. These were intended to ensure that the new water points did not have an adverse effect on the environment and wildlife in the region, and to identify areas in which borehole development activities should be precluded due to potential depletion of the water table (Manzella, 1994). The issuing of these certificates required that a representative of MWCT be present during the siting process for each borehole. However, very little information, such as environmental criteria which need to be considered in the siting of a borehole was available to MWCT at the time. This lack of data, in conjunction with the urgency that the borehole be sited in order to provide humanitarian aid in the form of drinking water to existing villages, meant that the MWCT officer was only able to give advice in cases where obvious environmental damage would occur (Tarr, pers. comm.). It was not determined whether the MWCT officer had the authority to refuse drilling in certain areas.

In December 1993 phase III of the development was temporarily halted. This was at the request of the Ministry of Wildlife and Tourism that an environmental assessment be carried out at each borehole site. The IMC proposed that an environmental baseline study be carried out in locations where Phase III boreholes were successfully implemented. Environmental Evaluation Associates of Namibia (EEAN) were then appointed to provide the first comprehensive environmental assessment of proposed borehole sites in Namibia (EEAN, 1994a).
11. Review of Case Study Boreholes

During the course of this study 12 boreholes, drilled and installed by the IMC, were visited. As mentioned in the previous section the results of the Nigerian Drilling Programme were not studied on the ground due to the programme’s failure.

Direct observations were taken regarding the water point infrastructure which was serving the settlement, while settlement members who most utilised the borehole were questioned on issues such as borehole yield and maintenance. The results from the boreholes which were assessed are presented in Table 11.1.

In general the infrastructure which was installed in the programme depended on the needs of the existing settlement. Where possible existing infrastructure seemed to be utilised, however, in some cases this was to the detriment of the community served. This was most evident with regard to environmental health issues, namely the provision of potable drinking water (see health section below). The IMC report made no mention of any infrastructure standards which might have been set, or any sort of quality control systems which might have been implemented to ensure that the infrastructure provided was of long-term benefit to the receiving settlement.

Maintenance conditions of borehole infrastructure varied widely, and although the responsibility of maintenance for these boreholes falls with the Regional RWS office in Khorixas, the condition of many of the water points was often directly related to the attitudes of the people concerned. An example of this is at Lofdal Post where the PVC pipes originally installed with the borehole, which are prone to leaks, are being replaced with unused steel pipes, and old cut out tyres placed under all taps to collect spilled water for use by the dogs and goats. This can be compared to Engelbrecht Post where the windmill was pumping into a full reservoir and hence overflowing onto the ground.
<table>
<thead>
<tr>
<th>Borehole</th>
<th>Installation</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halt Post</td>
<td>Windmill 2 500 litre reservoir Tap Trough</td>
<td>The IMC borehole is one of 3 presently serving the settlement. The oldest borehole (pre 1990) is very salty and is only used for stock consumption. A second borehole was drilled in 1990 (before the drought relief programme) is believed to have delivered sufficient water for human consumption since its installation, and, although quoted by IMC as capable of delivering 1000 litres/hr, the IMC borehole is presently only yielding sufficient volume for human consumption. This made it difficult to accurately determine whether the IMC borehole was installed for strictly humanitarian drought relief reasons.</td>
</tr>
<tr>
<td>Bergville Post</td>
<td>Windmill 2 500 litre reservoir Tap</td>
<td>The IMC borehole is one of 2 serving the settlement (the IMC borehole being installed as the 2nd borehole). At the time of installation of the IMC borehole a new concrete reservoir was built to catch the overflow from the old reservoir due to the expected increase in yield. However, due to the present low combined flow from both boreholes this new reservoir is no longer in use. A tap was placed on the pipe from the windmill to the reservoir, but due to short pumping times of the borehole (farmer estimates borehole pumps &quot;dry&quot; after about half an hour) this tap is not utilised and water has to be drawn from open reservoir.</td>
</tr>
<tr>
<td>Lofdal Post</td>
<td>Diesel engine</td>
<td>The IMC installed diesel engine pumps water from a high yielding borehole which is situated in a river bed, approximately 400 m over a small hill to an old existing reservoir in the village. The PVC pipes which have been lain for this purpose are very inefficient as they are perishing and often develop leaks. Pipelines have also been laid to clusters of homes in the settlement with improvised temporary storage facilities (210 litre drums) which allow for a very effective permanent household supply even when the pump is not working.</td>
</tr>
<tr>
<td>Engelbrecht Post</td>
<td>Windmill 10 000 litre tank Tap Trough</td>
<td>The IMC borehole at this post is not utilised by the settlement, who prefer to use a borehole which existed before the IMC borehole was installed. Only when their preferred borehole has a breakdown is the IMC borehole utilised, and this is seems to be very rare as grass was growing around the trough. Differing viewpoints were received from people in the settlement regarding the issue of whether or not they actually have to use the borehole in times of drought, posing an interesting question of whether or not it should have been installed as an emergency drought relief borehole. The borehole is served by a windmill which has not been locked off, and which was pumping continually with water overflowing onto the ground.</td>
</tr>
<tr>
<td>Nugas Post</td>
<td>Windmill 10 000 litre tank</td>
<td>The borehole installed by IMC replaced an inefficient handpump (now broken). Borehole yields are low and generally insufficient for the settlement it serves.</td>
</tr>
<tr>
<td>Renosterkop</td>
<td>Diesel engine</td>
<td>High yielding borehole uses diesel pump to pump water approximately 300m from borehole to settlement reservoir.</td>
</tr>
<tr>
<td>Borehole</td>
<td>Installation</td>
<td>Observations</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Freyer</td>
<td>Diesel engine</td>
<td>The IMC reported that a diesel engine with a power head was installed at “Freyer North”. However during this site investigation it was determined that Freyer is supplied by a borehole which was installed before 1993 (exact date unknown). A drilled and cased, but uninstalled, borehole is situated some 30m from this borehole, which people at the settlement say never produced any water during pump testing. Apparently a consultant sited and marked a position for this borehole to be drilled, however when the drillers arrived they set up and drilled this unsuccessful borehole approximately 10m away from the marked spot. It is hard to believe that this could be the IMC borehole - unfortunately a GPS was not available to determine whether the co-ordinates matched up with those stated in the IMC report. At the time of visit the farmers were busy making temporary repairs to the pipes leading to the reservoir which had been broken by elephants during the previous night.</td>
</tr>
<tr>
<td>Emmanuel</td>
<td>Windmill 10 000 litre tank Tap</td>
<td>IMC borehole was drilled to supplement a very marginal existing borehole. The borehole was sited approximately 500 m from the existing borehole, and water is piped from the borehole, via a new 10000 litre plastic tank, to the old existing reservoir and trough. The yield of this new borehole is poor - apparently it takes 2-3 weeks to fill the plastic tank during the dry season. A borehole, strictly for stock use, was drilled after the IMC borehole was installed. This borehole is sited about 1km away from the homestead and is used to supplement the IMC supply.</td>
</tr>
<tr>
<td>Petrusfontein Post</td>
<td>Solar powered mono-pump 10 000 litre tank Tap and Trough</td>
<td>Prior to IMC borehole no water point, or settlement existed in this area. The IMC borehole provided the means for a new settlement. A solar powered pump has been installed and adequately meets the needs of the settlement (it often has to be turned off). Plastic water tanks installed with borehole provide water for human and stock consumption.</td>
</tr>
<tr>
<td>Post 66</td>
<td>Windmill 10 000 litre tank Trough</td>
<td>The IMC borehole is one of four water points serving Post 66. The IMC borehole is used almost exclusively by one farmer who is farming in a semi-commercial manner, and it is doubtful whether this borehole would have qualified as a drought relief measure. The borehole’s infrastructure has been kept in excellent maintenance condition by the farmer.</td>
</tr>
<tr>
<td>Potgietersrus</td>
<td>Solar powered mono-pump</td>
<td>The best yielding borehole drilled by the IMC, this borehole is served by a solar panel which places a limit on pumping capacity. The people in the settlement feel they have had to decrease the size of their garden due to this lowered yield, especially in the months where cloud cover decreases pump yields further. In this community a higher yielding diesel pump is requested, regardless of the implication of subsequent higher maintenance costs.</td>
</tr>
<tr>
<td>Tussenby</td>
<td>Diesel engine Trough</td>
<td>Borehole originally installed by the IMC with a handpump which was later changed by Dept. of Rural Dev. to a diesel pump. Borehole has always been marginal regarding yield, and presently provides only sufficient water for one household's personal consumption.</td>
</tr>
</tbody>
</table>
12. Discussion and Evaluation of Environmental Impacts and Issues

12.1 Ecological Impacts

Boreholes in Khorixas have had impacts on the ecology. These are evaluated and discussed in the following sections under the headings of:

- Soil/land
- Vegetation
- Land-use and Grazing Management
- Wildlife
- Water resources

12.1.1 Soil/Land

The results of the soil description for all sites are presented in Table 12.1. (Horison did not have a IMC borehole, however, it has been presented for comparison.) The topography surrounding the sites, was mainly hilly apart from Halt and Engelbrecht which were flat. Boreholes and settlements were located along drainage lines in flatter areas. At eight of the ten sites, the land was very stony with sandy loam soil. Signs of water and aeolian erosion were noted at all sites.

The degree of disturbance of soil was closely correlated to the distance from the borehole. Soils around the boreholes and homesteads were heavily trampled due to animal traffic and in many cases there was a significant amount of trampling observed up to 500m from the boreholes (see photograph 12.1). One exception to this was Engelbrecht, where only light trampling was observed, due to the fact that the borehole is only utilised in emergencies.
Table 12.1: Results of soil descriptions for each site in Khorixas. Descriptions apply to an area within 500m radius of the borehole.

<table>
<thead>
<tr>
<th>Locality Names</th>
<th>Relief</th>
<th>Surface Stoniness</th>
<th>Form of Soil Surface</th>
<th>Soil Texture</th>
<th>Evidence of erosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halt Post</td>
<td>Flat, shallow water course present</td>
<td>Few stones</td>
<td>Heavily trampled</td>
<td>Sandy loam, loose and permeable</td>
<td>Yes</td>
</tr>
<tr>
<td>Bergville Post</td>
<td>Hilly, river bed</td>
<td>Many stones</td>
<td>Heavily trampled</td>
<td>Loamy, loose</td>
<td>Yes</td>
</tr>
<tr>
<td>Lofdal Post</td>
<td>Hilly, river bed</td>
<td>Many stones</td>
<td>Trampled</td>
<td>Loamy</td>
<td>Yes</td>
</tr>
<tr>
<td>Engelbrecht Post</td>
<td>Flat, river bed present</td>
<td>Few stones</td>
<td>Lightly trampled</td>
<td>Sandy loam, loose, permeable</td>
<td>Yes</td>
</tr>
<tr>
<td>Nugas Post</td>
<td>Hilly, river bed present</td>
<td>Abundant stones</td>
<td>Well trampled</td>
<td>Sandy loam</td>
<td>Yes</td>
</tr>
<tr>
<td>Freyer</td>
<td>Hilly, river bed present</td>
<td>Abundant stones</td>
<td>Well trampled</td>
<td>Sandy loam</td>
<td>Yes</td>
</tr>
<tr>
<td>Petrusfontein Post</td>
<td>Hilly, river bed present</td>
<td>Many stones</td>
<td>Well trampled</td>
<td>Sandy loam</td>
<td>Yes</td>
</tr>
<tr>
<td>Potgietersrus</td>
<td>Hilly, river bed</td>
<td>Many stones</td>
<td>Well trampled</td>
<td>Sandy loam, sandy in river bed</td>
<td>Yes</td>
</tr>
<tr>
<td>Tussenby</td>
<td>Hilly, river bed</td>
<td>Many stones</td>
<td>Well trampled</td>
<td>Sandy loam</td>
<td>Yes</td>
</tr>
<tr>
<td>Horison*</td>
<td>Hilly, bed</td>
<td>Many stones</td>
<td>Well trampled</td>
<td>Sandy loam</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*Was not the site of an IMC drought relief borehole. Included for comparison.
The presence of the boreholes has resulted in soil degradation in the study area. A study by Simmonds and Forbes Irving (1995), found moderate to severe water erosion and evidence of aeolian erosion in the area. This appears to correlate with the findings of this study.

Soils in the Khorixas area are generally thin and poorly developed. The main factor determining soil development and governing the present soil status is the arid moisture regime. It has been noted that climatically induced soil degradation overrides other limitations to the productivity and carrying capacity of soils in the region (EEAN, 1994a; Simmonds and Forbes Irving, 1995). However, this soil degradation can be enhanced by such factors as the absence of vegetation cover and intensive use of grazing in the vicinity of boreholes. The absence of vegetation can increase soil susceptibility to factors such as wind erosion and soils can be radically altered by constant livestock traffic (Jacobson et al., 1995).

As there is an absence of vegetation cover and intensive grazing is taking place in the vicinity of the boreholes at the study sites, soil degradation is more than likely taking place around the boreholes. It was not possible however, within the scope of this study, to determine the extent of this soil degradation.
12.1.2 Vegetation

Results of the vegetation description are presented in table 12.2. The observed vegetation at the sites was mopane scrubland interspersed with Acacia species and at most sites the state of vegetation cover was poor. Very little or no grass at all was observed in the vicinity of the boreholes (see photograph 12.1).

The exception to this was Engelbrecht, where grass was observed around the IMC borehole (see photograph 12.2). This is probably because it has not been utilised for stock watering (PRA interview).

![Photograph 12.2. Good vegetation growth around the borehole at Engelbrecht.](image)

Because of the lack of grass it was not easy to assess whether perennial or annual grass species were dominant in the area. However, around most of the study boreholes and homesteads an absence of perennial grass tufts was observed. Most bushes and trees showed signs of being heavily browsed, there was a lack of new growth and not many smaller bushes. At Petrusfontein Post, for example, bushes had been heavily browsed and there was a lack of new growth (see photograph 12.3).
Table 12.2: Results of vegetation descriptions for each site in Khorixas. Descriptions apply to the area within 500m radius of the borehole.

<table>
<thead>
<tr>
<th>Localty Names</th>
<th>Vegetation Components</th>
<th>Grass Description</th>
<th>Browse Pressure</th>
<th>Tree stumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halt Post</td>
<td>Mixed mopane, <em>Acacia</em> woodland</td>
<td>Not much grass. Mainly small herbaceous annuals. More annual than perennial grass observed</td>
<td>Trees/shrubs heavily browsed, coppiced mopane present</td>
<td>Few tree stumps around homestead</td>
</tr>
<tr>
<td>Bergville Post</td>
<td>Mopane scrubland</td>
<td>No grass observed around borehole</td>
<td>Lower branches no leaves, no young trees, no coppiced mopane observed</td>
<td>None observed</td>
</tr>
<tr>
<td>Loldal Post</td>
<td>Mopane scrubland, big trees, very few <em>Acacia</em></td>
<td>No grass observed around borehole, some grass around pump which is fenced off</td>
<td>Trees/shrubs heavily browsed, no young trees, not many small bushes observed</td>
<td>None observed</td>
</tr>
<tr>
<td>Engelbrecht Post</td>
<td>Large mopane trees and some <em>Acacia</em></td>
<td>Short mostly annual grass around borehole, few perennials seen</td>
<td>Big mopane trees, not heavily browsed</td>
<td>None observed</td>
</tr>
<tr>
<td>Nugas Post</td>
<td>Thornbush scrub mopane</td>
<td>No grass observed at all</td>
<td>Mostly heavily browsed <em>Acacia</em></td>
<td>None observed</td>
</tr>
<tr>
<td>Freyer</td>
<td>Scrub mopane, few <em>Acacia</em></td>
<td>No grass around borehole or in surroundings</td>
<td>None around borehole, heavily browsed, no young growth</td>
<td>None observed</td>
</tr>
<tr>
<td>Petrusfontein Post</td>
<td>Scattered mopane and <em>Acacia</em></td>
<td>Very small amount annual grass around homestead</td>
<td>Heavily browsed trees</td>
<td>None observed</td>
</tr>
<tr>
<td>Potgietersrus</td>
<td>Scattered mopane and <em>Acacia</em></td>
<td>Very small amount short annual grass around</td>
<td>Heavily browsed trees, no young bushes</td>
<td>None observed</td>
</tr>
<tr>
<td>Tussenby</td>
<td>Mainly <em>Acacia</em></td>
<td>No grass observed</td>
<td>Heavily browsed bushes/trees</td>
<td>Few stumps present</td>
</tr>
<tr>
<td>Horison*</td>
<td>Mainly <em>Acacia</em></td>
<td>Very small amount of annual grass around</td>
<td>Tree heavily browsed</td>
<td>None observed</td>
</tr>
</tbody>
</table>

*Was not the site of a IMC or drought relief borehole. Included for comparison*
As the status of vegetation in an arid region such as Khorixas is as much influenced by climate as by grazing pressure (as discussed in section 7), it is very difficult to determine the extent of overgrazing and degradation in the area. At all the sites except Engelbrecht and Tussenby, farmers reported that they had had none or not much rainfall yet in the year. This might explain in part, the observed poor state of vegetation cover, the absence of grass and the lack of new growth on bushes.

It was observed that vegetation cover was much greater in areas between boreholes than near the boreholes. These areas were along the road between the boreholes and presumably had not been subject to as intensive grazing pressure because they were far away from the boreholes. In addition, perennial grass tufts were also observed (see photograph 12.4). This was in contrast to areas around the boreholes where vegetation cover varied from very little to nothing. Although this, in part, could be due to patchiness of rainfall, the state of vegetation cover around the boreholes has been influenced by heavy grazing and browsing pressure.

The reduced vegetation cover around boreholes means that the soil is more prone to degradation processes. For example, the lack of low herbaceous cover exposes the soil to a greater potential for wind erosion. Soil degradation can also be detrimental to vegetation recovery as soil seed banks are destroyed. Although vegetation productivity was not determined, at seven out of ten sites, farmers felt that grass recovery was good following sufficient rainfall. This statement was borne out by a study in 1995, when high rains were
experienced (see figure 9.3) and grass recovery was very good (Jacobson et al., 1995; Sullivan, 1996b). It was thus not possible to gain any indication as to whether irreversible vegetation degradation is taking place around the study boreholes.

![Photograph 12.4. More vegetation cover and perennial grass tufts were observed in areas away from the boreholes.](image)

Problems encountered with the low percentage of cover are exacerbated by the lack of perennial cover. A lower amount of perennial cover means that vegetation responses will be lower in response to early and lighter rainfall events (EEAN, 1994a). This could result in grazing shortages. This does appear to happen in the Khorixas area as at least six of the ten sites visited (namely Petrusfontein Post, Nugas Post, Engelbrecht Post, Horison, Freyer, Potgietersrus), farmers spoke of having to move with their animals in search of grazing.
At most sites a gradation in vegetation cover could be observed. Closer to the boreholes cover was less and shrubs and trees more heavily browsed. As distance from the borehole increased, the amount of vegetation cover increased, more grass was visible and browse lines on bushes were lower. This has important implications for the siting of boreholes (as discussed in section 7). If boreholes are placed too close together, the most intensively used areas will be closer together and the total amount of less frequently utilised vegetation will decrease. Severe overgrazing could thus be more prevalent which would lower grazing reserves in dry times. The provision of boreholes could, therefore, indirectly exacerbate drought conditions.

Tree stumps were only observed at two of the sites. This correlates with information supplied by people who said they preferred to use dry wood rather than chop down trees for firewood (PRA interviews). However, any increase in population prompted by the installation of a borehole would result in an increased demand for wood. If this is not taken into account, deforestation could occur. This would have implications for fodder availability for livestock. This reduced fodder availability could exacerbate drought conditions and mean that fewer animals could be kept in the area.

12.1.3 Land Use and Grazing Management

The predominant activity at the study sites is livestock farming. Stock numbers varied from 150 animals to 350 animals being served by a borehole with far greater numbers of small stock than cattle (see Table 12.3).

Information gathered during PRA exercises indicated that livestock numbers at the study sites fluctuated greatly in response to variations in rainfall and grazing availability. The drought relief boreholes did not appear to have an influence this climatically induced variability. At seven of the ten sites (namely Bergville Post, Petrusfontein Post, Nugas Post, Lofdal Post, Horison Post, Freyer and Potgietersrus) livestock numbers decreased after the installation of the relief boreholes.

The installation of drought relief boreholes at sites where people were already established did not lead to an increase in livestock numbers. However, the establishment of a new post at one site (Petrusfontein Post) has definitely resulted in an increase in livestock numbers in this area. In addition, at three other sites (namely Halt Post, Potgietersrus and Nugas Post), people stated that they had moved to the borehole after it had been installed bringing their stock with them. This results in increased pressure on rangeland with the potential for increased degradation.
Table 12.3. Uses of the borehole and the number of small stock (goats and sheep) and large stock (cattle) at each settlement. Numbers are taken from PRA exercises and are approximate.

<table>
<thead>
<tr>
<th>Locality Names</th>
<th>Uses</th>
<th>No. of Small Stock</th>
<th>No. of Large Stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halt Post</td>
<td>Domestic mainly</td>
<td>200 (not watered at IMC borehole)</td>
<td>-</td>
</tr>
<tr>
<td>Bergville Post</td>
<td>Domestic and stock</td>
<td>150</td>
<td>-</td>
</tr>
<tr>
<td>Lofdal Post</td>
<td>Domestic and stock</td>
<td>200</td>
<td>10</td>
</tr>
<tr>
<td>Engelbrecht Post</td>
<td>Emergency use</td>
<td>300 (not watered normally at IMC borehole)</td>
<td>50 (not watered normally at IMC borehole)</td>
</tr>
<tr>
<td>Nugas Post</td>
<td>Domestic and stock</td>
<td>200</td>
<td>-</td>
</tr>
<tr>
<td>Freyer</td>
<td>Domestic and stock</td>
<td>No numbers obtained</td>
<td>-</td>
</tr>
<tr>
<td>Petrusfontein Post</td>
<td>Domestic and stock</td>
<td>No numbers obtained</td>
<td>-</td>
</tr>
<tr>
<td>Potgietersrus</td>
<td>Domestic and stock</td>
<td>Total numbers for the settlement not obtained</td>
<td>-</td>
</tr>
<tr>
<td>Tussenby</td>
<td>Domestic and stock</td>
<td>175</td>
<td>20</td>
</tr>
<tr>
<td>Horison*</td>
<td>Domestic and stock</td>
<td>200</td>
<td>30</td>
</tr>
</tbody>
</table>

In discussion with farmers, at all sites except Horison and Nugas Post, they indicated that there was generally enough grazing for their stock. However, at six of the ten sites, farmers have moved with their animals in search of grazing in dry times. At two boreholes (Nugas Post and Freyer), people move with their animals to natural springs in their area for some months in the dry season for grazing. At Potgietersrus, Petrusfontein Post, Engelbrecht and Horison people have moved out of the Khorixas region in search of grazing during droughts. This would seem to suggest that, if sedentary farming is going to be practised, animal numbers are often too high to be sustained by available fodder in drier times.

The provision of water as a drought relief measure, would thus appear to be misdirected. The problems experienced during droughts are more related to a lack of grazing than a lack of water. At one site, the farmer moved with his animals after the borehole had been installed in search of grazing.

As discussed in section 7, mobility is an important farming strategy to cope with an arid environment and fluctuations in resource availability, and is an appropriate adaptive strategy. Many farmers in the study area practice mobility as indicated. The provision of boreholes during drought might be encouraging farmers to stay on in areas too long before being forced to move in search of better grazing and water. This leads to increased pressure on rangeland which is not given a chance to recover and to degradation. Thus susceptibility to future droughts can be increased.

The creation of new cattle posts through the provision of water also leads to decreased options for future seasonal grazing utilisation as people tend to settle permanently at these posts. This has happened at Petrusfontein Post,
where people settled permanently at the post after the borehole had been installed.

In addition planning for the movement of stock between posts to manage grazing may be precluded if boreholes have been placed too close together. This limits options for successful management. It was not clear if this has happened in Khorixas.

Farmers showed different levels of awareness of the need to manage grazing. At four of the ten sites, farmers indicated that they rotated their stock between two or three camps, using fencing left from the previous white commercial farmers. Many others however left stock to graze where they could find fodder, in an open extensive system.

Frustration at being unable to have enough control over grazing to practice management was often expressed by farmers. They felt that they could not keep outsiders out and reserve grazing for drier times. If the installation of a borehole at a settlement makes it more attractive to other people, overuse of the area could result due to farmers' inability to control resource access. The lack of clear policy on resource control is exacerbating this situation.

In Khorixas, water was mainly provided at previously occupied areas. Thus the impacts of drought relief boreholes and existing boreholes are very difficult to differentiate. However, the provision of water might be allowing unsustainable land use practices to continue. A report by Simmonds and Forbes Irving (1995) indicated that much of the land use in the area was degrading the land.

12.1.4 Wildlife

Wildlife numbers in the area are relatively low (see table 9.1). Thus the impact on wildlife from the new boreholes should be minimal.

Of all the wildlife in the area elephants have the most direct effect on the people living in this area. At all the sites except Holt Post, Petrusfontein Post, Potgietersrus and Horison, people reported that they had problems with elephants. Stock water troughs and reservoirs, supplied by boreholes, are regularly utilised by elephants as water sources. If water levels in these troughs or reservoirs are insufficient to water the herd, the elephants will often damage the borehole. This is especially prevalent with boreholes pumped by windmills, which are often pushed over and have their pipes ripped up by the elephants in an attempt to find water. Diesel and solar pumps are generally not damaged by elephants.

When a borehole has been damaged, people often have to wait a while for DRWS maintenance to do repairs. During this time water has to be acquired from other nearby households. Stock are then moved to nearby posts for drinking.

In addition, elephants regularly destroy peoples gardens whilst utilising water from the boreholes. Some people reported that they had given up attempting to
garden due to the impact of elephants on these gardens. This is a potentially serious impact as it restricts peoples access to an important resource.

The confrontation between elephants and people in the region could be mitigated to some extent by the construction of stone elephant walls around pumps and the installation of additional water points intended for wildlife use only (Jones, 1994).

12.1.5 Water Resources

There is no monitoring of water levels or yield of the boreholes. It could not therefore be determined how sustainable the use of the boreholes has been. However at Bergville, the farmer reported that the borehole pumped dry in half an hour.

Water yield from the boreholes could be expected to vary from year to year and season to season according to the amount they are recharged. However these changes may be exacerbated by overuse. Many of the boreholes were sited along drainage lines which theoretically means they have good potential for recharge. However, overuse of these boreholes could have negative impacts downstream as aquifers associated with these drainage lines are depleted (Jacobson et al., 1995). It was not possible to ascertain the sustainability of these boreholes with respect to water tables.

There is evidence of numerous wells and boreholes in the western catchments that have been abandoned because of a drop in groundwater levels resulting from water being pumped in excess of its rate of recharge. Furthermore, overuse of vegetation near such sites, combined with compaction of the soil by livestock, may further contribute to decreasing water infiltration and groundwater recharge rates (Jacobson et al., 1995). The lack of vegetation and soil disturbance found at the sites, thus might be resulting in decreased recharge of the boreholes’ aquifers. This could not be ascertained, however.

12.1.6 Ecology Conclusions

An important point to note is that no difference between areas around the IMC boreholes and other boreholes visited in the area were noted. This is probably due to the fact that many IMC boreholes were installed at previously occupied sites.

Based on information gathered it did not appear as if boreholes had affected adaptive farming strategies to a large extent, as farmers still moved. Drought relief boreholes do appear to be misdirected relief in this case however, as grazing problems are more pressing in droughts than water problems as far as stock are concerned.
It could not be ascertained whether irreversible degradation is taking place around the study boreholes. However in some cases there has been increased pressure on soil and vegetation which could lead to degradation.

The lack of natural resource tenure has a major impact on people's ability to control and manage their environment. They do not have the power to exclude people from using their resources. This means that if a borehole is installed in an area and people lack access control, overuse of the natural resources of the area could occur. In Khorixas this appears to be happening.

### 12.2 Social and Economic Impacts and Issues

Boreholes have had an impact socially and economically. These impacts are evaluated and discussed in the following sections under the headings of:

- Movement and Settlement Patterns
- Networks of Settlements Round Boreholes
- Leadership Issues and Resource Access and Control
- Borehole Community Profile
- Economic Impacts and Issues
- Community Ownership
- Tourism
- Maintenance and Running Costs

#### 12.2.1 Movement and Settlement Patterns

Settlement and movement patterns in the area have resulted from water availability and more recently, the provision of permanent water points.

People have settled where boreholes have been installed, generally at the original Odendaal homesteads and at the more remote farm-posts (see photograph 12.5).

The provision of boreholes has meant that permanent settlements have occurred in the marginal lands where previously human and livestock movements were seasonal (Jacobson et al., 1995). Even the white settlers who had lived on the farms that were incorporated into Damaraland as part of the Odendaal Plan had abandoned many of the farms, the area proving to be unproductive and too marginal for livestock farming (ibid). In other cases, these farms were used seasonally as additional grazing reserves for farmers living elsewhere. This pattern was similar to the transhumance of nomadic pastoralists (ibid).
Because the land is marginal and is unable to support the survival needs of people and their livestock, movements continue to take place. This was confirmed by the findings of the study team where all households visited had family members who came and went at various times (see PRA results in Appendix 7). For instance, cattle still need to be moved to where grazing is available, as the provision of boreholes does not address this need.

In the study area visited there was found to be a variety of movement patterns both to and from the settlements around the boreholes with members leaving and returning at different times in response to factors such as employment, visiting of family members, water shortages and grazing. Movements occur between rural areas and town in response to employment and schooling. (Bergville post, for example). ‘Weekend’ or ‘absentee’ farmers who work in the nearby towns return periodically to the farms (for example at Lofdal post and Horison).

Cattle and human movements do not always coincide. For instance, at Bergville post, the farmer’s cattle stay at his son’s post nearby where grazing is better, returning every two days to drink at his borehole.

The number and composition of people at a settlement thus varies over time and forms part of the flexible system that operates in Damaraland. As a result, households and communities are often not clearly defined.
Movements into the area would not have been possible without the permanent water points. However, reasons for movements to the settlements from other areas were generally given as responses to shortages of water and grazing during various times of drought (see PRA time trend findings in Appendix 7). Movement directly as a response to borehole installation was only clearly apparent at one household, namely Petrusfontein post, where people moved to the post after the 1993 borehole was installed. At Halt post, additional newcomers moved in after the 1993 borehole, and at Nugas post movement was partially in response to this. It needs to be continually borne in mind, however, that the boreholes are necessary for these permanent settlements to have taken place at all.

Although it was found in the study that some people, with or without their whole families, have moved away from the area at times for grazing elsewhere, they usually return. Nugas post and Petrusfontein post provide examples of this.

Ongoing human migration into the area continues, putting increasing pressure on existing natural resources including water, soil and vegetation. People have settled on an ad hoc basis, with an absence of clear legislative control or regulation of settlement and no ‘traditional’ land allocation in place (Rohde, 1994). According to some people interviewed (such as Murowoa, pers. comm.) new people were at times moved into areas where boreholes were drilled, but where the water supply was not always sufficient to serve both existing and new settlers.

Potgietersrus, a fairly large settlement, provides an example of the type of settlement pattern that was found (for more details of this and other settlements, see PRA findings in Appendix 7):

- In 1966 the original settlers moved to the area when land was made available to them. There was plentiful water in the valley and three pumps at that time.
- In 1984 newcomers moved in from Windhoek.
- In 1986 some people with their livestock, left as a result of drought, but returned in 1995.
- Some adult children have left at times to work in the towns.
- In 1987 there was a drought and the fountain was dry. Water and grazing is reported to be declining since 1986, particularly after 1993.

The occupants reported that they would like the newcomers to leave, but feel they have no control over this. The newcomers responded that they have nowhere to go.
12.2.2 Networks of Settlements Around Boreholes

The aim of borehole provision is the reliable supply of water to people living in the Khorixas area. This was not found to be completely successful, however, with boreholes often proving unreliable, in terms of adequate water supply and variability in the quality of the water for human or stock consumption. Certain settlements have boreholes which were unsuitable for drinking, while others have in the past produced water that caused the death of livestock. Breakdowns frequently occur, and elephant damage is a problem.

Informal arrangements are made with neighbouring settlements. Most settlements were found to have a network of between one and five other settlements with whom they have reciprocal water use arrangements in times of need (see PRA network charts, Appendix 7). Thus each settlement is not self-sufficient with regards to water.

In addition, seasonal fountains and springs are available and used near certain settlements such as Freyer and Nugus post. One family mentioned that once the water cost recovery programme comes into effect, they will use the nearby fountain as their main water source. These springs and sometimes boreholes are also used by wildlife. Elephants also shared borehole water, often causing damage.

In addition to borehole use, other exchanges were found to take place among these networks, such as food sharing, borrowing, visiting and grazing (see PRA network charts, Appendix 7).

Each household or borehole therefore cannot be viewed as a completely separately functioning entity. Rather, settlements around a number of neighbouring boreholes were found to be interconnected, reciprocal and 'opportunistic', sharing water and other resources, such as grazing, transport and food in times of need.

Thus the traditional flexible, risk-spreading system of exchange networks as a strategy of coping in an arid environment, was found by the study team to continue to exist. The challenge is to retain this flexible system that permits groups to negotiate shared grazing and water, and stock mobility in times of stress.

12.2.3 Leadership Issues and Resource Access and Control

Control of access to resources, including water and grazing, and the exclusion of newcomers has been found to be a serious problem in the area. Prevention of influxes of people and their livestock appears to be difficult to enforce.

The lack of clear and effective leadership structures and a lack of coordination of government institutions and policies in the area, as well as a lack of community ownership and often less than clear cut community definition, allows for situations where outsiders can move onto the land and benefit from
the infrastructure and resources such as water and grazing, without necessarily contributing to management or maintenance, and at the expense of existing farmers. In dry seasons, for instance, people from the south (Erongo region) bring their cattle and invade areas around Khorixas. Farmers with large herds from other areas can have access in areas occupied by farmers with small herds, thus competing inequitably for water and grazing. The ‘community’ of an area is not homogeneous and various people with different interests co-exist, such as wealthy cattle owners and poorer communal farmers (Jones, 1993). Some stock owners, for example, have over 100 cattle or small livestock, while others have none at all (Rohde, 1994).

Furthermore, uncontrolled influxes of people into an area results in increased pressure on vulnerable resources, resulting in subsistence and livelihood losses to the community and putting further pressure on other sectors and on working relatives.

Communal resources are theoretically open and accessible to all communal residents (Rohde, 1994). During the drought and at present, access to water and grazing is negotiated on an ad hoc basis with few rules governing the resolution of conflicts of interest. Rights of access and rights of exclusion are generally negotiated on a flexible, informal basis (Sullivan, 1996a). Accommodation has generally been the norm, and refusals few, despite protestations from original residents (ibid and PRA findings).

Although the role of traditional leaders has been undermined, headmen and councillors are still generally consulted in land allocation and disputes. This was confirmed in the study, where community members responded that they continued to consult traditional leaders regarding these issues. The Department of Water Affairs also usually liaises with traditional leaders and the regional councillors, as their importance is seen as valued in the community (Koch, pers. comm.). Their effectiveness is limited, however. For instance, in the 1993 drought, the system was unable to prevent newcomers moving into a particular area (Rohde, 1994; PRA findings). The Ministry of Lands, Resettlement and Rehabilitation has declared its authority to settle disputes arising out of the drought, although it lacks the capacity to do so (Rohde, 1994).

The Regional farmer’s Union, with it’s seven associations, may be beginning to fill some of the gaps in leadership structures. The Welwitchia Farmer’s Union for example, has been involved in facilitating meetings between wards to mediate resource conflicts, as well as to organise the recent government subsidised movement of farmers to Ugab for grazing purposes (Rohde, 1993 in Sullivan, 1996a; Murowoa, pers. comm.).

Thus plans for the provision of waterpoints need to take into account the possibility of uncontrolled influxes of people and livestock into an area which could result in a strain on the resource base, and the need to support or strengthen existing control structures that people feel are legitimate.
12.2.4 Borehole Community Profile

Particular community profiles around the boreholes have developed in response to circumstances such as land use practices and the inability of the land to completely sustain the people. These profiles were found to vary between settlements. They can have an impact on resource use and management. Community composition included the following:

- Most farmers were found to be Damara/Nama speaking;

- Pensioners and pre-school grandchildren appeared to comprise the majority of the settlement communities. These pensioners comprise a significant segment of the farming population (Rohde, 1994; PRA findings). Following retirement, many wage employees who have maintained herds on the farm area, go to live their retirement years with their livestock, their state pension providing a small cash income. They play an important role in the extended family of parenting for working children. At school age, many children become boarders or live with kin in Khorixas. The elderly people also maintain the herds and the property for the extended family;

- Because of the necessity to supplement livelihoods with employment income, young adults often migrate to urban or other areas for employment. The resulting shortage of young adults in the rural areas has led to what has been called the ‘missing generation’ of able-bodied young adults. This can have a negative impact on farm labour, undermining farm production. An example of this was found at Potgietersrus;

- However, younger adult family members who are not in wage employment also often spend prolonged periods of time with their older relatives, assisting with herding and household tasks and benefiting from both a place to live and a source of subsistence. At some settlements such as Engelbrecht, three generations were present. A problem was cited in that the limitations of land precludes the young adults from farming themselves, and thus they need to find alternative means of livelihood;

- 'Weekend' or 'absentee' farmers were another group found at settlements. In the study, for example, these were found at Horizon and Lofdal post. Livestock herded on the farms often belongs to these farmers who work as unskilled or skilled employment in the formal sector, usually in the civil service in Khorixas. These farmers spend varying amounts of time on the farm, from those returning at weekend to those who rarely visit. They enhance the security of extended rural families and provide a subsistence wage to herders. However, this can also have negative implications regarding farm management; family members or herders are left in charge of day to day decisions as well as water point use and maintenance. These may be less skilled or physically capable, and may negatively affect management practices;
• Herders and farm labourers are employed by some farmers, such as pensioners as well as often being responsible for the day-to-day management of herds for absent farmers. These men usually in their twenties, are generally Damara speaking, but can be Ovambo and Herero, coming from areas of high unemployment, and usually staying for one to two years (Sullivan, 1996a). Of the group of four herders interviewed in the study at Lofdal post, one was Ovambo. These herders were also found to have family who spent amounts of time moving between the farm and elsewhere;

• The people in any particular settlement were not necessarily related. Some settlements consisted of family members only, while at others different groups co-existed around a borehole, having moved in at different times;

• The occupants of the farm cannot only be regarded as those who are at a settlement at any one time, but include a wider network, and involving movement to and away from the settlements over time;

• The definition of community is likewise flexible. A larger interconnected and fluid network operates.

12.2.5 Economic Impacts and Issues
A review of the research findings follows:

(See Appendix 6 for a more detailed section on Livelihood Systems and Resource Use. Details at individual settlements are found in Appendix 7: PRA results).

There is minimal economic growth in the area of the Khorixas communal lands. Despite the provision of boreholes, current land use practices alone, such as livestock farming or gardens, were found to be unable to sustain the people in the area. Thus survival and basic cash needs such as food, school fees, clothing, medicine, and transport need to be supplemented by other means.

The settlements are therefore not self-sufficient and rely on a variety of livelihood and income sources. These include assistance in the form of formal or informal transfers from kin or neighbours, from formal or casual employment, pensions and food aid.

Many community members, especially women and herders, appeared to be living ‘on the edge’ with little surplus. The migration of able-bodied young adults in search of employment has led to a further loss of production.

Any decline in productivity that may result from drought conditions or land degradation as a result of an influx of additional settlers and livestock will result in even further losses of subsistence and livelihoods. An absence of
surplus would result in a spiral of poverty and a fragmentation of the network
relations which depends on these, as discussed in the section on Networks.
This will place greater pressure on other sectors as there will be more need
for supplementary income.

12.2.5.1 Livestock Farming
Livestock was cited in the study as the most important livelihood resource
(see PRA Resources findings). Boreholes have enabled people to continue
this economic activity despite the marginal lands.

Goats in particular provide a safety net in times of need, providing quick cash
for emergency items such as food and school fees. As with other resources,
goats are used in the network system, in order to assist others in times of
need.

Cattle were considered highly important and brought in larger amounts of
cash. However, they were not as important in times of need as goats. Sales
are more difficult than other livestock, prices are often low, and during drought
milk supplies cease. Cattle are used for meat, and for occasions such as
funerals and marriages.

According to Rohde (1994), livestock off-take rates are around 10%, giving
the average farmer a cash return of about R1200 per year. The benefits of
milk production and the consumption of small stock adds to the calculation of
subsistence income.

Policies concerning livestock numbers needs to take into account the cultural
values of livestock as well as their use in food security and risk spreading.

Although highly important, livestock farming is not productive enough to meet
subsistence or cash livelihoods, and thus these need to be supplemented
from other sources, as mentioned.

12.2.5.2 Gardens and Natural Resources
Gardens with crops and vegetables are grown by most communities (see
photograph 12.6). At Potgietersrus, for instance, the fairly large communal
garden grew maize, sunflowers, paw paws, watermelon, lucerne, pumpkins,
tomatoes and spanspek. Although insufficient to fully meet the subsistence
needs of the community, and the necessity of food to be supplemented from
other sources, gardens contribute to the needs of the community.

Despite the existence of boreholes, people cited seasonal inadequate water
supply as a partial reason for poor garden production. Elephants also
frequently damaged ripe crops in many cases. As a result the gardens did
not always fully meet subsistence needs except during periods of good
rainfall, mainly in December, January and February. Only at these times is
there sometimes a surplus for cash income. Potgietersrus, for example,
experienced three particularly lean months in winter, when members of the community are often without food.

Wood is used extensively in all communities for fuel, fencing and building (see photograph 12.7). However, wild foods were of little significance to the communities visited. At Nugas post, however, the herders used wild plants for medicines.
12.2.6 Tourism

Tourism could provide a possible form of alternative land use in the area, where few other options for income exist, thus alleviating pressure on the land through agriculture. As a form of land use, it has been cited as one of the most important employers in Namibia, employing some 10,000 people (Jacobson et al., 1995). Although considered underdeveloped, it is viewed as offering potential livelihoods in rural areas. Conditions need to be suitable and attractive to tourists, however.

Although Khorixas is on route to the southern gateway of the Skeleton Coast National Park, and several attractions are found in the area, such as the White Lady Bushman painting at Brandberg, tourist facilities in the study area around Khorixas were not found to be well developed. The privately owned lodge for tourists employs few people from the community.

Tourism can be either consumptive or non-consumptive, with non-consumptive demand, such as wildlife viewing, indigenous cultural experiences and photography, being greatest in the more pristine areas where human and stock activities do not predominate.
Consumptive demand such as trophy hunting, while having a large earning potential, requires less pristine areas, but does require sufficient wildlife. Where human activities predominate, wildlife that competes for resources such as livestock or water becomes eliminated. Here, even consumptive tourism will be limited.

Thus permanent human settlements and livestock farming as the predominant land use of the area, made possible through the provision of boreholes, may serve to preclude tourism as a land use option.

Although there are tourism projects in the region, in the area visited by the study team, there appeared to be little than would appeal to tourists, there being relatively little remaining wildlife or unspoilt nature. Elephants provided the exception in the Khorixas area and benefits could possibly be derived from trophy hunting and sales here. This would help to compensate for the cost of elephant damage to boreholes and ripe crops suffered by the community, as in order for elephants to co-exist with humans, people need to reap some benefits from them. The Conservancy concept, whereby communities are given control over their wildlife resources, would be a step in this direction (see Appendix 3).

In certain areas, boreholes exist for wildlife only, under the control of the MET. Wildlife including elephants also use natural springs not exclusively for human use.

In order for tourism to succeed as a land use option, it must be seen to benefit the communities in the areas. There exist initiatives in the region, although not in the study area, that are currently developing strategies in order to ensure that this occurs, and that communities are fully involved in, and beneficiaries of, tourism initiatives.

It needs to be borne in mind, however, that tourism cannot be seen as the only solution for the rural poor. There is the danger that communities may have unrealistic expectations from tourism, particularly if their area is unsuitable.

12.2.7 Community Ownership

The DRWS will from 1st April 1997, implement the cost recovery policy for water points. To prepare for this, water point committees in different regions throughout the country are being established. In Khorixas, from January 1995, water point committees are being organised. By 31st January there were 114 committees in the region (Samupofu, pers. comm.). During the fieldwork by the study team, at Bergville Post, Potgietersrus, Tuskenby and Petrusfontein, people had recently elected a committee. In some cases, people at the settlements had only heard that water point committees were to be established, but did not understand what their role would be.

As highlighted by Samupofu (pers. comm.), there are mixed feelings about the new cost recovery policy in the region. This was established during the
field work. Some people in the settlements establishment of the water point committees and payment for their water supply would ensure that communities become more responsible for their resource. It was indicated that Government is ineffective in addressing community’s water problems. The new policy would therefore enable communities to do the repairs themselves.

However, people at most settlements and the members of the Central Water Committee had strong feelings about the introduction of the new policy. Common issues raised were (Inabab and Murowoa, pers. comm.):

- People in Khorixas are generally poor, and they would not be able to take the responsibility for maintenance because the borehole structures are very expensive.
- Water point committees are meaningless because in some cases there is only one family at a water point. At Bergville post for example, there was only an old man and his wife.
- Government does not explain how the people are to pay.
- People could not be denied water because culturally that is unacceptable.
- Local communities had not been consulted in siting the boreholes, and therefore cannot be expected to take over Government’s responsibility. In most cases, some of the boreholes sited by government geohydrologists do not even yield enough water for community needs or have run dry, while those sited by local diviners were seen by members of the community as being more successful.
- Water point committees do not have a legal status, and they will not be able to enforce or regulate use of the boreholes.

Murowoa (pers. comm.), one the community leaders, strongly emphasised that the cost recovery policy would not work because ownership of boreholes could not be addressed in isolation from land tenure in the communal areas. Thus, as long as there was no clear land policy on communal land, it would be impossible to control newcomers into settled areas because people are free to settle wherever they wish irrespective of whether resident communities approve.

Regional staff from the DRWS also indicated that for the policy to be implemented efficiently, the regional office needs to have the necessary resources so that it can fulfil its functions.

The study team observed that in principle, the communities were not against payment for their water supply. Communities, however, did not basically understand what the policy meant, how it was to be implemented, and what the advantages of the new changes would be. As a result the policy was either misinterpreted, or people only accepted it because Government had made a decision and they had no choice. However, their concerns would need to be taken cognisance of, if the policy is to be effectively implemented.

People at the study sites indicated that implementation of the policy has to be phased to enable the people to prepare themselves. People were not ready
to take the responsibility within the next 5 to 10 years - a view shared by some of the Khorixas DRWS regional staff. Overall, the communities are scared of change, and it needs to be gradually implemented (Castens and Plenaar, pers. comm.).

The interconnections of settlements can make it difficult to define what a ‘community’ is. Water Point Committees may contribute to the defining of ‘communities’ and assist in keeping out newcomers.

12.2.8 Maintenance and Running Costs of Boreholes

A considerable amount of money was spent on new borehole provision in the 1992/3 drought relief programme. However, boreholes cost money to run and to maintain. Considering that communities are soon to carry this cost themselves, the question needs to be asked whether the most appropriate technology, in terms of cost effectiveness, was employed. Many factors contribute to this equation of maintenance and running costs. Such factors would be the remoteness of the installations, the likelihood of breakdown or damage, wildlife such as elephant causing damage and ease of maintenance by local people.

Table 12.4 outlines the estimated capital, running and maintenance costs of the various installation options for boreholes. These figures and information were obtained from the Regional Office of the Directorate of Rural Water Supply in Khorixas (van der Merwe, pers. comm.; Castens, pers. comm.).

It was the opinion of those in the regional office who are responsible for maintenance that solar panels are the most cost effective option in this area (van der Merwe, pers. comm.; Castens, pers. comm.). The initial outlay for a solar panel is the highest of the options, however, it is cost effective in terms of running costs and maintenance costs which include savings on personnel time and transport of maintenance teams. A solar powered pump has a pumping capacity which is less than that of a diesel and is affected by cloudy weather. It was, therefore, sometimes less popular in communities than a diesel pump, however, it seems that in most situations a solar pump can provide adequate volumes of water (van der Merwe, pers. comm.) at much less cost.
<table>
<thead>
<tr>
<th>Type of Pump System</th>
<th>Diesel</th>
<th>Windmill</th>
<th>Solar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost to Install</td>
<td>N$ 15000</td>
<td>N$26000</td>
<td>N$30000</td>
</tr>
<tr>
<td>Running Costs</td>
<td>N$ 150 per month for diesel</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Maintenance Cost Estimates</td>
<td>Monthly service N$ 100-200</td>
<td>Maintenance is needed less often and is less costly</td>
<td>Very little maintenance is required and if is, this is not demanding in terms of time and personnel resources. These pumps have been found to be extremely reliable.</td>
</tr>
<tr>
<td></td>
<td>Overhaul (every six months to a year) N$ 4000 to N$5000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advantages and Limitations</td>
<td>Has high pumping capacity and can pump from any depth.</td>
<td>Many farmers complained that the windmills had a low pumping capacity mainly because there was often very little wind.</td>
<td>There is usually not a shortage of sunlight in Khorixas, although some farmers complained that the pumps produced poor yields if it was cloudy. It is a clean and efficient source of power. Solar pumps are also able to pump from great depths and have a reasonable capacity.</td>
</tr>
<tr>
<td>Other Comments</td>
<td>Frequent breakdowns and often damage resulting from well-intended but non-expert 'mechanics.'</td>
<td>Damage by elephants is a significant problem. Elephants push over and destroy about 5-7 windmills a year in the Khorixas area and in some years this number may be double. This represents a large additional cost and a possible safety hazard.</td>
<td>Elephants never seem to damage solar panels. It was even suggested that they are sensitive to the electricity and averse to approaching the solar panels. The reason for their lack of interest in solar panels may be debatable but it represents a significant saving in damages and repair costs.</td>
</tr>
</tbody>
</table>
The IMC borehole programme in 1992/3 installed 2 solar, 8 diesel and 17 windmill pump systems. The two solar installations were seen by the team, neither had required maintenance and they were in very good running order. Many of the windmills in the study were in disrepair. Most commonly there was damage to the central wooden pump shaft and to the mechanism for engaging the gearing. All the diesel pumps had had breakdowns and had needed repairs to a lesser or greater degree.

Solar powered pumps seem to be the most cost-effective and the fact that most pumps installed were not solar pumps represents an additional avoidable cost which the government has to bear. This is more significant now that the community is to be responsible for maintenance and running costs. Those communities without solar powered pumps will be most affected by this change of policy. This represents an ongoing impact of the drought relief programme.

12.3 Health Impacts

The impacts of boreholes studied in Khorixas may be discussed under two headings:

- Water Quantity
- Water Quality

12.3.1 Water Quantity

The primary objective of providing the drought relief boreholes was to provide water. Of twelve of the boreholes visited, six have, in the opinion of the local community, an inadequate yield (see table 10.6). The other six boreholes can supply adequate amounts of water for the needs of the community.

12.3.2 Water Quality

There are two categories of factors which determine water quality for the end-user. The first is the quality of the water in the aquifer. The second is the range of factors that may affect the water between leaving the aquifer and being used by the end-user. This would include its storage, reticulation and the standard of the water facilities provided.

In this respect two investigations were done. The first was the measurement of total dissolved solids (TDS) in the water, the second, the coliform count of the water sample.

12.3.2.1 Total Dissolved Solids (TDS)

TDS is an indication of the total salt concentration in the water. It is a useful measurement of salt content but does not give any indication of the type of salts contributing to the total. The WHO recommendation for a maximum allowable TDS in water for human consumption is 1000 mg/litre. Above 1000 mg/litre there is a possible health risk to the user which may manifest as
cardio-vascular, renal and renal tract disease - depending on the type of salts involved. (Specific analysis is necessary to determine possible disease risks.) The TDS is a useful and easily measured guideline but is not specific or accurate. Its value therefore is as an indicator of potential problems which would need further investigation.

The results of the TDS measurements done at the case study boreholes is presented in figure 12.1.

![Total Dissolved Solids (in mg/litre)](image)

**Figure 12.1. Estimated TDS of Study Boreholes.**

*Note: Potgietersrus (2) was not a drought relief borehole but is still a source of water in Potgietersrus and shows the improvement in water supply gained by the 'drought relief' borehole (Potgietersrus (1)).*

From these figures it is clear that three of the boreholes did not always supply adequate drinking quality water to the community and, therefore, the positive health effects of providing water are minimised. One, Petrusfontein, seems to be excessively high and could represent a health hazard. This is of course only one test result and it would need to be thoroughly investigated to make a more authoritative comment. However, the community using the water did spontaneously offer the information that it was very brackish and caused stomach upsets. This particular symptom could possibly relate to a high magnesium salt content.
12.3.2.2 Coliform Counts
This investigation revealed deficiencies in the drought relief borehole project in terms of health impacts. Many of the boreholes, having been installed, pumped water into old, open storage reservoirs and through reticulation systems which allowed the contamination of water before use.

High Total Coliform counts, as detected in many samples, suggest faecal contamination of water and are an indication that the water is not safe to drink without further treatment. There is not a well defined quantitative link between coliform densities and disease. Coliform counts are still, however, one of the best indicators of the microbial quality of water (Genthe and Kfir, 1996). WHO guidelines for total coliform counts allow a maximum of 3 per 100 ml in the occasional sample of drinking water (Chapman, 1992). The maximum allowable *E. coli* count is 0 per 100ml (Chapman, 1992). *E. coli* was not found in any samples.

Figure 12.2 is a summary of the findings in the study boreholes in Khorixas.

The pre-1993 borehole and infrastructure at Potgietersrus (Potgietersrus 2) was particularly poor and the 1992/3 installation represents a vast improvement in terms of health (see photograph 12.8). Table 12.5 elaborates the above information and the figure and describes the water infrastructure provided at each borehole and the relevant coliform counts.

![Photograph 12.8: Open reservoir in Potgietersrus from which drinking water is drawn.](image-url)
Figure 12.2. Total Coliform Counts at Study Boreholes

*Note: No sample obtained from Emmanuel. Renosterkop sample not representative and therefore not shown.*
Table 12.5: Coliform Counts at Study Boreholes in Khorixas

<table>
<thead>
<tr>
<th>Place</th>
<th>Date (of Borehole)</th>
<th>Comments on Infrastructure Arrangements</th>
<th>Coliform Counts (per 100ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potgietersrus 1</td>
<td>1992/3</td>
<td>New borehole pumps into new 3m high concrete reservoir which is not covered but not accessible. Water reticulated to animal troughs, garden and houses.</td>
<td>0</td>
</tr>
<tr>
<td>Potgietersrus 2 (previous system for comparison)</td>
<td>pre 1992/3</td>
<td>The previous borehole still pumps into an old, 1.5m high, open, concrete reservoir which looked heavily contaminated (laden with algae, tadpoles and floating scum). Livestock were able to drink directly from open reservoir. Water is still reticulated to animal troughs and houses.</td>
<td>3900</td>
</tr>
<tr>
<td>Bergville Post</td>
<td>1992/3</td>
<td>Old open, 1.5m high, concrete reservoir still used for storage of water pumped from new borehole.</td>
<td>600</td>
</tr>
<tr>
<td>Lofidal Post</td>
<td>1992/3</td>
<td>This borehole replaced an existing borehole. Water from the new borehole is pumped into the old concrete open reservoir (1.5m high) before reticulation.</td>
<td>1000</td>
</tr>
<tr>
<td>Halt Post</td>
<td>1992/3</td>
<td>Completely closed water system. Windmill pumps directly into a 2500 litre closed, plastic domestic tank.</td>
<td>0</td>
</tr>
<tr>
<td>Tussenby</td>
<td>pre 1992/3</td>
<td>Water from new borehole (1992/3) not stored but piped directly to outlying house. Residents of Tussenby still, therefore use water from old windmill and open concrete reservoir system. This is the water that was tested as it is the water available to the village. No sample was obtainable from new borehole.</td>
<td>200</td>
</tr>
<tr>
<td>Post 66</td>
<td>1992/3</td>
<td>Water from borehole pumped by windmill through a well maintained, closed system to a 10000 litre closed, plastic domestic tank. Separate reticulation for human and stock use.</td>
<td>0</td>
</tr>
<tr>
<td>Petrusfontein Post</td>
<td>1992/3</td>
<td>Water from borehole pumped by solar pump through well maintained, closed system to a 10000 litre closed, plastic domestic tank. Separate reticulation for human and stock use.</td>
<td>0</td>
</tr>
<tr>
<td>Nugas Post</td>
<td>1992/3</td>
<td>Water from borehole pumped by windmill through a closed system to a 10000 litre closed, plastic domestic tank. Separate reticulation for human and stock use.</td>
<td>0</td>
</tr>
<tr>
<td>Freyer</td>
<td>1993</td>
<td>Water pumped to 3m high open, concrete reservoir.</td>
<td>0</td>
</tr>
<tr>
<td>Renosterkop</td>
<td>1993</td>
<td>Water pumped by diesel engine into open, 1.5m high, concrete reservoir before reticulation. A representative sample could not be obtained as the reservoir was very dirty and had been drained for cleaning.</td>
<td>Sample from residual water - estimated count of 20 000</td>
</tr>
<tr>
<td>Engelbrecht Post</td>
<td>1993</td>
<td>Water from borehole pumped by windmill through a well maintained, closed system to a 10000 litre closed, plastic domestic tank. Separate reticulation for human and stock use.</td>
<td>0</td>
</tr>
</tbody>
</table>
In summary, two drought relief installations, one at Lofdal Post and one at Bergville, failed to provide safe water as the infrastructure was not adequately upgraded. Although the Renosterkop sample was not representative, that particular reservoir does also indeed seem to be contaminated. At Tussenby the residents still use the old supply of unsafe water as the new borehole does not supply the immediate community with drinking water. The drought relief programme did not supply safe water, therefore, for four out of eleven targeted communities. In these communities the programme maintained or created a potential for negative health impacts.

12.3.3 Health Conclusions

It is clear that for the health benefits of water provision to be maximised it is necessary to provide an appropriate storage and reticulation system. Open, concrete reservoirs, especially those that are low, are prone to contamination. Most of the IMC installations, however, used a closed system, closed plastic domestic tanks and provided separate facilities for people and livestock. None of these had significant bacterial contamination and hence, maximised the positive health impacts of providing water.
13. Review of Drought Relief Process

The 1992/93 drought relief programme had positive and negative spin-offs. The Namibian Government, with assistance from international and local donors and NGO's, averted any loss to human life and prevented what could have been a wide-spread famine (Artivor and Mwazi, 1995). People were provided with potable water and their level of awareness on health issues and the scarcity of water in the region was raised. Many people also perceive boreholes as contributing to an improvement in their livelihood (Inaibab, pers. comm.).

Perhaps one of the most potentially positive aspects of the DRP lies in the lessons that it presented and that have subsequently emerged from its implementation.

However the DRP was not without its problems. These include policy deficiencies, lack of community consultation and involvement, and problems of accountability. It is necessary then, to look at the DRP critically and to assess whether lessons learnt and offered have been effectively incorporated into Namibia’s present day policies, programmes and processes.

13.1 Accountability

The 1992/93 drought it seems, saw the indiscriminate and random construction of boreholes by various agencies, contractors and donors. Documentation is difficult to come by at national and regional levels and the research team found it difficult to access relevant records.

Records that were accessible contained information that differed to the situation observed by the team. For example, the IMC Report (Manzella, 1994) used by the research group, describes borehole yields and community numbers in a manner not reconcilable with case-study observations. The methodologies used to arrive at the data and information presented in this report are not made explicit and it is thus difficult to establish the validity of the document (refer to Table 10.6).

Additional problems of accountability emerged as research progressed. For example, the fact that the drought was a crisis, and interventions and donations thus viewed as emergency measures or "gifts", was the explanation provided to members of the research team for the lack of any kind of environmental impact assessment (Binding, pers. comm.).

It seems that any retrospective designation of responsibility or accountability for what is now emerging as perhaps inappropriate intervention may be difficult.

Many of the government structures and institutional bodies both at regional and national level have subsequently either been dissolved or undergone
13.2 Stakeholder Involvement and Community Ownership

Lack of community involvement in decision-making and siting of boreholes in the 1992/93 drought period has engendered a culture of dependency and entitlement in rural communities, instead of creating a beneficial partnership with Government. Despite the fact that over 50% of the needy population were adult able-bodied people, a very insignificant number were involved in community development activities (Giorgis, 1995).

It would appear that as a result of this lack of partnership, communities are reluctant to take responsibility for the operation and maintenance of boreholes as per current new DWA policy, as they feel that they were not consulted during the DRP and local knowledge was not used during DRP siting and construction of boreholes.

The perceptions of people interviewed, both in Government and the communities (both Khorixas and Gam), is that the success rate of boreholes sited by local diviners was higher than those sited by geohydrologists. In Gam, only 19 boreholes out of the 82 that were sited by geohydrologists were successful (in terms of sufficient water yield). "All the boreholes sited by the local diviners were successful" (Shikongo and Mungendje, pers. comm.).

Despite the new DRWS Cost Recovery Policy, it became evident to research group members during discussions with communities, that community members feel that water supply (including operation, maintenance and management of borehole structures) should remain Government's responsibility.

13.3 Land Tenure and Community Ownership

The lack of land tenure security that exists for farmers in communal areas negates any positive benefits that relief measures may have for the environment, as it is a disincentive to proper management and ownership of natural resources such as the water and grazing. Government plans to give communities ownership and responsibility for operation, maintenance and management of their boreholes. On the other hand, the land on which these communities live belongs to the State. As such a system of open access exists for people and their livestock, affording resident communities little or no security.
Although the Outline of a National Land Policy (1997) proposes different forms of tenure for the communal areas, community tenure has still not been addressed. The concept of community tenure is being opposed by some people who feel that certain groups of people will be excluded from ownership of land on ethnic grounds. The meaning of community is being equated with ethnicity (Shumba, pers. comm.).

As long as the land security issue remains unresolved, and related community concerns are not adequately addressed, sustainable natural resource management may be difficult.

For example, if a community wishes to let an area of land lie fallow in anticipation of dry periods, newcomers can move in to take advantage of the good grazing, without having to even consult the community concerned. As it is impossible to refuse to provide new members of an area with water, it is not possible for a resident community to manage water sustainably. In addition, even if water is managed sustainably in anticipation of dry periods, when drought comes, the presence of water (because of good community management and sustainable use practices), will merely attract newcomers who will deplete the resource very quickly.

Clear evidence of this insecurity and its consequences was highlighted in both Khorixas and Gam. Communities interviewed all stressed that unless they had control over land and on who settled in the area, they could neither manage borehole use nor control water consumption and grazing practices. The land issue has also been raised strongly in workshops for the Kunene region held in June and October 1996, and the recurring question, which has still not been answered to anyone’s satisfaction, is “How can you own the water point without owning land” (DRWS, 1996).

The recommendations of the October workshop in the Kunene region emphasised that there can only be community commitment to water supply management, if ownership of land and water are combined. Management of the boreholes (and thus sustainable water use and drought planning and preparedness), will only be successful if residents are empowered to devise and agree on community rules and regulations, including those that exclude others in order to manage resources (ibid.).

13.4 Policy

As has already been discussed, early in January 1992, SADC’s Regional Early Warning System warned of impending drought in the region of an unprecedented scale and severity. However, SADC member state governments were reluctant to take heed of the warning until the situation became visible in their backyards. (Moorsom et al, 1995). The Namibian Government it seems was no exception, and it was only in mid May that they launched the DRP, at a stage when there was no other option than for relief to be undertaken under emergency conditions.
Yet as was the case in the 1992/1993 drought, current policy and policy development in Namibia still seems determined to address drought as an unusual occurrence and thus as an emergency. This is evidenced by that fact that drought preparedness and planning falls under the jurisdiction of the Emergency Management Unit (EMU) and has not been incorporated in the country’s long-term development planning, the National Development Plan 1995-2000.

If drought preparedness does not form part of national development planning, inappropriate responses may occur by default, thus potentially increasing environmental, social and economic susceptibility to the negative effects of the low and variable rainfall of Namibia. Cumulatively, this could have serious negative consequences on the number of potentially sustainable development alternatives that exist for the country and its people (Giorgis, 1995).

The manner in which a dry period is defined by policies and institutions determines the institutional response and this may result in inappropriate interventions.

A clear example of such an inappropriate intervention can be seen in the case-study conducted in parts of South Kunene. The 1992/93 drought in this region was about a shortage of grazing, rather than about a shortage of water (van der Merwe, pers. comm.) Yet the chosen form of relief intervention was the construction of numerous boreholes which may have served to exacerbate the grazing shortage as discussed in section 12.1.

A communal farmer, who has lived in the South Kunene area since 1963, described 1994 as the “worst drought he’d ever experienced”. He described drought relief as being of no help to him despite the fact that a borehole was constructed as a drought relief measure during ’92/93. Together with his family and all his livestock, this communal farmer went on “trek” to “the white farmers for help and stayed there for 10 months. “They just helped me because they knew me...........not enough grazing.....baie van my bokke en beeste het op die pad gesterf “ (Emmanuel Post, pers. comm.). Another member of a nearby community that had also received an emergency borehole described how he and his family had to move to Ugab “because of the grazing not because of the water” (Emmanuel, pers. comm.).

Thus 1992/93 provides numerous lessons about how policies and institutional responses may lead to reactions and interventions that increase susceptibility and vulnerability and thus exacerbate the effects of succeeding droughts.
13.5 Planning and Co-ordination

From interviews and literature reviews undertaken by the research team it would seem apparent that lessons of 1992/93 have not been sufficiently incorporated into medium and long-term development planning. Namibia could therefore repeat the mistakes of the past.

Examples include:

- The NPC and other line ministries do not yet deal with drought in their long-term development planning.
- Drought has still not been integrated in the current National Development Plan, 1995-2000.
- Drought is still seen as an emergency which can be handled with foreign donor assistance rather than as an integral component of the country's long-term development planning.
- The establishment of EMU as a permanent institutional focal point for management of emergencies which include drought, highlights the inappropriate problematisation of "drought" in an arid country. This understanding of drought as an emergency or unusual occurrence, rather than as a natural condition which can be anticipated, and planned and prepared for, is still lacking for decision makers and development planners (Seely et al, 1995). However, a recent draft report by the Drought Task Force (October 1996) indicates that this understanding is changing.
- The formation of the EMU as a co-ordinating body creates an additional bureaucracy fragmenting responsibilities between the NPC and the EMU. Members of the research team believe this could lead to lack of accountability and co-ordination.
14. Summary of Issues and Impacts - Khorixas

The section below summarises the water supply and maintenance, biophysical, socio-economic, institutional and community resource management impacts and issues that have emerged retrospectively from the 1992/93 Drought Relief Programme in Khorixas.

14.1 Water Supply and Maintenance

During the IMC programme Environmental Certificate clearances were to be issued by the MWCT before drilling of new boreholes. However, a general lack of capacity within the MWCT regarding relevant environmental criteria for siting of boreholes, hampered the effectiveness of this method of environmental control. The MWCT were only able to provide advice where obvious environmental damage could occur at specific sites. The first time an environmental assessment report (including an environmental baseline study) was prepared for a borehole installation project was in the phase 3 of the IMC programme. Under the Nigerian programme, environmental implications of borehole siting were not considered.

It appears that the Nigerian programme was not successful and resulted in an extremely low number of successful boreholes. Of 23 drilled, 14 were installed. However, of these 14 installed only 4 are delivering water, of which only 2 are fit for human consumption. It seems that little responsibility was taken by the donors, or the geotechnical consultants, for the quality of the work of this programme. Cost control does not appear to have been implemented. It is estimated that the programme could have cost more than N$600 000 out of the total N$1.5 million provided. The balance does not seem to be accounted for (Hoffman, 1993).

Furthermore, there also appears to have been little or no consultation with the relevant stakeholders such as Government officers, local chiefs and headmen. It seems boreholes were sited with a lack of procedure and fairly arbitrarily.

A general trend existed between what was observed in this study and what was reported by the IMC regarding borehole yields and numbers of people served. Generally the IMC report states that both yields and numbers were higher than what was observed on the ground. Correlating these (yield) observations to depleted groundwater reserves was not possible as monitoring has occurred since installation. However, stepped pump testing of the boreholes drilled by the IMC did not seem to have take place (van der Merwe, pers. comm.), and hence the recommended installations and pumping rates could not have been based on degree of accurately measured sustainable yields.

Although the IMC had a good success rate of supplying emergency drought relief boreholes, some of these boreholes seem to have been installed in
communities which already had a steady source of water (Engelbrecht Post, Halt and Post 66). This raises a query on the procedures which were used to classify a drought relief borehole. The issue, however, could not be clarified by either the IMC, Khorixas DRWS Regional office, or the communities.

Maintenance conditions of boreholes varied widely. Although the responsibility for maintenance of boreholes falls under the Khorixas Regional DRWS office, the condition of many water points was often directly related to the attitudes of the community concerned. Attitudes to water conservation also varied considerably, with some villages making a concerted effort to stop leakage, while others seemed unconcerned over water wasted through leaks.

14.2 Biophysical

The soils in the region are generally thin and poorly developed. Degrees of soil degradation were observed around all the boreholes, except in cases where boreholes were only utilised for emergencies. Severe soil degradation could result from the presence of boreholes with intense utilisation such as heavy grazing, constant animal traffic and reduced vegetative cover.

The vegetation cover around the boreholes has been influenced by heavy grazing and browsing pressure. Perennial grass was absent around boreholes and trees and bushes showed signs of heavy browsing. The vegetation in the area is as much influenced by rainfall as by grazing pressure and therefore determining whether irreversible vegetation degradation has taken place, was not possible.

Establishment of new posts through water supply provision has resulted in an increase in livestock numbers in some parts of the region which has increased pressure on the rangeland. This has been exacerbated by poor planning and siting of boreholes during emergency provision.

This region has a low groundwater potential, with groundwater reserves being restricted to secondary aquifers. As groundwater is the exclusive source of water in the region, unmonitored exploitation could increase the risk of water shortages.

Most boreholes have been sited along drainage lines. Overuse of these boreholes could have negative impacts downstream as aquifers associated with these drainage lines are depleted. Furthermore, overuse of vegetation near boreholes combined with compaction of the soil by livestock may further contribute to decreasing water infiltration and ground water recharge rates.

Requests for new boreholes are generally restricted to areas of good grazing potential, and to sites close to the communities, rather than to areas where a greater ground water potential may exist. This has resulted in low success rates for drilling of boreholes, with successful boreholes generally producing low yields.
Based on information gathered it did not appear as if boreholes had affected adaptive farming strategies to a large extent, as farmers still moved in response to dry times. Drought relief boreholes do appear, however to be misdirected relief in this case however, as grazing problems are more pressing in droughts than water problems as far as stock are concerned.

14.3 Socio-Economic

Provision of permanent water points has enabled settlements to develop where previously such areas were not habitable due to a lack of permanent water.

The installation of poorly planned water points in the region without proper consideration of their spacing, the grazing capacity of surrounding land and the changing patterns of grazing demand is having negative impacts. Where leadership structures are weak, there is no control on numbers of newcomers and sizes of herds. This results in competition over scarce resources.

In this region, the mobility, interconnection and composition of a community at a settlement varies over time due to the flexible livelihood patterns that operate. Thus, households and communities may not be clearly defined. Any systems (such as establishment of water point committees) imposed from outside without taking these factors into consideration are likely to fail.

In terms of health impacts most of the IMC installations used a closed system, closed plastic domestic tanks and provided separate facilities for people and livestock. None of these had significant bacterial contamination and hence, maximised the positive health impacts of providing water.

Provision of the IMC boreholes during the 1992/93 period initiated an educational programme on rural health focusing on hygiene, sanitation, water use patterns, efficiency and sustainable borehole yields. This has to some extent raised people’s awareness on health aspects, scarcity of water and its sustainable use (Murowo, per. comm.).

The Namibian Government is planning to implement a new cost-recovery policy for the maintenance of boreholes - to be implemented 1st April 1997. However, it seems that little consideration has been taken in regard to the economic sustainability of boreholes in terms of cost effectiveness, efficiency, reliability, and appropriateness of technology.

14.4 Policy and Decision Making

The inability of farmers to have control over their land due to the lack of a clear land policy that gives them exclusive and secure tenure to the communal lands tends can result in a disincentive to manage resources sustainably. Communities cannot control individuals or communities who infringe on their traditional rights.
Although the communities have benefited from provision of water supply through the 1992/3 borehole drilling programme, a full environmental impact assessment study was not done. Consequently, this programme could have contributed to the vulnerability to drought of communities who were recipients of relief interventions.

If planning for drought continues to be seen as a short-term, emergency measure, inappropriate and unsustainable responses and strategies will continue to be implemented. Boreholes that were drilled as temporary "relief" measures in the 1992/93 drought period are now being used on a permanent basis. This has increased stress on natural resources.

Dependence on foreign aid in funding drought programmes may derail efforts by policy makers and development planners to incorporate drought in long-term development planning.

A poor understanding of an arid environment in Namibia is reflected in the continued declaration of drought as an emergency, rather than a norm in Namibia. This has changed people's adaptive strategies to their arid environment. Coping strategies, other than adaptive strategies to ameliorate the effects of living in an arid environment, have evolved. Simultaneously, new institutions such as EMU have been created to deal with emergencies such as drought. This could lead to further fragmentation and duplication of resources between the EMU and the NPC.

Top-down decisions which do not involve the communities in decision making processes, nor utilise local knowledge (for example, using local diviners in the siting of boreholes) can entrench a culture of dependency, and promote resentment towards new policies. The general result is a lack of community responsibility.

Lack of co-ordination of government policies leads to dissemination of conflicting messages to rural communities. The introduction of a cost recovery policy and community ownership for rural water points (and other natural resources) cannot be addressed in isolation from the land tenure issue. In order for sustainable natural resource management to occur, these policies need to be harmonised.

14.5 Community Resource Management

The concept of conservancies is still new in the area. This concept (conservancies) is being promoted by locally-based organisations such as Save the Rhino Trust and Namibia Nature Conservation. However, issues such as land tenure security, definitions of what comprises a community, capacity building and how to achieve this, and equitable allocation of generated revenues still need to be addressed.
14.6 Conclusion

Provision of drought relief boreholes in Khorixas has had both positive and negative impacts. Provision of IMC boreholes initiated educational programmes on rural health focusing on hygiene, sanitation, water-use patterns, efficiency and sustainable borehole yields. This has to some extent, raised people’s awareness on health aspects, scarcity of water and its sustainable use (Murowoa, pers. comm.).

However, the provision of boreholes as a drought relief measure appears to have been inappropriate given that in many areas, lack of grazing was more of a pressing problem than shortage of water. By providing boreholes farmers were being encouraged to stay in one area thus encouraging unsustainable land use practices. Pressure on rangeland has been increased, and, if not given a chance to recover, this may lead to irreversible degradation.

Lack of community involvement and absence of use of local knowledge in the siting of boreholes seems to be impeding current efforts by the Government to create water supply partnerships with the local communities. The introduction of the first phase of the Cost Recovery Policy (i.e. Operation and Maintenance) to communities seems to be problematic.

This is exacerbated by the fact that sectoral policies which address the management of natural resources are uncoordinated, thereby giving conflicting messages to the local communities (Murowoa, pers. comm.).

If management of natural resources such as water points is to be sustainable in this region, issues such as land tenure; community composition; existing leadership structures and their role; livelihood systems; equity and cost-effectiveness of programmes may have to be addressed.

Finally, in Namibia, it is worth considering drought as a development issue that should be incorporated into national and regional medium and long-term development planning.
PART III

GAM CASE STUDY
15. Regional Profile - Gam

The following section provides an outline of the cultural and livelihood practices of the inhabitants, the Bushmen and Herero. The biophysical environment is discussed under climate, geology, vegetation, and wildlife. An outline of health conditions in the study area completes the section.

15.1 The Geographical Location

Gam is located in north eastern Namibia on the western edge of the Kalahari Basin. Bushmanland and Gam became part of the Otjozondjupa region - one of the 13 regions established by the Delimitation Commission - in 1992. Eastern Otjozondjupa which comprises the communal lands of western, central and eastern Bushmanland and the Gam district, was part of former Hereroland East (Botelle and Rohde, 1995). The so-called Gam resettlement area borders the Okamatapati area to the west, the veterinary control fence to the south (Eiseb area), the international boundary with Botswana to the east and the 20° latitude to the north (figure 15.1).

15.2 History and Politics

Gam is the site of a permanent spring that for many centuries served as an important convergence point for the Ju/'hoansi bands of the southern Nyae-Nyae. During the past 120 years, traders and pastoralists have been frequent visitors to Gam.

Prior to the inception of the Gam resettlement programme, the Gam district was inhabited by a few Herero and Ju/'hoansi families. Due to the remoteness of the area and the absence of any sort of infrastructure, Gam's communities were isolated and self-contained. Tsumkwe is the nearest town and is located 90 kilometres north of Gam. However the Tsumkwe road, until it was upgraded in 1995, was often impassable during rainy periods. Services such as clinics and food supplies are available in Tsumkwe and Grootfontein.

The area has been the scene of many upheavals and resettlements. The Odendaal Commission recommended the creation of a "Bushmen Homeland" in 1964 and as a consequence it was proclaimed in 1976 (Proclamation 208, 1976). Earlier government decisions had ceded parts of the Ju/'hoansi territories (known as the Nyae-Nyae region) into the Hereroland and Kavango regions. The Ju/'hoansi were therefore left with about 30% of their original territories inside Eastern Bushmanland (Botelle & Rohde, 1995).

Unlike the other 'homelands', Bushmanland never had any second tier authority. Until 1989, all decisions were taken in central government by the South African Administration. There is little evidence that any cognisance was taken of the needs of the local residents.
Figure 15.1: Gams district

scale 1:500 000
15.3 Demography

Prior to 1985, when the first borehole was drilled to serve a small group of Herero that had moved to the Gam area from Botswana, 50 to 60 Ju/'hoansi were the only permanent inhabitants of Gam. In 1991, the population of Gam district numbered 139 according to the national housing and population census (Botelle & Rohde, 1995).

Repatriation from Botswana has meant that in 1994 the population consisted of 68% Herero and 32% Mbanderu (ibid.). The majority of the estimated 3000 residents in Gam repatriation camp are women and children (Rudert, 1996).

15.4 The Biophysical Environment

15.4.1 Climate

The climate of this area is classified according to the Koppen system as ‘Hot Steppe’ (MLRR, 1994). According to the National Atlas (Van der Merwe, 1983), the Gam area lies within a zone in which rainfall averages 300-400mm annually. Ganzí, the nearest town with climatic data available, has a twenty eight year annual rainfall of approximately 435mm (Environmental Information Services and EEAN, 1994b). The rainy season occurs from October to March. In terms of variability the average deviation, expressed as a percentage of the annual average, is 20% to 25%. Annually, 4 to 5 months experience more than 50mm of rainfall.

There are no direct recordings of potential evaporation rates for the area, however it is estimated from a correlation with humidity, as 2750 mm per annum (ibid.). In the heaviest rainfall months of January to March, potential evaporation is three times that of rainfall.

15.4.2 Geology, Geomorphology, Soils and Drainage

Gam is essentially a flat area with little relief, with the exception of the drainages (omiramba) incised in the sand plains and the dunes in the south (Environmental Information Services and EEAN, 1994b). The area falls within the Kalahari Geological System which extends through much of the western half of Africa. The Kalahari System is made up primarily of aeolian sand deposits. These deposits obscure much of the basement geology and it is a feature of the Kalahari System that there is little surficial exposure of the bedrock over much of its extent (ibid.).

The resettlement area falls within a semi-arid region, and the recent geological origin of superficial deposits, combined with the low moisture environment inhibit, to a large degree, the development of mature soil. Soils are therefore largely unstructured and are derived from redistributed surficial deposits (rather than basement rock), through aeolian and surface flow processes (Environmental Information Services and EEAN, 1994b).
The area consists of very deep sandy soils (dunes) with patches of weakly developed sandy loams in the omirambas (dry river beds) of the Otjisondjou and Danieb - running from west to east through the area towards the Okavango Delta rivers. The north-western corner consists of calcareous soils where arable farming on small scale can be practised (MLRR, 1994). No surface water flow occurs in these appreciably higher land-use potential areas.

Although the Gam area lies in within the Okavango Delta catchment, the higher absorption capacity of the sand covered parts prevents much surface runoff from taking place (ibid.).

15.4.3 Vegetation

Acacia species dominate on the more calcareous soils north-west of Gam whilst forest savannah and open woodland dominate the rest of the area with plenty of Terminalia sericea (Sand Yellow Wood) and occasional occurrences of Red Serigia, Pterocarpus angolensis (Dolf wood) and Mangheeti trees more to the west of the area (MLRR, 1994).

Most of the omiramba plains are covered with open grassland with patches of Acacia and solitary Camel thorn trees. Dichapetalum cymosum (a poisonous plant commonly known as gibflaar) is endemic to the area and occurs throughout the area (MLRR, 1994). This poisonous plant is of major concern to livestock farmers in north-eastern Namibia. Small quantities of leaves are sufficiently lethal to bring about death in most domestic animals (Environmental Information Services and EEAN, 1994b).

15.4.4 Wildlife

Animal species assemblages in Gam (undisturbed area) closely resemble those recorded further North in Bushmanland. Fauna types found in the Gam area include amphibians, reptiles, birds, and mammals (Environmental Information Services and EEAN, 1994b).

Large game species such as gnu (blue wildebeest), oryx giraffe, kudu and eland, are found in small numbers around the Gam area. Small game present in the area include steenbok, duiker and warthog, as well as predators such as jackal, cheetah, leopard and both brown and spotted hyena. Lions may occasionally enter the area from the Nyae-Nyae region (MLRR, 1994).
Table 15.1: Wildlife in Bushmanland (including Gam) according to a wildlife survey in August 1995 (Stander, 1995).

<table>
<thead>
<tr>
<th>Species</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hartebeest</td>
<td>32</td>
</tr>
<tr>
<td>Wildebeest</td>
<td>165</td>
</tr>
<tr>
<td>Giraffe</td>
<td>6</td>
</tr>
<tr>
<td>Roan</td>
<td>20</td>
</tr>
<tr>
<td>Elephant</td>
<td>302</td>
</tr>
<tr>
<td>Gemsbok</td>
<td>110</td>
</tr>
<tr>
<td>Steenbok</td>
<td>14</td>
</tr>
<tr>
<td>Ostrich</td>
<td>190</td>
</tr>
<tr>
<td>Duiker</td>
<td>33</td>
</tr>
<tr>
<td>Kudu</td>
<td>249</td>
</tr>
<tr>
<td>Honey Badger</td>
<td>5</td>
</tr>
</tbody>
</table>

15.5 The Socio-Political Environment

15.5.1 Settlement Patterns

Over the last 30 years, settlement patterns in the region have been determined by external factors: the establishment of an administrative capital at Tsumkwe in 1959, the Odendaal delimitation of Bushmanland in 1970, the construction of army bases from 1978 and the resettlement of different language groups since Independence. With each phase of development there has been the introduction of new language groups, with new settlers entering the region and local inhabitants moving to other settlements (Botelle and Rohde, 1995).

Within the region, household settlement structures differ according to the different people of the region, and its permanence. The commonality is their material use, layout and scale.

The principle unit of settlement in Herero villages is the onganda (household ozonganda) consisting of related men and their wives and children. A person’s identification with his parents onganda and ohamba (locality) is lifelong, but links to extended households may be invoked to extend rights to land (Botelle and Rohde, 1995). In the Herero village the eldest male member has the highest authority. He is most respected man in the group and his decisions are never challenged.

At present in the Gam area, people are settled at the resettlement centre at Gam recieving camp and around some of the installed boreholes.
15.5.2 Organisational Structures

Tsumkwe is predominantly an administrative centre, with government buildings housing the ministries, their employees and other essential services such as a police station and clinic.

The following ministries have offices in Tsumkwe and/or in Mangetti Dune: the Ministry of Regional and Local Government and Housing (MRLGH), Ministry of Agriculture, Water and Rural Development (MAWRD), and the Ministry of Environment and Tourism (MET). The Ministry of Lands Resettlement and Rehabilitation (MLRR) is responsible for all activities in theGam area related to the resettlement of the Herero people and their livestock. It is expected that other ministries will take over some of MLRR’s work, but due to limited resources, this is not guaranteed. However, the DRWS has been given the responsibility of borehole maintenance in the region from early 1997. Government ministries without offices are located in Windhoek or one of the regional centres within Otjozondjupa.

Organisational structures have been established in relation to the repatriation programme. The Herero Repatriation and Resettlement Committee (HRRC) is supposed to oversee the welfare of the repatriates and bring their concerns to the MLRR. The HRRC includes committees on cattle, food, the camp and the school.

15.5.3 The Herero

The Herero are nomadic pastoralists who migrated south in the middle of the 18th century from Kaokoland due to severe drought. Their history in Namibia consists of many conflicts over land with colonialists and other tribal nations in the latter 19th century. In August 1905, a decisive battle was fought at the Waterberg between the Germans and the Herero at which Herero power was crushed. Many fled to the Ngamiland of former Bechuanaland (now Botswana).

On 26 October 1905, the German authority confiscated all the land that formerly belonged to the Herero and ruled that no cattle could be owned (Malan, 1993). The only action the Herero nation could take was to seek work on farms and in towns as labourers. In 1920, the Native Reserves Commission recommended that a number of reserves be provided for the Herero. Here, the Herero were able to revive their cultural life and practice their traditional subsistence economy based on pastoralism. At present Hereroland is a consolidation of the former reserves and additional land purchased.

15.5.3.1 Political structures

After the Herero secured a more settled mode of livelihood, regional political structures under the leadership of non-hereditary headmen was established. This created a centralised political structure within the society. The need for a national leader brought about the election of a paramount chief.
paramount chief does not have dictatorial power, and must seek the advice and consent of the Herero Council, a representative body consisting of headmen chiefs and prominent men from all major Herero communities. This council has the highest authority in Herero politics and decides the national leadership (Malan, 1995). The present chief, Kuaima Riruako was elected in 1976.

15.5.3.2 Social Organisation
The practice of double descent reckoning is a unique and distinguishing feature of the Herero (Malan, 1995). Every person in society is linked to two distinct groups of relatives, the first through the father and the second through the mother. The two groups have entirely different functional interests. Residence patterns, religious activities and authority are organised accordingly to patrilineal principles. The economic function of control and the inheritance of movable wealth is the maternal domain (Malan, 1995).

15.5.4 Bushmen
The Bushmen represent 2.9% of the total population of Namibia, with 45,000 people estimated in 1994 (Malan, 1995). For thousands of years the Bushmen were a hunter-gatherer society in many parts of Southern Africa, where game and veld foods were plentiful. Today, the Busmen have been forced onto reduced land and have a diverse livelihood combining crop farming, livestock production, cash incomes, food aid and hunting and gathering. (Botelle and Rohde, 1995).

The Bushmen population of Eastern Otjozondjupa consists of two ethno-linguistic groups: the Ju/’hoansi (central !Kung) and the Vasekele and Mpungu (northern !Kung). These divisions correspond to dialects and cultural units.

Three categories of social organisation stand out as factors crucial to understanding the way in which Bushmen interact with their environment:
- Social networks: kinship, distribution of property, sharing and exchange
- Territory and rights to natural resources
- Leadership and decision making structures

15.5.4.1 Social Organisation
Social networks throughout Bushmanland are based on extended family groups or bands. The band size is flexible and structured according to kinship ties and networks of exchange that extend far beyond the immediate band territory (Botelle and Rohde, 1995). !Kung society is governed by strict rules of sharing which sustain both basic food security for households and cooperation within and between the bands. A formal system of exchange, known as hxaro, involves the establishment of gift giving partners over a wide geographic area. Implicit in these gift giving relationships are rights to water and plant resources. Kinship links are an important key to understanding the
15.5.4.2 Territory
The !Kung territory or nlore (nloresi pl.) varies in size between 2000 and 3000 hectares, comparable to a commercial farm. Nloresi do not have firm boundaries but regulate social rights and obligations associated with the use of natural resources. Individuals are affiliated to nloresi on the basis of birthplace, parental inheritance and marriage. In the past, two types of nlore could be identified: those with reliable water which could accommodate people throughout the year and those with intermittent water supplies. The introduction of boreholes has allowed people to settle permanently in nloresi which previously were settled intermittently.

15.5.4.3 Leadership and Political Activity
Political activity traditionally occurs at band level. The power of an individual is dependent on their relationship to the core kin group, age, experience and personal qualities. !Kung decision making is characterised as 'consensual'. Leadership operates through compromise based on acute perception of the band’s mood. When compromise is impossible, the traditional response to avoiding violent confrontation is separation or band fission (Botelle and Rohde, 1995).

15.6 The Socio-Economic Environment

15.6.1 Livelihoods

15.6.1.1 The Herero
Traditionally the Herero pastoralists followed a nomadic way of life with large herds of cattle. More recently, this movement has been restricted, resulting in permanent settlements being erected. Livestock management is based on the principle that there is no private ownership of cattle (Malan, 1993). The cattle belong to the lineage, of which a person is a member and from which they have acquired most of their wealth through inheritance.

The Herero in Gam have a pastoralist economy, depending on cattle and goats as a source of food and income. Sharing, which does not depend on kinship relations, takes place with wealthier neighbours assisting poorer ones when necessary. Not all people have livestock however, particularly single women, who are dependent on the government and the community.

15.6.1.2 The Bushmen
Most of the Bushmen living in the region rely on incomes derived from both permanent and seasonal employment, (wages, pensions and crafts), and on
a variety of food sources (wild foods, crops, livestock, food aid and purchased food) (Botelle and Rohde, 1995). Temporary employment was generated by the repatriation programme, such as construction of the veterinary fence, livestock quarantine camp and the reception area at Gam.

15.7 Infrastructure in Gam and at the settlements

Gam and the outlying settlements lack infrastructure: communication for government employees is restricted to a two way radio and services are minimal. The Namibian public radio service is unobtainable and people listen to Botswana radio. Social services are provided by the police and a health clinic. Supplies are at three “general dealers” that sell basic items.

Housing in the camp consists of tents supplied by the MLRR and timber and earth structures erected by the newcomers. Water in the town is obtained from three boreholes. There appears to be sufficient water although the settlement often has shortages due to technical or management problems. Many of the ablution facilities are not operational in the camp. The residents have been using the surrounding bush for their daily needs for the last 3 to 4 years (Shikongo, pers. comm.).

Gam serves as the centre for the settlements developing around boreholes.

15.8 Health Profile of Gam study area

Gam has a range of health problems which may be expected to accompany the poor facilities and state of development.

Information on the relative incidences of disease was not readily available from the state. That which was available did not always seem reliable and contradictions were often present. Nevertheless the following two lists of the most frequent health problems for children and for adults were compiled from a recent health needs assessment report (Health Unlimited, 1996) and information derived from the communities themselves. Relative frequencies as indicated, by the ranking, could well be incorrect but nevertheless it provides a fair indications of the most significant health concerns.

The top ten health problems in children are:

1. Diarrhoea
2. Respiratory Infections
3. Skin infections and problems
4. Worms
5. Seasonal Malaria
6. Nutrient and Vitamin Deficiencies
7. Malnutrition
8. Trauma
9. TB
10. Eye problems
Of note all of these diseases, with the possible exception of respiratory tract infections, trauma and TB, may relate directly to either water (for drinking, sanitation and hygiene or diet. It was noted that vitamin A and vitamin C deficiencies were particularly problematic - probably because the Herero diet is traditionally lacking in fresh fruit and vegetables.

The top ten significant diseases in the adult category are:

1. Diarrhoea
2. Respiratory Infections
3. Skin infections and problems
4. Seasonal Malaria
5. Sexually Transmitted Diseases
6. TB
7. Trauma
8. Hypertension
9. Cardio-vascular disease
10. AIDS

There are obviously a host of environmental and socio-economic factors which contribute to this disease profile. It is also quite likely that the boreholes and the manner of water provision can contribute significantly to this profile both in terms of preventing or lowering the incidence of a disease and in terms of contributing to its high incidence. This will be examined further.
16. Overview of Resettlement in Gam

The planning of the resettlement process started after Independence. An outline of the policy, the process and the implementation of the programme that has been achieved in the Gam district is discussed. The suitability of the biophysical environment in which the programme has been implemented is considered in terms of ecology and sustainable land use, water supply, grazing and wildlife.

16.1 History of Resettlement

On 30 April 1991, the cabinet of the Namibian government designated three line ministries to facilitate the repatriation of Herero from Botswana. The ministries involved were Lands, Resettlement and Rehabilitation (co-ordinating ministry); Home Affairs and Foreign Affairs. This decision followed a long history of plans to resettle the Herero from Botswana.

During the last 100 years, several attempts were made by Herero groups to settle in the Nyae-Nyae area. Drought, distance, Ju/hoansi resistance and harassment from the South African Police were largely responsible for the failure of these attempts (Botelle and Rohde, 1995).

In 1959/60, the Union Government and the British High Commission in South Africa considered the issue of repatriating the Herero people from Botswana. It was not pursued and the issue only re-emerged in 1980 when it was considered by the South African government. It was then stipulated that the process could only occur once all relevant issues had been defined and addressed.

During the early 1980’s, the Herero in Botswana agitated for a speedy repatriation. During the period 1980-1989, the issue was continually delayed due to the cost implications. A decision was taken by the South African government to delay the repatriation until Namibia gained its independence (MLRR, 1993).

16.2 Resettlement Policy

The Ministry of Lands, Resettlement and Rehabilitation began in September 1990 to facilitate the resettlement of the ‘destitute and landless people of the country’ (MLRR, 1996b)

The aims of the resettlement programme are to:
- redress past imbalances in the distribution of resources, particularly land;
- encourage people to become self sufficient in the production of food;
- introduce subsistence farmers into the commercial markets;
- create employment through farming;
- alleviate human and livestock pressure on communal lands;
offer citizens, displaced by colonial rule and war of liberation an opportunity to re integrate into society.

Certain groups are targeted by the programme:
- the San (considered by the Ministry to be the most disadvantaged community in Namibia due to exploitation, discrimination and displacement by other Namibians and colonial governments);
- returnees (former exiles);
- ex-soldiers, members of the former fighting forces;
- the displaced (retrenched farm labourers, landless people forced to leave rural areas to become squatters in more urban areas).

Several conditions are stipulated by the policy:
- the applicants should be Namibian citizens above the age of 18 years;
- all previous rights held to land elsewhere should be relinquished;
- settlers should be prepared to hold land under leasehold tenure after a two year probation period;
- settlers should be prepared to support cost recovery measures introduced by the Government.

Land will be provided to the beneficiaries on a leasehold tenure system for 30 to 50 years and thereafter on a freehold tenure system. All settlers are on a probation period for two years to ensure that land is used productively and for the purposes that it was applied for. It is envisaged that land under the leasehold tenure system could be used as collateral for loans from credit facilities especially established to benefit settlers.

The Directorate of Resettlement and Rehabilitation is responsible for purchasing land on behalf of the State for the programme on a ‘willing seller, willing buyer’ basis. Land should be ecologically assessed and the proximity to available infrastructure determined before resettlement is undertaken (MLRR, 1996b).

The success of the Resettlement programme is deemed dependent on the industry of the settlers and the ‘dedication and efficiency of the administration’ (MLRR, 1996b). Experience in agriculture or the other enterprises on which a proposed project is based enhances an applicant’s chances of being chosen for resettlement.

However, it is considered necessary to offer support services due to the marginal living conditions of many of the beneficiaries. Water supply from boreholes, temporary housing (prefabricated shelters and tents), food rations and agricultural services are provided to assist the settler until a subsistence livelihood level is reached. Food is provided under a food for work programme.

Broad inter-ministerial co-operation is described as necessary for the successful implementation of infrastructure. For example, the Ministry of Health and Social Services would provide the necessary health services and
the Ministry of Environment and Tourism would assist in the environmental planning and management.

Government support of specific resettlement programmes is restricted to a maximum of 5 years. Within this time, settlers are expected to gain skills and a livelihood that does not require supplementary aid. The basic requirement is that a settler should make the land productive (MLRR, 1996).

16.3 The Present Resettlement Process

After independence and the designation of responsible line ministries, an Inter-ministerial Technical Committee was established to assess the following:

- potential areas for the resettlement and existing surrounding infrastructure,
- possible involvement of local communities,
- feasible water sources,
- potential entry points along the Namibian/Botswana border.

The Gam area was decided on for the Herero resettlement programme and negotiations occurred between the governments of Botswana and Namibia to establish a modus operandi. In 1991, the Botswana Government began registering Herero and Mbanderu wishing to be repatriated. Most of these people were born in Botswana and held Botswana citizenship.

An initial group of women and children arrived in 1993, 498 in April, followed by a further 1670 in September. Initially 2000 head of cattle arrived in February 1994 with a second group of approximately 3000 cattle in May and June 1994.

Due to a lung disease outbreak in late 1994, most of the cattle remaining in Botswana were shot by the Bostwanan government. Thus no more cattle have been brought to Gam by new repatriates. Instead cattle are bought in Namibia. People are still moving into Gam, though arrival numbers are decreasing.

Various reasons for returning to Namibia have been given. Many Herero felt they were marginalised and underprivileged while in Botswana and that more equal opportunities were available in Namibia (Botelle and Rohde, 1994). It also emerged in personal conversation that they see Namibia as their motherland and thus wished to return (Mungendje, pers. comm.). In addition, Botswana does not pay a pension and this is probably acts as an incentive for elders to return to Namibia (Shumba, pers. comm.).
16.4 Suitability of land for resettlement

16.4.1 Ecology and sustainable land use

Prior to the resettlement programmes, the Gam area was sparsely populated by people and domestic stock and was considered to be largely pristine (Environmental Information Services and EEAN, 1994b). San people hunted and collected food there on a seasonal basis and wildlife was common. During exceptional rainfall years, livestock from more densely settled areas to the South may have been herded as far as Gam and grazed there for several months until surface water resources gave out (Environmental Information Services and EEAN, 1994b).

This is a strong contrast to the area along the south-western border and the omiramba of former East Hereroland, where high population densities of both humans and livestock have had profound negative effects on the environment (Environmental Information Services and EEAN, 1994).

In these areas, there is extensive evidence of reduction in the quality and quantity of grazing and bush encroachment. The relationship between areas of population concentration, environmental degradation and water supply is well established. It is apparent that current land tenure systems and associated livestock management practices are not compatible with the semi-arid environment of the region and are consequently not sustainable (Marsh and Seely, 1992).

16.4.2 Water supply

Surface water is entirely absent during dry years and, and present only for a few months during years with above average rainfall (Environmental Information Services and EEAN, 1994b). Boreholes tapping groundwater at depths of hundred metres are the only possibility for supplying water for the resettlement programme.

16.4.3 Grazing

Despite estimates based on grazing potential, water is the ultimate limiting factor in the area and determines whether any animals can exist for more than a few months at any particular place. Boreholes allow long-term grazing. Once reliance is placed upon grazing in one particular area in the Kalahari, rangeland degradation becomes a reality even at recommended stocking rates. The resultant degradation leads to the eradication of the most palatable grass species and ultimately to bush encroachment (Environmental Information Services and EEAN, 1994b).

Moreover, the use of carrying capacity as a single number is misleading in the variable conditions of a semi-arid environment. Unless flexible, adaptive management (reducing and increasing the animals present on the range as
conditions vary) is used in the area, even though it is almost an impossibility under the current land tenure and range management systems, degradation can be expected in an environment such as this, that is not at equilibrium (Westoby et al., 1989).

16.4.4 Wildlife

As recently as October 1992, during the development of the Roads Master plan for the area, the repatriation of people was not considered possible, and game was thought to represent a major land use option in the area (HKW Engineering, 1992). Despite all the concerns, Gam district was eventually chosen as the most viable area for resettlement because of its vastness, and the fact that it was virtually uninhabited by people (MLRR, 1994).

It has been speculated that some of the animal species including several Red Data Book species are going to be severely affected by the changes in land use that have occurred as a result of the resettlement programme (Environmental Information Services and EEAN, 1994b). However it is not possible to predict the significance of the impacts as most of the habitat requirements of these species are unknown.

Thus, despite advice that the Gam area was not suitable for sustainable resettlement given the envisaged land use practices and limited water availability, resettlement occurred. The provision of boreholes made resettlement possible and has resulted in many negative impacts which are discussed later in section 18.

16.5 Planning and Implementation of Resettlement

16.5.1 Theoretical Overview

Planning for a resettlement programme should involve various stages over an extended time period. Initially, an analysis of the area to ascertain its suitability for resettlement should be conducted. Baseline surveys on ecological and socio-economic suitability should be done which can serve as a basis for further recommendations.

Land use planning is an essential next step in defining appropriate land use and management plans within which local communities would be able to guide their own development and utilisation of natural resources.

Thereafter, the planning of the implementation of the programme should occur. For example, the co-ordination of supplying the infrastructure, transporting people and their belongings and providing essential services has to be done. Broad inter-ministerial co-operation enhances the rate of success for a project of this nature.

Monitoring of the impacts of the resettlement programme is a final stage which should feed back into land use and management plans.
On a regional level, it is widely recognised that devolving decision-making powers to a grass-roots level, in line with central government policy, is the most effective way to ensure sustainable and equitable natural resource use, provided the framework for decision-making is culturally and socially acceptable (Botelle and Rohde, 1995). The integrated participation of local communities, government ministries and donor organisations is essential for effective implementation of land use plans.

16.5.2 Planning and Implementation in Gam

In the Gam resettlement programme, the baseline ecological study was commissioned in June 1993 by the Inter-Ministerial Standing Committee on Land Use Planning. Environmental Information Services and Environmental Evaluation Associates of Namibia (Pty) Ltd completed the study between January and August 1994. This study was commissioned after resettlement had started and thus many of its recommendations were ignored or failed as they were not developed in conjunction with the community (see Ecology section on livestock). A monitoring programme was designed but never implemented (Seely and Shikongo, pers. comm.). This is discussed in more detail later.

A description and analysis of the socio-economic conditions in eastern Otjozondjupa was commissioned by the MLRR and published as "Those Who Live on the Land" by Botelle and Rohde in 1995. This study was also commissioned too late to feed into recommendations of the area’s suitability for resettlement.

The Gam resettlement programme had a minimum of inter-ministerial cooperation. All final decisions were taken by the MLRR. In addition they did an evaluation of the project for further planning themselves. This was despite recommendations made by the Department of Water Affairs that a comprehensive planning document encompassing all relevant sectors be prepared by a private consultant (MLRR, 1994).

Reasons for the lack of commitment to the project by certain Ministries include their lack of involvement from the outset of the project and their disagreement with certain conditions proposed by MLRR that contradicted their principles (ibid.).

Warnings were given to the MLRR about the unsuitability of the area for the proposed project and the lack of proper infrastructure provision within the programme. At the initial inspection of possible sites (at which all ministries were not represented), the department of Water Affairs expressed strong concern about the selection of Gam as a resettlement destination and explained that water supply would be an ongoing problem due to the difficulty of establishing permanent water points. This concern was detailed in a letter given to cabinet by DWA - DRWS, which was ignored (Confidential, pers. comm.). Shortages of time and funds have been cited as reasons for the lack of co-operation and infrastructure, and shortages in water supply.
The MET also reiterated the Water Affairs Department's concern that the current livestock practices are incompatible with the characteristics of the semi-arid environment (MLRR, 1994).

Concerns were also voiced about the inappropriate use of funds, critics believing that jobless Namibians should be attended to prior to high costing projects of the nature of the repatriation programme. Clashes of interest emerged during the process of planning between those who favoured conservation and those in favour of development. While active opposition to the aims and designs of the project did not materialise, a reluctance to participate, initiate discourse and find solutions occurred (ibid).
17. Water Supply at Gam

As already described, Bushmen, who utilised a natural spring, were the first settlers in what is now Gam, and since the mid 1980's a small, mainly Herero, cattle farming community occupied the area, tapping into the old Gam spring and utilising a few isolated boreholes which were developed in the vicinity of Gam and along a linear east-south-east geological feature immediately to the south (the Gam lineament). These isolated boreholes were developed by the CSIR and it was recognised then that groundwater was scarce in the area, and very difficult to locate (Inter-Consult, 1996).

The successful development of boreholes in the Gam region was vital in the facilitation of the recent Herero Resettlement Programme. This section starts by explaining some of the difficulties encountered during the siting and drilling process of these boreholes, and then goes on to discuss the procedures followed. Finally, a summary of the technical issues observed by the research team at the boreholes visited in the Gam area is presented.

17.1 Siting and Drilling

As mentioned above, groundwater is difficult to locate in the Gam area, and it was only through a combination of an expensive high resolution aeromagnetic survey with standard geological, geophysical and remote sensing data that potential water bearing structures were detected beneath the Kalahari overburden (Inter-Consult, 1996). Even with this high degree of geohydrological investigation (200 targets were selected), success rates of boreholes drilled during the repatriation programme in the Gam area were low. Of a total of 82 boreholes which were drilled, only 19 were considered successful and recommended for installation - in order to be considered successful a borehole had to yield more than 1.0 M³/hr (considered a minimum for stock watering points in the area) (Ibid.). This reflects a 23% success rate. In general the water quality was found to be suitable for human and livestock consumption, although isolated boreholes did intersect poor quality (unpotable) groundwater.

The repatriation drilling programme was divided into 3 Phases:

Table 17.1: Phases of repatriation drilling programme

<table>
<thead>
<tr>
<th>Phase</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 93 - Feb 94</td>
<td>To supply water to the quarantine area.</td>
</tr>
<tr>
<td>Feb 94 - Nov 94</td>
<td>To locate water points for the resettlement of people and cattle at 7-10 km spacing from the quarantine area westwards across the repatriation area.</td>
</tr>
<tr>
<td>Nov 94 - July 95</td>
<td>To continue to locate water points for resettlement at 7-10 km spacing from quarantine area westwards across the repatriation area.</td>
</tr>
</tbody>
</table>
All drilling on the project was carried out with air percussion methods. Casing was installed down to bedrock depth, in order to prevent a collapse of the Kalahari overburden. Due to time constraints not all boreholes were tested using a stepped pump test to determine sustainable yields (ibid.). The recommended depth for pump installation and recommended sustainable pumping rates of 11 out of the 19 boreholes declared successful, have been based on estimated yields from blow test results only. Blow tests are taken over a very short time frame, and cannot be used with any sense of accuracy to long term sustainable yield (Hartley, pers. comm.).

Further drilling for this resettlement programme has been concentrated to the south of Gam in the Eliseb block. This area has been shown to have a greater potential for borehole development (Simmonds, pers. comm.).

17.2 Borehole Installation

Of the 19 boreholes which were considered successful, 7 have been installed (MLLR, 1997):

Table 17.2: Boreholes installed in Gam area

<table>
<thead>
<tr>
<th>Borehole Number</th>
<th>Target Number</th>
<th>Communities Name (if available)</th>
<th>Yield (m³/hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WW 34451</td>
<td>TGT 13</td>
<td>&quot;Borehole No. 5&quot;</td>
<td>2.5</td>
</tr>
<tr>
<td>WW 34455</td>
<td>TGT 3</td>
<td></td>
<td>4.8</td>
</tr>
<tr>
<td>WW 34463</td>
<td>TGT 48</td>
<td>Otjimuhama</td>
<td>3.5</td>
</tr>
<tr>
<td>WW 34469</td>
<td>TGT 52</td>
<td>Ondamamahi</td>
<td>4.5</td>
</tr>
<tr>
<td>WW 34837</td>
<td>TGT 60</td>
<td>Otjinguinddi</td>
<td>3.8</td>
</tr>
<tr>
<td>WW 34846</td>
<td>TGT 62</td>
<td>Otjanagela</td>
<td>3.4</td>
</tr>
<tr>
<td>WW 34856</td>
<td>TGT 55</td>
<td>Otjiseranu</td>
<td>24.0</td>
</tr>
</tbody>
</table>

During the data collection stage of this study, 3 boreholes, which were drilled for the resettlement programme, were visited. As in Khomas, direct observations were taken regarding water point infrastructure which is serving the community, and community members who most utilised the borehole questioned on issues such as borehole yield and maintenance. The results of the boreholes which were assessed are presented in Table 17.3.

All three boreholes were installed with a diesel pump and a set of 15 000 litre closed PVC water tanks. These water tanks were placed on top of a 2 - 3 m high steel stand to provide sufficient head for the outlet points. Apart from these structures the infrastructure at the various water points seem not to have been installed according to any set standards (see Table 17.3). Maintenance of this infrastructure, through the regional DRWS office in Tsumkwe, is subject to long delays - at times of up to 2 - 3 months. Although this has created problems with the communities involved as their cattle now have to travel long distances each day to get water from neighbouring water points, they seem unwilling to take the initiative of fixing the problem themselves. They feel that the boreholes are the property of the government.
and if they are found to be altering this property they will be charged for damage to government property.

Diesel for the boreholes is supplied by the government. It is interesting to note that in the Gam area, the farmers are receiving 210 litres of diesel per month, as compared to the Khorixas area were farmers are only receiving 210 litres every 3 months. This highlights the difference in the scale of farming being practised in two different communal areas.

Photograph 18.1: No separate infrastructure was installed at borehole number WW 34463 at Otjimihama where water for human consumption could be drawn.
### Table 17.3: Summary of Boreholes Visited in the Gam Region

<table>
<thead>
<tr>
<th>Borehole</th>
<th>Infrastructure</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>WW 34457</td>
<td>Diesel pump (with zinc shelter) 2x15,000 litre PVC tanks</td>
<td>- This borehole was installed for the original period of quarantine, utilised during this period and then vacated. The borehole was then resettled in 1996 and has been utilised by the present community for 7 months.</td>
</tr>
<tr>
<td>“Borehole No. 5”</td>
<td>cattle trough tap &amp; washing basin</td>
<td>- Yield was good, with the borehole needing to be run 6 - 7 hours per day to supply water needs for stock and human consumption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- One farmer, who seemed to have been placed in charge of the running of the pump as “caretaker”, felt that if bigger diameter pipes were installed the pump could fill the tanks quicker and they could save on diesel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- A washing basin had been installed with the tap, and all infrastructure was in a well maintained condition.</td>
</tr>
<tr>
<td>WW 34463</td>
<td>Diesel pump (no shelter) 2x15,000 litre PVC tanks</td>
<td>- This borehole was apparently the first borehole to be installed outside of the quarantine area and Gam village. It did not have a shelter to protect the pump, nor did it have a tap for human consumption.</td>
</tr>
<tr>
<td>“Ojimihama”</td>
<td>cattle trough (no tap)</td>
<td>- Water had to be collected from the cattle trough which was placed in a low point and was therefore surrounded by mud and water (see photograph 18.1).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- General maintenance was poor at this water point. At this borehole no “caretaker” seemed to be solely in charge of running the borehole, pipes were leaking, and the water tanks had been placed directly on top of the steel grid platform which was resulting in the tanks bulging between the grids and being prone to cracking (one tank had already been replaced due to this problem). No attempts have been made at this borehole, either by MLLR or the community, to remedy these seemingly simple problems.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- It appears that water table levels are dropping at this borehole, according to the farmers using the borehole an additional 5 lengths of pipe have been installed in the hole since its original installation. This would indicate that the pumping depth has dropped by approximately 15 meters. If this draw down of the water table continues at the same rate the borehole will have to be deepened within 4 years.</td>
</tr>
<tr>
<td>WW 34846</td>
<td>Diesel pump (with zinc shelter) 2x15,000 litre PVC tanks</td>
<td>- As in Ojimihama the borehole was originally installed without a base for the water tanks. One tank has had to be replaced, however plywood boards have now been placed under the tanks to prevent further bulging or cracking.</td>
</tr>
<tr>
<td>“Otliseru”</td>
<td>cattle trough tap</td>
<td>- Although a tap has been installed for human consumption, no washing basin, as at “Number 5”, was installed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Original pipes in the borehole were considered too small for the yield required, these have been replaced with larger diameter pipes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Again, no “caretaker” seemed to have been appointed, and leaks were evident around the pump and reservoir area.</td>
</tr>
</tbody>
</table>
18. Discussion and Evaluation of Environmental Impacts and Issues

Boreholes in Gam have had significant impacts on the environment. These are discussed and evaluated in the following sections under the headings of:

- biophysical environment
- land use and rangeland management
- socio-economic environment
- health issues
- monitoring

18.1 Biophysical Environment

18.1.1 Soils

Soils at all the borehole sites range between sand-loam in texture, typical of the Kalahari Geological System within which the study area falls. Soils around the boreholes are heavily trampled, and despite the coarse texture, cattle hoof prints were evident. However due to the unstructured nature of the aeolian sand deposits of the Kalahari Systems, soil compaction at all sites was low except for Otjiserandu (see Table 18.1).

Table 18.1: Soil Components

<table>
<thead>
<tr>
<th>Locality Names</th>
<th>Relief</th>
<th>Surface Stoniness</th>
<th>Form of Soil Surface</th>
<th>Soil Texture</th>
<th>Evidence of Erosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gam - receiving camp</td>
<td>Basically a flat area with borehole positioned at a slightly elevated area</td>
<td>Stoneless</td>
<td>Heavily trampled Low compaction</td>
<td>Sandy loam</td>
<td>Slight: Water erosion (rills) and top soil washed away in a few spots</td>
</tr>
<tr>
<td>Borehole No. 1 (1st cattle post)</td>
<td>Flat land</td>
<td>Stoneless</td>
<td>Heavily trampled Medium compaction</td>
<td>Sand</td>
<td>None</td>
</tr>
<tr>
<td>Borehole No. 5 (2nd cattle post)</td>
<td>Flat land</td>
<td>Stoneless</td>
<td>Heavily trampled Low compaction</td>
<td>Loam</td>
<td>Water: splash erosion</td>
</tr>
<tr>
<td>Otjomihama</td>
<td>Flat land</td>
<td>Stoneless</td>
<td>Heavily trampled and compacted</td>
<td>Loam</td>
<td>Heavy water erosion: rills, denuded top soil.</td>
</tr>
<tr>
<td>Otjiserandu</td>
<td>Flat land</td>
<td>Stoneless</td>
<td>Heavily trampled, Highly compacted. Crust formation.</td>
<td>Loam (within the vicinity of borehole); elsewhere - sandy</td>
<td>Water erosion:</td>
</tr>
</tbody>
</table>

Signs of erosion, both by water and wind were not easily evident during the time of study. However, some signs of splash erosion from previous rain were observed at Borehole Number 5. At the borehole sites on slightly sloping ground, and at those where the reservoir was leaking such as the
Gam receiving camp and Otjimihama, signs of water erosion through rill or channels could be seen. Though it was not the strong wind season, the risk of wind erosion was apparent from the presence of unconsolidated fine soil particles in the vicinity of the boreholes (see Table 18.1).

18.1.1.1 Soil Erosion
Erodability of a soil is based on its resistance to erosion derived from a complex range of physical (texture and structure) and chemical variables. The variables influence the detachment of soil particles and their transport (Environmental Information Services and EEAN, 1994b). Generically the Kalahari soils are fragile. The finer components within the course sand textured soils are more prone to erosion both by wind and water. This is due to poorly developed structure as well as lack of the binding clay particles. The soils found in the study area fall into this category and are prone to severe erosion.

Erosion hazards in the vicinity of the boreholes are exacerbated by large numbers of animals using the boreholes on a permanent basis. The observable negative impacts caused by animals around the boreholes and homesteads studied include trampling and overgrazing (complete loss of vegetation cover).

18.1.1.2 Soil Compaction
The process of heavy trampling of livestock on soils with or without vegetation cover (though more prominent on sandy soils with a higher clay component) may compact the surface of the ground. Compaction may then inhibit the growth of palatable species. All the borehole sites visited clearly showed this feature. There were hardly any plant species seen in the vicinity of the boreholes (see Table 18.3) except for unpalatable species such as the wild pumpkin (fruits eaten by donkeys only).

Moreover, compaction inhibits water movement in the soil by allowing rain water to rest on the surface. Upon drying a cemented or backed surface is left behind (as seen in Otjiseroandu). The result is a surface impenetrable to most plant seeds which limits the establishment of most plant species (Environmental Information Services and EEAN, 1994b).

18.1.2 Vegetation
The ground within 10 m radius from the borehole at all sites had no vegetation at all. According to people who were interviewed, all the areas were covered with vegetation just like the surrounding areas before boreholes were installed. Overgrazing and trampling from livestock drinking daily at these points have contributed to destruction of all the vegetation. However, a few tree stumps were seen around boreholes indicating that some of the trees were cut down. This was acknowledged by farmers at Otjimihama who said that they use some of the trees especially Terminalia prunioides (Omihama) for constructing kraal fences and houses (see Table 18.2). Young trees or seeds which could give an indication of re-vegetation were not seen around the boreholes.
Table 18.2: Vegetation Components - within 600m distance from the borehole

<table>
<thead>
<tr>
<th>Locality Names</th>
<th>Vegetation Cover Within 10m Radius</th>
<th>Grass Description</th>
<th>Dominant Vegetation Cover</th>
<th>Browse/graze Pressure</th>
<th>Tree Stumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gam- receiving camp</td>
<td>Scattered shrubs.</td>
<td>Heavily grazed annuals scattered within the first 200 m. Tall and dense annuals observed from 500 m.</td>
<td>Grass with a few scattered Acacia bushes.</td>
<td>Moderate, increasing with increasing distance from the borehole.</td>
<td>Not seen</td>
</tr>
<tr>
<td>Borehole (1st cattle post)</td>
<td>No vegetation observed</td>
<td>Heavily browsed annuals observed at 100 m distance from the borehole.</td>
<td>Scattered Acacia trees with a few short, thorny bushes.</td>
<td>High</td>
<td>Not seen</td>
</tr>
<tr>
<td>Borehole No. 5 (2nd cattle post)</td>
<td>No vegetation observed</td>
<td>Short annuals, lightly grazed were observed at 20 m distance. The annuals got more denser with distance from the borehole.</td>
<td>Trees</td>
<td>Low</td>
<td>Not seen</td>
</tr>
<tr>
<td>Otjimhama</td>
<td>No vegetation observed</td>
<td>Scattered annuals overshadowed by big Terminalia trees seen about 15 m to the southern direction of the borehole. More grass observed at 200 m distance from the borehole in the northern direction.</td>
<td>Trees, except for the unpalatable wild pumpkin which dominated the first 200 m radius from the borehole.</td>
<td>High</td>
<td>scattered within the 600 m radius.</td>
</tr>
<tr>
<td>Ojiserandu</td>
<td>No vegetation seen</td>
<td>Seen beyond 100m as grass stumps-heavily grazed. More annual grass, short in a patchy and scattered distribution seen form 500m. Grass increases in height and density with distance, though sparsely distributed.</td>
<td>The wild unpalatable pumpkin found about 50m and extend as far as 600m towards the homesteads. Very few trees and bushes (Acacia and other sp.) sparsely distributed. Both grass and trees-low density</td>
<td>High</td>
<td>A few seen</td>
</tr>
</tbody>
</table>
Non-palatable plant species such as the Wild Pumpkin were found around the boreholes beyond 10m (see photograph 18.2). In the surrounding areas, indigenous invasive dicotyledons such as *Sida cordifolia* (at Otjimihama) were found in higher densities. These species are among the prominent species which were not present in the past (Kahaku, pers. comm.). Bushes as well as lower branches of Acacia trees were heavily browsed. The grazing pressure was high near the boreholes where grasses were completely overgrazed. Unpalatable bushes such as *Catophractes alexandrii* were observed about 500 m and beyond.

Grass species which were found within 600 m distance form the borehole were mainly annuals. Perennial species were found in places where grazing and browsing pressure was low such as Borehole Number 5. In some places only dry stumps of perennials such as the *Panicum* sp. were found in very low densities (e.g. Otjimihama).

A poisonous plant, *Dichapetalum cymosum* (gifblaar) was found in lower densities in some places such as Otjiserandu (within 600m). This plant has killed a lot of cattle and is a big problem on sandy soils. It is a stolon (an underground stem) and turns green in the late dry season attracting livestock when most of the surrounding vegetation is dry. Roots are deep in the ground hence any attempt to destroy the plant results in more growth and multiplication (Hofmann and Seiffert, 1996).
Vegetation degradation observed around the borehole increases the risk of land degradation through processes such as soil erosion, loss of soil productivity from compaction, impaired filtration, reduction of soil moisture and surface capping. Moreover, the re-establishment of palatable species as well as soil organisms are hindered.

18.1.3 Wildlife

The increase in human and livestock population in Gam has lead to a decrease in number of both large game species as well as carnivores. It was reported that illegal hunting of large game was done by Herero people who have moved in from Botswana (Standen, pers. comm.). Predators radio collared by researchers from MET for research purposes, have also been shot at Gam (ibid.).

Predators such as lions, leopards, wild dogs, spotted hyaena and cheetahs are killed especially when they attack livestock; for instance a leopard was killed about 3 days before our visit to Borehole no. 5 for killing cattle.

No convictions can take place for the killing of predators, as people are allowed to kill them in defence of their livestock (ibid.).

18.1.4 Water tables

Ground water (aquifers) occurs mainly in bedrock structures in the Gam area, making development difficult and expensive. This is illustrated by the historical 20-30% borehole success rate reported by Dijkstra (1993) and maintained during the programme (Inter-Consult, 1996). The regional water table level in this area is approximately at 90 m.

The absence of surface water flow and the ubiquitous deep sandy soils resulting in rapid infiltration of rainfall into the surface sands affects aquifer recharge. In areas where the Kalahari sand cover exceeds several metres most of this water will be lost through evapotranspiration during the dry season. It is unlikely that any direct recharge from the local rains or indirect recharge from riverbeds occurs, and secondary aquifers probably rely solely on very slow flow through bedrock fracture systems for replenishment.

In summary ground water is scarce in the area and very difficult to locate (Inter-Consult, 1996).

18.2 Land Use and Rangeland Management

The primary land-use in the Gam area is livestock farming. Types of livestock grazing in the area are primarily cattle, goats, donkeys, horses and a few sheep. The animals are grazed in an open extensive system. Large livestock like cattle, donkey and horses roam freely over the area and only return to a central point for water. This has profound impacts on rangelands around
boreholes in terms of land degradation and sustainable yield. Since animals use boreholes as permanent water points, the surrounding land is subjected to continual degradation. This has implications with regards to the distance between boreholes, as degradation extends further outwards with time as well as with growth of livestock populations (see photograph 18.3).

Photograph 18.3: Land degradation around a borehole at Otjiserandu in Gam

Though the carrying capacity of the area has been estimated as 1:15 (1 Large Stock Unit per 15 ha), implying that each borehole will accommodate 300 Large Livestock Units (MLRR, 1994), this estimation does not hold on the ground. More than 500 cattle use one borehole in Gam, as well as the visited cattle posts (except in Otjiserandu where grazing is limited by Gifhlaar). Extended family culture and lack of proper structures for monitoring cattle numbers or families using the borehole are a problem (Shikongo, pers. comm.). Moreover herders take their cattle to any neighbouring borehole in case of emergencies.

Rangeland management practices such as rotational grazing are not practised in Gam. Several cattle posts (such as borehole number 5) have been established away from the main settlement (the receiving camp) to ease pressure on grazing. However, these posts still use boreholes on a permanent basis. Thus instead of easing pressure, degradation is spread from one successful borehole to another. This has been exemplified in the study by some of the cattle posts which have been turned into permanent settlements, such as borehole number 5.
Table 18.3: Summary Table for Sites (Gam)

<table>
<thead>
<tr>
<th>Locality Names</th>
<th>Borehole Number</th>
<th>Uses</th>
<th>Number of Animals</th>
<th>Number of Households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gam-Receiving Camp</td>
<td></td>
<td>Livestock and domestic</td>
<td>About 1000</td>
<td></td>
</tr>
<tr>
<td>1st cattle camp</td>
<td>Private Borehole</td>
<td>Livestock and domestic</td>
<td>No interview done</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>WW 34451</td>
<td>Livestock and domestic</td>
<td>600 Cattle and more than 1000 goats</td>
<td>7</td>
</tr>
<tr>
<td>Otjimbingi</td>
<td>WW 34463</td>
<td>Livestock and domestic</td>
<td>About 2000</td>
<td>10</td>
</tr>
<tr>
<td>Otjiserandi</td>
<td>WW 34856</td>
<td>Livestock and domestic</td>
<td>300 cattle</td>
<td>16</td>
</tr>
</tbody>
</table>

18.3 Socio-economic Impacts and Issues

18.3.1 Settlement Patterns and Movements
The permanent resettlement of the Herero and Mbanderu from Botswana, where they had felt marginalised and disadvantaged, back to their ancestral home of Namibia, would not have been possible without the provision of boreholes supplying the people and their livestock with water.

However, this has radically altered the community composition of the area, which previously comprised of Ju’hoan who utilised what was a spring at Gam (a borehole now exists on this site) on a seasonal basis (Botelle and Rohde 1995). The area was also used seasonally in good rainfall years by livestock from the more densely populated south, when surface water was available. Thus transhumance was the predominant land use of the area as a result of previous lack of permanent water supplies. After the late 1970’s a small community of mainly Hereros who also used surrounding isolated boreholes, settled in the area (ibid).
18.3.2 Settlement

Gam, the repatriation camp, has been situated near the site of the Gam borehole. It is approximately 10 hectares in extent, and consists of prefabricated government buildings, including a clinic and police station, and an 'informal' settlement, inhabited by the Herero and the Mbanderu, consisting of tents and mud dwellings. There are a few poorly stocked shops, a number of 'shebeens', and an inadequate school. Adult literacy classes exist.

Infrastructure is thus poorly developed. In addition, transport and means of communication with the outside world is lacking. The settlers indicated that they feel isolated (PRA interviews).

A small group of former Ju/'hoan residents live on the outskirts of Gam.

The residents of Gam plan to make Gam a permanent central settlement, and are motivating for improved infrastructure and facilities (Mungendje, pers. comm. and PRA interviews). This has only been made possible through the existence of a permanent water supply.

Surrounding Gam are a number of boreholes drilled for the purpose of the resettlement project, as well as those drilled prior to this. Small scattered groups of Ju/'hoan have settlements at a few of these earlier boreholes. Their villages are approximately 500m - 1 km from the actual borehole, so that wildlife that drink at the waterpoints do not impact on the people.

Certain boreholes currently remain cattleposts, with members of the Herero extended families remaining there with livestock, and returning to Gam periodically. People interviewed indicated that they were waiting to see if the boreholes at these posts proved adequate and reliable, after which family groups will move out to settle permanently at the posts.

18.3.3 Borehole Networks

Water supplies from the boreholes are often unreliable, inadequate or unsuitable for consumption. This includes the borehole at Gam. As a result, each borehole settlement is not a separately functioning entity. Each borehole was found to have a network of up to four others that reciprocated informally in times of need. Visiting also takes place between these (PRA findings).

18.3.4 Impacts of Resettlement

This issue of resettlement of the Herero is value laden, as the presence of the recent Herero settlers has impacted on the previous occupants of the area, the Ju/'hoan, and severely compromised their lifestyle and means of subsistence and livelihood.
Furthermore, Herero from the area are moving northwards with their livestock into Ju’hoan areas, despite the presence of the veterinary fence. Denial of access is a problem here, as it is unconstitutional to deny access to resources on ethnic grounds. However, the incompatible land use patterns of the Herero pastoralists and the Ju’hoan subsistence livelihoods mainly based on sustainable natural resource use, is an issue that needs to be addressed.

18.3.5 Leadership Structures and Control over Resources

The Herero appear to be politically united and motivated in their goal of successful resettlement in the area. Community leadership structures exist. They are aware of their needs and make representation to central government to voice their aims and concerns.

The Ju’hoan, on the other hand are at a disadvantage as they lack a representative leadership structure. This issue is being addressed and the Nyae Nyae Development Foundation (NNDF) and the Nyae Nyae Farmers Union (NNFC) has emerged as the representative Organisation to act on their behalf.

This has resulted in problems with control over the resources on which the Ju’hoan depend, and difficulties in preventing influxes of Herero settlers with their livestock northwards past the veterinary fence into Bushmanland. Currently, however, attempts are being made to deal with this issue and representation is being made to central government. Furthermore, the area north of the veterinary fence is applying for Conservancy status in order to have control over and benefit from wildlife and as a means to prevent newcomers with incompatible land use patterns.

18.3.6 Livelihoods and Resources

18.3.6.1 The Herero

The Herero have a predominately pastoralist economy, with livestock, in particular cattle providing the major means of subsistence and cash livelihood (PRA findings)

The existence of the boreholes in the Gam area has allowed for this pastoralist economy to continue in Namibia, despite the fact that this may not prove to be a sustainable land use practice for permanent settlements in the Kalahari area. Besides water, grazing is a longer term limiting factor in the area, as rangeland degradation has been found in nearby areas (south west Hereroland) as a result of long term overgrazing. This would result in increasing pressure on the vulnerable natural resources, necessitating larger areas for grazing, or loss of livelihood and subsistence. The possible influx of Hereros proves a threat to the surrounding areas, settled by Ju’hoan.

Cattle represent more than a means of livelihood for the Herero. They are a symbol of wealth and status, and are used on occasions such as funerals,
marriages, and as a means of strengthening social ties, such as used in assisting one another, particularly kin (Malan 1995). Thus it is unlikely that farmers will adopt a flexible and adaptable management approach and reduce stock when conditions demand this.

The Herero suffered dramatic stock losses while in Botswana as a result of their extermination by the government during the recent Lung Disease epidemic. Although they were compensated at the rate of 500 Botswanan Pula per head, all community members described this as being a tremendous setback, from which they are currently suffering. Their intention is to rebuild their herds as soon as possible.

Permanent water from boreholes has resulted in the creation of gardens which are planted in most settlements, but have not yet proved successful. Pests such as rats, and damage by cattle as a result of inadequate fencing materials, and a lack of seed, were cited as reasons for this. The AgriculturalExtension Officer at Tsumkwe (Kakujaha, pers. comm.) reported that farmers are assisted with seeds, ploughing services as well as advice, but felt that the growing of crops was not traditional among the Herero.

Natural resources are inadequate for survival needs (PRA findings). Little use is made of wild foods, which were used in Botswana. However, natural medicines were used in some cases. Wildlife hunting provides a dietary supplement, despite its illegality, but game was described as being not as plentiful as in Botswana. The Conservation officers are seen as a problem.

Although subsisting mainly on milk and meat provided by cattle, supplemented by maize meal, their livestock resources are inadequate to meet their needs (PRA findings). Furthermore, prices for cattle were described as being low, and markets problematic. Thus cash for food and other necessities such as school fees, clothing, medicine and transport is needed from other sources.

However, alternatives are limited. Employment opportunities are almost non-existent in the area, and alternative skills are few (PRA findings).

Those interviewed, particularly the women, indicated that they lack the necessary means to develop alternative means of livelihood. This included fabric for the making of clothing, as many possessed sewing machines, as well as grass for basketmaking.

The settlers are using the cash resources they brought from Botswana. They have not yet received their pensions from the government. Government food aid is provided as an emergency measure. Families and neighbours assist each other with food and cash for necessities. There were some women who had no livestock or alternative means of survival and depended on food aid and assistance from others (PRA findings).
Thus, despite the provision of boreholes, the land is not capable of supporting the population due to lack of natural resources, employment opportunities and access to infrastructure.

18.3.7 Tourism

Tourism as an alternative means of livelihood in the Gam area has largely been precluded by the resettlement of the Herero with their livestock, and thus indirectly by the provision of boreholes which have made this possible.

Wildlife and unspoilt natural beauty are attractions for tourists, including consumptive trophy hunting. These are under increasing threat by the present land use practices of the Herero. Carnivores are being exterminated as a threat to livestock, and other wildlife is hunted for food.

North of the veterinary fence, however, community tourism projects, are being initiated, such as the campsite and sale of crafts operated by the NNFC. In addition, a private tourist lodge at Tsumkwe offers tours to a Ju/hoansi traditional village, providing the community there with income. This village is planning to develop its own tourist campsite.

However, the Herero repatriates can have a negative impact on these initiatives should they move northwards into these areas. Furthermore, wildlife from these areas are being eliminated as animals move south into the Gam area as part of their movement patterns. Thus events south of the Veterinary fence also have an impact on other areas.

18.3.8 Community Ownership

In order to prepare for the new DRWS policy of cost recovery, Water Point Committees have been established in Gam. In the Gam resettlement camp, a committee was established in December 1996. Two meetings have been held to explain the policy, and "there was dissatisfaction amongst the people, but they have now accepted the policy because they have no choice" (Shikongo and Kahaku, pers. comm.).

While the establishment of water point committees is still in its early stages, community leaders and communities members raised the following major concerns (Mungendje, pers. comm.):

- Implementation of the policy has to be phased in because communities are still trying to settle in the area, and are still recovering from the loss of their cattle in Botswana. There would be need for support from the Government for the next 10 to 15 years.
- Water point committees and communities need extensive training on operation and maintenance of the borehole structures before the policy comes into practice.
- Local communities were not consulted in siting the boreholes, and thus feel that they should not take over the burden from Government of ineffective water supply. (It was cited that out of a total of 82 boreholes
drilled by geohydrologists, only 19 had been successful in yielding enough water. Most of the boreholes had run dry or could not be used throughout the year (Mungendge and Shikongo, pers. comm.). The community strongly believed that their own local diviners should be consulted in the siting of boreholes.

- Ownership of boreholes should not be addressed in isolation from ownership of land around the boreholes since this would jeopardise the success of the policy.

As in Khorixas, the study team observed in the discussions with the communities that they were not against the principles of the policy per se, but they did not understand the essence of such a policy and any advantages to be derived from it.

Effective implementation of this policy as well as any other which addresses the question of natural resource management, should address some of the concerns raised by the communities more closely.

18.4 Health issues and impacts of boreholes surrounding Gam

18.4.1 Quantity

Seven outlying boreholes around Gam have been settled. Only those boreholes supplying sufficient water for large herds of cattle have been chosen for settlement.

There is adequate water for drinking, domestic use and hygiene. However, it has been stated that cattle are often given a higher priority than people in access to water (Health Unlimited, 1996). The Ministry of Lands, Resettlement and Rehabilitation estimated that less than one twentieth of the water available is used directly by humans - the balance is used for watering cattle (MLRR, 1994). Consequently, hygiene and sanitation assume a low profile. This may contribute to the high incidences of diarrhoea and water washed diseases.

In terms of economic benefit and wealth creation and its subsequent secondary benefit to health, the plentiful water supply contributes significantly by sustaining large herds of livestock. These numbers are, however, unlikely to be sustainable and the environmental damage that is occurring as a result may have a long term negative health impact (see ecology section).

18.4.2 Quality

Local community is generally of the opinion that the water is of a good quality for human and stock consumption.
As in Khorixas water was sampled for TDS and tested for coliforms.

18.4.2.1 TDS
Only three boreholes were sampled for TDS and the results are displayed in the following table. The acceptable TDS readings are verified by the fact that there were no complaints from any communities of brackish water. (WHO maximum allowable TDS is 1000 mg/litre)

Table 18.4: TDS Results (Boreholes sampled in Gam)

<table>
<thead>
<tr>
<th>Post</th>
<th>TDS (mg/litre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borehole 5</td>
<td>860</td>
</tr>
<tr>
<td>Otjomühama</td>
<td>810</td>
</tr>
<tr>
<td>Otjiseranu</td>
<td>610</td>
</tr>
</tbody>
</table>

18.4.2.1.1 Coliform Count
The table 18.5 summarises the bacterial results from water sampled from three boreholes and provides a description of the associated water infrastructure. (WHO guidelines stipulate a maximum allowable E. coli count of 0 and coliform count of 3). Not surprisingly the residents of Otjomühama were experiencing a severe outbreak of diarrhoeal disease. This represents a significant impact arising out of the provision of boreholes.

Table 18.5: Coliform Counts (Boreholes sampled in Gam)

<table>
<thead>
<tr>
<th>Post</th>
<th>Comments on Water Supply Structures</th>
<th>E. coli/Count (per 100ml)</th>
<th>Total Coliforms (per 100ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borehole 5</td>
<td>Water is pumped by diesel engine into two 15000 litre tanks. This is distributed through a closed system to animal drinking troughs and to a separate tap with a basin from where water is obtained for human consumption.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Otjomühama</td>
<td>Water is pumped by diesel engine to two 15000 litre tanks. From here it is piped down a slope to a cattle trough about 30m away. Water leaks from the piping and a small rivulet has formed down the slope. The area around the trough could be described as a cesspool. There is no separate outlet for water for human use and people draw their drinking and washing water from the cattle trough (see photograph 18.1)</td>
<td>2500</td>
<td>3000</td>
</tr>
<tr>
<td>Otjiseranu</td>
<td>Water is pumped by diesel engine into two 15000 litre tanks. This is distributed through a closed system to a animal drinking trough and to a separate tap with a basin from where water is obtained for human consumption.</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
18.4.3 Infrastructure
It is worth noting some of the deficiencies in infrastructure and management that were found at Otjimba. The lack of separate facilities for obtaining water for human consumption is having severe consequences in terms of the quality of the water obtained. However, this factor along with the leaking pipes, lack of adequate fencing around the cattle trough and heavily polluted water around the trough has created several health hazards.

- Malaria Risk
The abundance of stagnant water from leaks, spillage’s and overflows has created several ideal mosquito breeding loci within the village. This is not desirable in an area in which malaria is endemic.

- Physical Danger
Muddy areas (at Otjimba, about ten metres in diameter) around animal troughs have to be negotiated by people to obtain water, and this presents a hazard particularly for children. Local herdsmen here were quick to point out that smaller stock, such as goats and kids, sometimes got stuck in the deep mud and on occasion had been lost in this way. This is undoubtedly a hazard, a negative health impact, which could be avoided if the water infrastructure was of a higher standard.

- Other Diseases
The severely unhygienic conditions surrounding the water collection point could be a nidus for several other disease outbreaks such as cholera, enteric fevers such as typhoid and paratyphoid fever, amoebic dysentery, shigellosis as well as other diarrhoea-causing organisms such as giardia.

18.4.4 Health - Conclusion
In conclusion therefore, borehole provision has provided several immediate health benefits. Higher level health benefits are attainable through activities allowed by a plentiful water supply such as pastoralism and subsistence gardening. These have to be managed within environmental constraints so that the health of the environment, and consequently public health, is optimised.

However, the standard of the infrastructure and facilities involved in water provision needs attention if new immediate health hazards and negative health impacts are not to be created in the process.

18.5 Monitoring
Prior to the repatriation process’s commencement, no environmental impact assessment was conducted concerning the state of the environment in the Gam area or the potential impacts the resettlement would have on natural resources. However a consultancy was commissioned by the Inter-Ministerial
Standing Committee for Land Use Planning (IMSCLUP) to carry out a baseline ecological study of the resettlement area and to establish an ecological monitoring programme to track changes in the environment following completion of the resettlement programme. A separate study was also commissioned on the relevant social-economic factors (Environmental Information Services and EEAN, 1994b).

From this study, four objectives for environmental monitoring in the Resettlement Area were developed:

1. Develop a baseline for on-going biophysical and socio-economic data collection.
2. Monitor the response of the biophysical and socio-economic systems to the influx of livestock and people.
3. Use examples encountered in this programme to formulate post-facto recommendations for use in support of future decision making for similar projects.
4. Raise the level of environmental awareness (for example, limited water resources in Namibia, consequences of overgrazing and potential socio-economic impacts) of decision makers, politicians and development agencies.

One of the recommendations of the monitoring procedure was the use of boreholes as monitoring foci at appropriate frequencies. Moreover, it was recommended that major biophysical and socio-economic studies should be undertaken at five-year intervals for the first ten years of the resettlement process.

The first environmental monitoring study was done in 1995 approximately one year after the baseline study was conducted. It has been reported that many changes in the biophysical environment have taken place in the area as a result of the resettlement (Kavaa et al., 1995). These changes were induced by the concentration of livestock around successful boreholes. On assessment of these changes, it was recommended that high concentrations of livestock around boreholes should be reduced to prevent further degradation of rangelands and the consequent lost of stock (Kavaa, et al., 1995).

Other than the 1995 study, the environmental monitoring programme has not been carried out in full as recommended (Seely, pers. comm.; Shikongo, pers. comm.).
19. Summary of Issues and Impacts - Gam

This section below summarises issues and impacts which arose from the study. These issues are divided into five sections:

- policy and decision making
- biophysical
- socio-economic
- water supply and borehole maintenance
- community resource management

19.1 Policy and Decision Making

- A general lack of co-ordination between government sectors has existed during the Gam resettlement programme. This has resulted in many unnecessary problems, with issues such as basic health services, sanitation, veterinary extension services and education still needing to be adequately addressed by the respective ministries. Present agricultural offices and extension services are inadequate and this is resulting in farmers being denied adequate agricultural assistance.

- The decision to establish a resettlement area in Gam did not acknowledge the environmental constraints (social, biophysical and economic) of the area. The lack of an environmental assessment to determine site suitability prior to the resettlement bears testimony to this. It is predicted that the recent changes in land use will have severe negative impacts on the environment in Gam. Although local farmers' views were positive regarding the present productivity of the area, signs of patchy deterioration around boreholes gave negative indications for long term productivity.

- A general lack of structured policy and planning exists with regard to the sustainable use of natural resources. This extends to the provision and use of water points. During this study it became obvious that the provision of water is generally seen as an engineering problem, and as such little interaction between social and environmental concerns is occurring.

19.2 Biophysical

- Despite the fact that the study was carried out during the rainy season, land degradation around the boreholes was clearly noted.

- Soil degradation was observed in soils around all the boreholes. Soils were heavily trampled and in some areas highly compacted. Degradation was more prominent around boreholes than in the grazing area or in the vicinity of homesteads. Kalahari soils are fragile and from the damage observed during the study, it was apparent that the soils cannot sustain large numbers of animals concentrated at one point.
Overgrazing and trampling have destroyed all vegetation types immediately around the boreholes and chances of re-growth are limited. This lack of vegetation around boreholes visited is an indication of what sedentarisation and an absence of proper grazing management means to a fragile ecology such as that found in the Gam area.

- The heavily browsed trees and shrubs observed around the boreholes and near the homesteads gave an indication that elimination of palatable species was already taking place. Moreover no signs of coppicing trees and/or young trees were observed. Such signs imply that in a short while palatable species will disappear leaving room for growth of unpalatable bushes (bush encroachment).

- The spread of unpalatable species such as *Sida cordifolia* in areas where palatable species have been lost is another sign of vegetation degradation which will consequently affect the quality of grazing in the area. Though the poisonous plant, *Dichapetalum cymosum* is endemic in the area, its density has been increasing due to grazing pressure which suppresses palatable plant species. It has been established that this species generally occurs at low densities, but spreads faster in areas with higher disturbances through trampling, overgrazing, and excessive fires (Environmental Information Services and EEAN, 1994).

- Despite the fact that there is no data on the numbers of animals lost as a result of the resettlement programme, it can be clearly stated that "Gam as a habitat is lost" (Stander, pers. comm., 1997). Habitat disturbance or destruction will definitely lead to changes in species numbers and composition. Since the resettlement is still on going programme, it is apparent that further population growth will lead to more biodiversity loss.

### 19.3 Socio-Economic

- Water supply provision has altered the previous land use practices of seasonal transhumance. Permanent settlements have occurred around boreholes, particularly at Gam (receiving camp), despite the fact that existing amenities and infrastructure are unsuitable for a permanent human settlement of this size. Permanent settlements are also developing at surrounding boreholes, although the trend is to try and settle as close to Gam as possible.

- The provision of boreholes to supply the people and their livestock with water has enabled permanent resettlement of the Herero and Mbanderu from Botswana. This has radically altered the composition of the previously existing Ju/hoansi and Herero communities of the area. The existing Ju/hoansi community have been affected through enforced changes in their means of subsistence and livelihood.

- Water points in the Gam area lack proper infrastructure for safe hygienic water supply. A recent review shows that there are several diseases associated with water supply in Gam. These include diarrhoea, skin infections, worms and seasonal malaria. An example observed of the results inadequate infrastructure has on health was the extremely high *E. coli* counts measured at Ojitimhama.
where a tap had not been installed and drinking water is collected from the cattle trough. This problem was exacerbated by the fact that the trough was placed in the middle of a knee-deep pool of dirty, muddy water.

- Each settlement around a borehole does not function as a separate entity. Networks have been established and neighbouring settlements often assist each such as when there is a need for emergency water provision. It was found that the main 'link' is usually with family and services found in Gam.

- The majority of the returning Hereros cattle were destroyed due to a lung disease epidemic in Botswana before they returned to Namibia. These farmers are all engaged in rebuilding their herds as soon as possible. Unless appropriate and adaptable land-use management practices are immediately implemented in the area, observed land degradation will continue.

- Employment opportunities are almost non-existent in the area and alternative skills are limited. People with no livestock depended on food aid and assistance for their survival. In these cases very little money is available for other necessities such as school fees, medicine and transport.

- Resettlement of the Herero into the Gam area has resulted in an increased pressure on the natural resources and social lifestyles of the Bushmen communities north of the 20° latitude veterinary fence. Due to the higher quality grazing, larger numbers of game, and the Bushmen’s lack of political influence, the Herero are constantly trying to settle in this area.

19.4 Water Supply and Borehole Maintenance

- The Ministry of Lands, Resettlement and Rehabilitation took on the responsibility of providing water through a borehole development programme. This was after DRWS refused to become involved in providing water due to the lack of potential groundwater reserves in this area and the technical difficulties involved in locating and extracting from these reserves. The drilling programme has had a very low success rate: of 82 boreholes drilled, 19 are considered successful (a 23% success rate), and 7 have been installed. Further drilling for this resettlement programme has been concentrated further south in the Eiseb area which has a greater groundwater potential.

- The maintenance of boreholes, through the regional DRWS office in Tsumkwe, is subject to long delays - at times of up to 2-3 months. In cases where a borehole is no longer functioning, this is resulting in ecological impacts at surrounding boreholes which need to sustain far larger herds during this time. This delayed maintenance is also making it difficult for people to decide whether or not to put up permanent homes, as they need to be guaranteed a reliable water supply.

- All the installed boreholes are using diesel pumps. Farmers receive 210 litres of diesel per month from the government. This highlights the volumes of water required and the scale of farming in this area in comparison to Khorixas, where farmers receive the same amount of diesel, but only every 3 months.
• Although some stepped pump tests were done to determine sustainable yields, many boreholes were recommended for installation using roughly estimated blow yield test results. This, together with the fact that no monitoring of volumes or water tables is taking place, raises concern as to whether these boreholes are delivering a sustainable yield in the long term. At Otjimihama (one of the three boreholes assessed in this study), water table levels seem to be dropping. The pumping depth has had to be increased by 15 m since installation, if this continues the borehole will have to be deepened within 4 years.

19.5 Community Resource Management

• In Gam the idea of conservancies is relatively unknown, and little enthusiasm was shown even after explaining the issue to the interviewed community members. Traditionally, cattle and large cattle herds play an important role in Herero culture. Thus a lack of interest is not surprising.

19.6 Conclusion

• The supply of permanent water points in the Gam area in the form of boreholes, has allowed for the resettlement of pastoral Hereros into a relatively ‘pristine’ area, previously utilised by a small population Ju/'hoansi and Herero on a very localised scale. The resulting increase in both human and livestock numbers around these permanent water points is changing farming practices from mobile/seasonal movement to sedentary livelihoods. Habitat loss, rangeland degradation, and a loss of livelihoods and subsistence methods of the original inhabitants has resulted.

The principle symptoms of environmental degradation related to Herero repatriates in Gam include soil degradation, severe reduction of quality and quantity of grazing and bush encroachment. In the study area, several factors contributing to land degradation were identified:

♦ concentration and increased duration of livestock in grazing areas;
♦ concentration and increased duration of livestock at water points;
♦ lack of herding and rotational grazing,
♦ lack of accountability or responsibility for sustainable use of common property, mainly free access to resources;
♦ installation of boreholes with no monitoring of impact on water tables, vegetation and grazing due to inadequate extension services and awareness programmes.

• In a marginal area such as Gam, the provision of permanent water points, coupled with the sudden population increase of both livestock and people, could give short term benefits at the expense of long term productivity. Localised degradation which was observed during the study especially around boreholes and homesteads provides an indication of degradation which is already taking place in Gam. Extensive land degradation and hence a greater susceptibility to droughts will result if sustainable land-use practices are not put into place.
• Resettlement, made possible by boreholes provision, has resulted in the imposition of a sedentary and intensive system on an ecologically fragile area. This has lead to a disruption of appropriate coping mechanisms, such as transhumance, which enabled sustainable use of the area.

• A lack of clear ownership rights over the resources contributes to major problems in resource management. Without secure tenure, boreholes, like any other natural resource are regarded as government property. This contributes to the farmers' lack of incentives and opportunities to manage resources in a sustainable manner. Farmers utilising a borehole are unable to deny other people either the right to grazing on surrounding land or to the use of the borehole. In the study area, dependency on the government seemed to frustrate farmers especially with regard to the long delays experienced in borehole maintenance.

• Planning for the Gam resettlement programme was short-sighted and ineffective, generally lacking in guidelines or any indication of a move towards integrated regional development. In addition, no consideration was given to the development of a holistic land-use plan for the region, and no guidelines were provided to contribute to the sustainable use of the natural resources upon which the programmes' success is wholly dependent.
PART IV

DISCUSSION FROM CASE STUDIES
RECOMMENDATIONS
PART IV

DISCUSSION FROM CASE STUDIES

RECOMMENDATIONS
20. Discussion of Sustainability Issues Arising from the Case Studies

Namibia is the driest country in sub-Saharan Africa. Rainfall is highly variable and unpredictable, and productive land is fragile. In many areas environmental degradation has resulted in a loss of productivity and biotic diversity. As discussed, human pressure on the environment has been a major cause of desertification. With approximately 70% of Namibians directly dependant on natural resources for their livelihoods, degradation directly affects the quality of life of many people.

Drought is a recurrent feature of Namibia’s dry environment. To date this has not been recognised by the Namibian government and incorporated into long term planning. Many responses to drought, such as the provision of boreholes as emergency relief measures, have been implemented with short-term goals in mind, exacerbating existing impacts and leading to unsustainable use resource use.

As water is scarce, water provision in Namibia is an important issue with regards to sustainable use of the country’s resources. More than 50% of the population are dependant on groundwater. However, provision of a point source of water (borehole) in an arid environment, without adequate planning, can lead to sedentarisation, loss of seasonal grazing areas and desertification. In addition, people’s susceptibility to droughts can be increased. Water point provision also impacts on social exchange systems and on people’s ability to control natural resources (see discussion in section 7).

Given the unique features of Namibia, the dry and variable climate, limited and finite water resources, and the dependency on natural resources, future development needs to be carefully co-ordinated.

The two case studies presented in this report examined the environmental impacts of emergency borehole provision. In Khorixas boreholes were drilled as a relief measure for drought and in Gam for a resettlement programme.

Although the findings presented in this report represent a very small proportion of the diversity of issues as regards borehole provision in Namibia, a number of conclusions can be drawn. The two case study areas differ in the rationale behind emergency borehole provision, but many of the underlying issues and resulting impacts are similar.
20.1 Sustainability

20.1.1 Definition
Sustainability encompasses a broad range of issues, and popularity of the use of the term has resulted in its frequent misuse without examination of how a particular development plan will ensure long-term sustainable management of resources (Jacobson et al, 1995).

Sustainable development has been defined as 'development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs' (IUCN/UNEP/WWF, 1991). Achieving sustainable development requires careful consideration of four different aspects of sustainability. (Extensive reference in compiling these four aspects has been made to Jacobson et al (1995) and Hill and Bowen (1996)):

Social sustainability entails:
- ensuring social self-determination
- a social framework which empowers self-control over resources
- the definition of rights over resources and land
- skills training and capacity enhancement

Economic sustainability incorporates:
- defining and evaluating goals for appropriate resource use
- developing plans to meet objectives of resource users
- ensuring financial affordability for beneficiaries

Environmental sustainability entails:
- effective use of natural resources within the productive carrying capacity of the natural system to maintain them

Technical sustainability implies:
- technology is appropriate for the use it is intended
- structures are durable, functional and reliable

A set of overarching principles guides the implementation of these sustainability criteria. Pre-assessment of projects, timeous involvement of affected people and the promotion of inter-disciplinary collaboration and multi-stakeholder partnerships are important.

Reconciling these aspects of sustainability is a difficult task. However, Namibia should give careful consideration to these aspects in planning programmes given its dependency on its natural resources.
20.1.2 Sustainability and the Case Studies

The environmental policy directive in the Namibian constitution states that:

"The State shall actively promote and maintain the welfare of the people by adopting, inter alia, policies aimed at the following:

...(I) maintenance of ecosystems, essential ecological process and biological diversity of Namibia and utilisation of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future..." (Article 95(1)).

In accordance with this directive, the provision of water points should aim at being sustainable. During this study, it was found that emergency borehole provision did not give enough consideration to aspects of sustainability.

The programmes occurred with little, or no, reference to long term planning policies, needs assessment or environmental assessment. People who were most affected in rural areas were often not involved in decision making, there was a lack of interdisciplinary collaboration and sectoral thinking appeared to have occurred.

Emergency borehole provision occurred within a framework that was socially unsustainable in some aspects. Rights over natural resources and land are not clear, and people are not empowered to take control. Communities cannot control individuals or communities who infringe on their traditional rights. Thus people may seek to maximise short term benefits as they are disempowered.

IMC borehole provision did address aspects of social sustainability relating to skills training and capacity enhancement through the development of an educational programme.

A general lack of planning, combined with inappropriate considerations regarding resource use, makes provision of boreholes, under 'emergency' conditions, economically unsustainable. In Gam the provision of boreholes is resulting in land use practices that may prove unsustainable in the long term, whilst in Khorixas, continued water provision may be supporting land uses which are inappropriate for the environment. In these cases alternative more sustainable land uses could have been planned for, in conjunction with the provision of boreholes.

The consequence of this lack of holistic thinking, regarding infrastructure provision in conjunction with land use planning, is environmental unsustainability. Unmonitored exploitation of groundwater is occurring which could be unsustainable in the long term. Pressure on rangelands has been increased, overgrazing and soil degradation are occurring and adaptive farming strategies have been limited. Thus resource utilisation might be unsustainable which will increase people's susceptibility to future droughts and lead to desertification.
Water point provision has been technically sustainable in some cases. In Khorixas most of the IMC installations were technically sustainable as appropriate infrastructure was supplied for the needs of the community in terms of health. However, a lack of adequate infrastructure for providing a safe hygienic water supply was found in Gam. The technology of infrastructure was also sometime inappropriate given that the DRWS is implementing a cost recovery scheme. If infrastructure is too expensive to maintain, it will be economically unsustainable for the beneficiaries.

20.2 Conclusions

The provision of water on an emergency basis without reference to holistic land use planning occurring in conjunction with affected users, has engendered a situation which might be unsustainable in the long term in the two case study areas.

However, if accompanied by appropriate land use management practices, with plans which take environmental limitations and social systems into account, the provision of artificial water points need not contribute to an unsustainable situation. Consideration should be given to all aspects of sustainability and the needs of people now should be balanced against needs in the future.
22. Recommendations

From this study it is clear that boreholes, whether provided as part of a drought relief programme or as a component of a resettlement scheme, are powerful determinants of and influences on the social, economic and biophysical environment. Namibia is a country which relies significantly on its ecological production. It is expedient, therefore, that the provision of boreholes in communal areas is planned, implemented and managed in such a way that their positive environmental impacts can be optimised and negative impacts minimised. In achieving this end, boreholes will have to be planned and managed within a holistic framework which is cognisant of the environmental implications of decisions and activities at all stages and levels involved in the provision of a borehole. **Borehole provision must be subject to a process of environmental assessment and holistic environmental planning and management.**

It is suggested, therefore, that the environmental implications of borehole provision need to be addressed at three levels:

1. A national level which addresses the wider political, economic, social and ecological context

2. The programme level which addresses the environmental implications of a particular borehole provision programme

3. The local level of the individual borehole and user community

Recommendations presented below have been formulated to provide input and guidelines to each of these levels.

22.1 National Level Recommendations

In order to facilitate a more sustainable approach to intervention and “relief” work, and in order to reduce increasing drought susceptibility and vulnerability, government policies, priorities and rationales need to undergo a paradigm shift. This paradigm shift needs to take cognisance of the realities facing a country with an arid climate in which the recurrence of “drought” is frequent and regular. Principles and recommendations for implementation and consideration at national level and the national context are presented below:

- **Strategic Environmental Assessment**
  Every development plan, policy and programme should be assessed at a strategic level in terms of its impact on the environment and on the community who are the recipients of such interventions. Both positive benefits and negative impacts need to be assessed to determine the feasibility of the programme under long-term sustainability criteria regarding
Namibia's development. It is at this level that cumulative impacts of programmes and a succession of such programmes need to be studied and addressed.

- **National Strategy for Drought**
A national strategy should be developed to reduce the country's vulnerability to drought thereby reducing the social, economic and environmental impacts resulting from drought. As social, economic and environmental issues are inter-related and inseparable, this exercise would have to assume a holistic and multi-disciplinary approach that involves development planning from all sectors.

- **Co-ordination**
Effective co-ordination is required for government policies at national, regional and local levels. The establishment of LUEB chaired by the NPC at national level will be a useful step in ensuring that development proceeds in an integrated manner.

The appointment of an Environmental Commissioner in the NPC will ensure that environmental considerations are taken into consideration during a project's appraisal.

- **Capacity Building and Community Participation**
Plans, policies and programmes should be directed at enhancing and building capacity - from individual rural communities to top government levels. This needs to be achieved by assisting in the promotion of self-sufficiency, dignity and increasing productivity and creativity.

Both formal and informal education should play an important role in empowering people to have the relevant knowledge, awareness, attitudes and necessary skills to adapt to aridity. Large scale training of extension workers will contribute to changing people's attitudes where necessary in rural areas, with a focus on reducing their susceptibility to drought and increasing activities for coping with drought and managing land in arid areas.

It is important that use is made of indigenous knowledge and that existing community capacity and resource use are recognised and incorporated into any policies and programmes.

Decision making in the implementation of development plans, policies and programmes should be a co-operative effort between Government and local communities.

- **Land Tenure**
A flexible approach to land tenure, needs to be adopted that will enable constituted communities and groups to exercise joint ownership rights over land. Community tenure will therefore be central to the success of the policy for community ownership of boreholes and other natural resources which need to be managed collectively. Only if communities can reap the benefits of sustainable management of their natural resources will they have an
incentive to do so. As long as outsiders can use resources with impunity sustainable management will be undermined. However, care needs to be taken that existing adaptive reciprocal social networks are not disrupted in the process.

The CBNRM programme (see appendix 3) would be a possible framework within which sustainable management of natural resources can be achieved.

- **Land-use**
  In conjunction with a flexible approach to land tenure, holistic land-use planning is required to address sustainable resource management in Namibia. The provision of all water points in rural areas should be subject to this planning.

Land-use planning needs to take cognisance of the necessity of flexible farming strategies to cope with Namibia's arid environment. These strategies should allow farmers to track environmental fluctuations through (Scoones, 1995a):

- Increasing the amount of locally available fodder;
- Reducing the amount of feed that animals need;
- Moving animals to areas of available fodder;
- De-stocking and restocking in response to drought cycles.

Thus, policies and plans for droughts should enable farmers to achieve these aims.

In order to alleviate the pressure on natural resources as a result of livestock farming as a major economic activity, alternative land use and livelihood options need to be explored and developed where possible. These could include tourism, use of wildlife to benefit communities and the development of alternative markets and skills. Again, the concept of CBNRM may serve as a useful framework for achieving this economic diversification.

- **Monitoring and Evaluation**
  Monitoring and evaluation of human activities which increase susceptibility to drought should be established. Such monitoring and evaluation must be thoroughly integrated into the awareness, education and training processes mentioned above, and be based upon knowledge and understanding of the processes contributing to and exacerbating the effects of dry and variable rainfall.

- **Appropriateness of Foreign Aid**
  Any foreign donor assistance needs to be subject to a process that tailors projects, plans and programmes to the particulars of the Namibian environment. All relief work that takes place should be held to certain development standards based on an appreciation of local capacity and designed to support and increase this capacity. It is essential that future programmes decrease susceptibility to drought.
• **Cost Recovery Policy and Water Point Committees**

The implementation of the new cost-recovery policy for borehole maintenance should be phased. The policy also needs to take into consideration the differing conditions for each region, as well as the wealth of community leadership experience existing in traditional authorities. Policies and programmes should rather strengthen existing structures than create new systems which may not be appropriate or meaningful to the communities. More specifically, the definition and composition of a community should be taken into account before water point committees are introduced.

### 22.2 Programme Level Recommendations

Although providing boreholes as a drought relief measure has been shown to be unsustainable in some respects, ongoing rural water supply will incorporate continued borehole development. It is imperative that each borehole provision programme be submitted to a process of **environmental appraisal**. Without stipulating the specific format of this appraisal, the following should be highlighted as important features of the environmental assessment or review of a borehole provision programme.

#### 22.2.1 Definition of Emergency Borehole Provision

The provision of boreholes under “emergency” conditions, whether as drought relief or resettlement, needs to recognised as ongoing rural water supply development, not simply “emergency relief”. As such it should be subject to full environmental appraisal - environmental considerations can not be ignored because the programme is labelled “emergency relief.”

#### 22.2.2 Commitment to Environmental Protection

Every borehole drilling programme should be aware that it has the potential to impact the environment both positively and negatively and should, therefore, be required to commit itself to the aim of combining environmental protection with development through environmental assessment.

A borehole programme should commit itself to the principles of social, economic, ecological and technical sustainability. These principles should inform all aspects of the programme.

#### 22.2.3 Environmental Assessment

* **Needs Assessment**

A standardised, well documented needs assessment must be completed. This needs assessment must take cognisance of existing water supplies, stock and human population numbers and alternative solutions to the problem other than borehole provision. It should also clearly state who the
beneficiaries of the project will be those who will be responsible for the water point.

- **Consideration of Alternatives**
  It is important for there to be an analysis and appraisal of alternatives to water provision through supplying new boreholes. Such alternatives could, for example include:
  - rehabilitation of existing boreholes
  - alternative means of water supply
  - destocking in response to drought
  - encouraging economic activities that are not 'livestock orientated.'
  This could include CBRNM options.

- **Assessment of Impacts and Use of Appropriate Technology**
  A programme should consider how it will affect the environment. In particular the following points are presented as key issues to be examined:

  **Social impacts**
  - effect on settlement patterns
  - influx of people into the area
  - effect on existing functional social and resource exchange networks
  - effect on indigenous sustainable land use practices
  - quality and standard of infrastructure with respect to the provision of safe water

  **Economic impacts**
  - costs to the community of maintaining boreholes
  - appropriate technology

  **Ecological impacts**
  - cumulative effects of boreholes on ecology
  - spacing of boreholes
  - entrenchment of land uses inappropriate to environmental limits

**22.2.4 Commitment to Transparency and Accountability**

The decision-making process and activities of a borehole programme should be conducted in an open manner.

A borehole provision programme must be accountable for its decision-making, activities and book-keeping. In the light of this study it seems important that the financial activities of borehole programmes must be competently recorded, available to authorities, donors and public and subject to audit.
22.3 Individual Borehole Level Recommendations

In addition to the above general guidelines and recommendations there are several important recommendations which apply to provision of the individual borehole.

22.3.1 Pre-requisites and Conditionalities of borehole provision

Full community participation is required at all stages of decision making and planning.

- Need for water
In this study it was evident that some boreholes were provided in communities which already had sufficient water - even during the drought. It is recommended that before a borehole is provided to a community there must be a well defined need for it. This should be documented.

- Number of people to benefit
Another observation in this study was that the number of people who benefit from a borehole was often extremely low and in some cases a borehole might not even be used (Nigerian Programme). It is recommended that the costs, benefits and alternatives be evaluated and documented in this respect so that the maximum number of people may benefit at the least cost.

- Management awareness
Boreholes should not be installed unless there is a clear understanding of the need for management of natural resources and a strong community structure to do this. Grazing and water rights need be allocated to resident families to prevent over-utilisation of these communal resources. This will require capacity building within communities and the creation or strengthening and support of strong community based organisations. CBNRM organisations could be the basis of organisations used for management of natural resources.

22.3.2 Siting of Boreholes

- Siting Process
Present distrust of professional geohydrologists by rural communities needs to be addressed through clearer lines of communication between the geohydrologists, regional Rural Water Supply offices, and the community who have motivated for the borehole. Communities desires of having a borehole close to the village and which is sited by a local ‘diviners’ are often in conflict with geotechnical considerations. These difficulties need to recognised and negotiated openly to engender a sense of community ownership in the process.

- Groundwater Abstraction
Areas of low groundwater potential need to be recognised, and a moratorium on further drilling placed on these areas. These points will become especially
important in future years when communities will be expected to fund the drilling of their own boreholes.

Available groundwater resources need to be taken into account to prevent unsustainable drawdown of water tables because boreholes are too close together.

- **Zones of Impact**
  Boreholes need to be sited such that their zone of impact does not overlap the zones of impact of surrounding water points. The distance between water points will be dependant on the type of livestock, their numbers and the particular environmental conditions prevailing in the area.

- **Natural Springs**
  Boreholes should not be sited in an area which would result in an impact on natural springs - both in terms of detrimentally lowering water tables and affecting wildlife patterns.

- **Biodiversity and sensitive environments**
  Boreholes should not be sited in areas of high biodiversity or ecological sensitivity such as wetlands. Instead boreholes should be sited such that they attract settlement and human activity away from such areas.

Consideration of the sensitivity of soil and vegetation to degradation is needed in siting of boreholes.

22.3.3 **Appropriate Technology - pumps and infrastructure**

- **Sustainable yield**
  The pump capacity should not be able to exceed the sustainable yield of the borehole. Recommendations regarding sustainable borehole yields need to be based on stepped pump test results, not simply on inaccurate blow testing results.

- **Maintenance costs**
  The most appropriate pump mechanism should be installed given the costs of installation, running and maintenance. Other environmental factors such as remoteness of the installation, availability of wind or sunlight and potential damage by elephants should be taken into account in this decision. It is suggested that in most cases solar pumps are the most economical to install, run and maintain. Although sunlight availability is not usually a problem, the few days which are overcast may be planned for with appropriate water storage facilities and water consumption management. Maintenance costs will become even more important as local communities are asked to bear these costs.
• **Water Infrastructure**

The water storage and reticulation infrastructure should be of a high standard to ensure that water is not contaminated before consumption. To provide high quality water, water storage should be in closed plastic tanks and reticulated through a closed system. Furthermore drinking facilities for animals should be separate from distribution points for water intended for human consumption.

Open reservoirs are not only vulnerable to contamination but provide a locus for mosquito breeding and consequently are a malaria hazard.

Water outlet points should be planned and designed in such a way as to ensure a safe user environment.

### 22.3.4 Operation and Management

• **CBNRM**

CBNRM could be an essential component of community management and monitoring of boreholes. Implicit in the conservancy concept is the notion that the management of natural resources cannot occur effectively unless integrated with the management of water. Neither can effective and sustainable management of water and water supply occur if attempted in isolation from land-use practices and management of natural resources. Although CBNRM currently only applies to rights over wildlife, the concept of community-based natural resource management should arguably be extended in the future to include rights over, or ownership of, other natural resources such as water.

• **Cost Recovery and Water Point Committees**

The implementation of the new cost-recovery policy for borehole maintenance should be phased. The policy also needs to take into consideration the differing conditions for each region, as well as considering the wealth of community leadership experience existing in traditional authorities. Policies and programmes should rather strengthen existing structures than create new systems which may not be appropriate or meaningful to the communities. More specifically, the definition and composition of a community should be taken into account before water point committees are introduced.

• **Management Plans**

Attention needs to be given to developing appropriate monitoring and management plans to reduce the impacts on sensitive soil and vegetation. These plans could include (EEAN, 1994a):

- managing vegetation to protect soils in particularly vulnerable seasons
- degraded soils should be allowed to recover some vegetation before degradation is irreversible
- cordonning of particularly sensitive or agriculturally valuable soils to protect them from trampling.
• Seasonal Use
Water point provision in conjunction with land use planning, could incorporate seasonal or occasional use of boreholes in emergencies. Thus seasonal grazing areas would remain as such and sedentarisation in these areas would be dissuaded.

22.3.5 Record Keeping and Monitoring
A pertinent problem encountered in this study was the lack of borehole data and records. Information such as this is vital to achieving efficient environmental management and sustainability.

• Baseline borehole data
Accurate, regularly updated records of borehole data must be kept. This will include information about rock strata, water tables, depth drilled and results of stepped pumped tests.

• Yields
Regular monitoring of pumping volumes needs to be implemented. This data could be incorporated into a regional data base indicating seasonal changes in borehole yields and water tables, and provide information towards determining longer term sustainable yields.

• Water quality
Water quality in terms of bacterial contamination and TDS should be monitored on a routine basis as well as at the time of installation. Where there are abnormal findings or indications of a potential problem this should be fully investigated.

• User Data
There should also be a comprehensive data base regarding number of people and livestock using a borehole as well as maintenance costs of each borehole.

22.3.6 Decommissioning
It was clear from this study that boreholes are never decommissioned. Boreholes provided in times of drought as emergency boreholes remained an integral part of the resource base of the user community. The notion that a borehole could be decommissioned after a period of drought did not appear to be a viable option in practice because the borehole provides such a basic resource which is used until it runs dry or otherwise ceases to function. The decommissioning of boreholes is not recommended. This factor must, therefore, be considered in the provision of a borehole, that is, it becomes a permanent feature of the environment.
22.4 Recommendations for Further Study

22.4.1 'User Pays' options as a sustainability principle

The concept of 'user pays' should be investigated as a principle to promote sustainability. Although it is in effect being implemented by the DWA, it should be fully investigated in the context of water supply for communal areas. It is possible that the system would be more appropriate for some areas than others and should be flexible to meet the requirements and needs of individual areas.

22.4.2 Development of legal process / environmental management

It is considered necessary that a formal process of environmental assessment for borehole provision programmes should be developed. This would be a process of environmental assessment, possibly based on existing environmental assessment procedures, but designed specifically for borehole provision programmes. It could specifically incorporate the guidelines presented above.
References


References


Appendix 1

List of Interviews
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<tr>
<th>Name</th>
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<td>Senior Foreman, Mechanical Maintenance and Repair, DRWS, Khorixas</td>
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<td>Outreach Project Manager, IRDNC</td>
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<td>Deputy Director-North, Directorate of Water Supply, Windhoek</td>
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<td>SSD, University of Namibia</td>
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<td>Programme officer, Environment, USAID, Windhoek</td>
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<td>Groundwater Consulting Services</td>
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<td>Acting Chairman of Central Water Committee, Khorixas</td>
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<td>Managing Director, Interconsult Namibia (Pty) Ltd, Windhoek</td>
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In addition, informal interviews took place with people from communities visited.
Appendix 2

Components Employed in the Description of Soils
Appendix 2

Common Errors Employed in the Description of Solids
Components Employed in the Description of Soils

- **Relief:** within the radius of 100m including the relation of the site to the main drainage lines, whether the topography was flat or hilly.
- **Surface stoniness:** description of lithology; size, shape and abundance of surface stones. Terms for stone abundance based on Hodgson (1974).

<table>
<thead>
<tr>
<th>Term</th>
<th>Abundance (%)</th>
<th>Alternative term for use where standard terms are awkward in context</th>
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<tr>
<td>Stoniless</td>
<td>&lt;1</td>
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<tr>
<td>Very slightly stony</td>
<td>1-5</td>
<td>few stones</td>
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<td>Slightly stony</td>
<td>6-15</td>
<td>common stones</td>
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<td>Moderately stony</td>
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<td>many stones</td>
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<td>Very stony</td>
<td>36-70</td>
<td>abundant stones</td>
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<tr>
<td>Extremely stony</td>
<td>&gt;70</td>
<td>extremely abundant stones</td>
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- **Form of soil surface:** Lightly, moderately or heavily trampled/compacted.
- **Soil Texture:** description was done in the field based on a simple set of teset for determining the class of soil texture based on Shaw (1928).

*Sandy:* Loose and single grained. Individual grains can be readily seen and felt. When squeezed dry it will fall apart when pressure is released. When moist it will form a cast which crumbles when touched.

*Sandy loam:* A sandy loam contains much sand but has enough silt and clay to make it somewhat coherent. Individual sand grains can be seen and felt. Squeezed when dry, it will form a cast which readily falls apart but when moist a cast can be formed which will bear careful handling without breaking.

*Loam:* An even mixture of different grades of sand, silt and clay. Has somewhat gritty feel, yet it is fairly smooth and slightly plastic. Squeezed when dry, it forms a cast which will bear careful handling; the cast formed by squeezing when moist can be handled quite freely without breaking.

- **Signs of erosion:** evidence of flooding, soil erosion by wind or water.
Components Employed in the Description of Soils

- Pumice or solfataric lithic, welded or pyroclastics produced by explosive activity.
- Soil Texture: Association with the main soil type is not easy to determine as some soil types have a similar texture.
- Easily determined by the size of soil texture based on Shore's (1967) test.

<table>
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<th>Texture</th>
<th>0-10</th>
<th>10-20</th>
<th>20-30</th>
<th>30-50</th>
<th>50-70</th>
<th>&gt;70</th>
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<td>5</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>3</td>
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<tr>
<td>Silt loam</td>
<td>2</td>
<td>1</td>
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<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Sandy clay</td>
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<td>0</td>
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<td>Clay</td>
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</table>

- Soils formed under grass or shrub vegetation can be easily studied and identified. When some investigation is needed, it will identify which vegetation is present. When more investigation is needed, a series of tests can help identify which vegetation is present.

- Soil Testing: A variety of tests can be used to identify the type of soil, such as texture, color, and particle size. This information can be used to determine the best management practices for the soil.
Appendix 3

Conservancies in Communal Areas
Appendix 3

Communications in Communist Areas
Conservancies

Outline of Conservancies in Communal Areas

A conservancy is defined as a group of commercial farms or areas of communal land on which neighbouring land owners or members have pooled their resources for the purpose of conserving and using wildlife sustainably (MET). Conservancies have been in operation on commercial farmland in Namibia since 1968 when commercial farmers were able to gain rights over wildlife from government. Conservancies on commercial farms have been successful in achieving the joint objectives of wildlife preservation and generation of wealth at the local level as well as at national level (Jones, pers. comm.).

Until recently, communal area farmers, however, were not legally able to derive benefit from wildlife in communal areas as they did not have rights of use over wildlife. Consequently, they were alienated from traditional practices of natural and wildlife resource management and from a significant part of the resource base. Besides not deriving benefits from wildlife they have had to bear some of the costs of wildlife preservation such as stock losses to lion and hyena, and crop and water point damage by elephants. There is, therefore, little economic or other incentive for wildlife conservation in communal areas (Jones, pers. comm.).

The Community Based Natural Resource Management (CBNRM) Programme designed and initiated by the MET now allows communities in communal areas to organise to form a conservancy - a legally constituted body which has the rights to use and manage wildlife within the conservancy’s boundaries for the benefit of the community. Use of wildlife for economic gain may include direct consumptive use, selling of live game, granting of hunting concessions and eco-tourism ventures and contracts. The only condition on the use of wildlife stipulated by the MET is that it is managed and used on a sustainable basis (Jones, 1995).

Proceeds from the use and management of wildlife will be distributed and used at the discretion of the community. The condition stipulated in this regard is that there is competence and equity in the management of profits and proceeds.

All members of the community should benefit from the conservancy, both in terms of direct financial benefits, and in terms of community development projects which would become possible with funding from the conservancy.
Before a conservancy is registered the MET has to be satisfied that:

- the management community is representative of the community,
- the conservancy has a proper constitution which includes sustainable management and includes a set of rules as to how the conservancy will operate,
- the committee has the capacity to manage funds adequately and a policy or plan for the equitable distribution and use of funds and
- the conservancy has geographical definition which is not disputed.

(Jones, 1995)

It is argued, therefore, that a conservancy provides many new economic opportunities and consequently diversifies the economic activity of the area. It also broadens the accessible resource base of the community. These factors should contribute to more economic self-sufficiency in the community and less dependence on outside and government assistance. Diversification of economic and production activities would also make the community less susceptible to natural phenomena such as drought.

Relevance of Conservancies to this Study

Conservancies, or community based natural resource management programmes (CBNRM) are relevant to the study of boreholes in communal areas in Namibia as they are a planning option and consideration in communal areas. Also, implicit in the conservancy concept is the devolution of rights and control over natural resources to the community for community benefit. However, perhaps most important, is the notion that management of natural resources cannot occur effectively unless integrated with the management of water. Neither can effective and sustainable management of water and water supply occur if attempted in isolation from land-use practices and management of natural resources.

Although CBNRM currently only applies to rights over wildlife, the concept of community based natural resource management should arguably be extended in the future to include rights over, or ownership of other, natural resources such as water. The Directorate of Rural Water supply has a programme underway already to devolve responsibility for maintenance of boreholes to the user community (Koch, pers. comm.). There is also a 15 year cost-recovery plan whereby over time, communities will be responsible for the complete cost of drilling and installation of boreholes (ibid.). CBNRM could, therefore, include management over water resources in the near future.
By diversifying economic activities, as would occur in a conservancy, a community would be more self-sufficient and less susceptible to the impacts of drought. They would therefore be less dependent on government and external aid. This decrease in vulnerability would serve to counteract some of the negative impacts arising out of borehole construction.

Lastly, the concept of conservancies contains several important resource management principles for communal areas and provides a possible framework for integrating management recommendations which arise out of this study.

Implicit in the concept of conservancies, therefore, are several principles and factors relevant to this study:

1. Community management of resources.
2. Community development.
3. Wildlife use and conservation as an alternative and possibly more efficient and ecologically sensitive economic activity and means of accessing the ecological production of an area than livestock farming.
4. Economic diversification, development and opportunities for entrepreneurship.
6. Community organisation and equitable access to resources within the community.

The above are important development and management principles which may also be applied to the management of other natural resources in the communal areas such as that of water. Ideally communities could be devolved rights or ownership over most natural resources in the community so that communities can develop locally appropriate, integrated and holistic resource management strategies.
The emerging economic activities are now seen in a community.

It's important to note that the community's economic activities are not limited to the community itself. They extend well beyond the boundaries of the community and have a significant impact on the local environment.

The emerging economic activities are not limited to the community itself. They extend well beyond the boundaries of the community and have a significant impact on the local environment.

The study of the community's economic activities reveals several important aspects:

1. Community management of resources
2. Community development
3. Welfare use and conservation as an measure and policy
4. More efficient and ecologically sensitive economic activity
5. Better organization and coordination of economic activities
6. Community organization and more efficient access to resources
7. The community

The study reveals how the community's economic activities are managed and developed. It also highlights the importance of efficient and ecologically sensitive economic activity.

The study also emphasizes the need for better organization and coordination of economic activities. It highlights the role of community organization in ensuring efficient access to resources.

In conclusion, the community's economic activities play a crucial role in the local environment. They must be managed and developed in an efficient and ecologically sensitive manner to ensure the sustainability of the community and its environment.
Appendix 4

Desertification
Desertification

This appendix is based mainly on a paper by Seely et al. (1994) given at Namibia's National Workshop to Combat Desertification.

Definition

Desertification can be defined as land degradation in arid, semi-arid and sub-humid areas resulting mainly from negative human impacts combined with difficult climatic and environmental conditions. Considerable uncertainty about the extent, causes and costs of land degradation exists but that it has, and is continuing to take place is undisputed (Dewdney, 1996).

Desertification: Process and Symptoms

The processes and causes of land degradation are multi-faceted and complex and many can be linked to inappropriate and unsustainable land use practices. There are three essential components worth noting:

- the processes are not the result of normal rainfall variation or drought, but may be initiated or worsened by these short term factors
- the human influence is almost always dominant but climate, and particularly potential long-term climate change may also have an influence
- the processes are more or less irreversible (except possibly over a long time).

In Namibia desertification has several facets and symptoms (Seely et al, 1994):

Overgrazing and Soil degradation

Overgrazing entails excessive trampling and consumption of grasses by livestock to the extent that the productivity of grass cover is reduced or completely destroyed (Seely et al, 1994). The removal of vegetation cover and trampling may result in soil degradation. The capacity of the soil to hold water is diminished and the soil can be reduced to a powder. This results in increased water and wind erosion.

Bush encroachment

Bush encroachment is the increase of woody plant species relative to the grass component which results in reduced productivity of rangeland. Inappropriate grazing management and the exclusion of fire may contribute to bush encroachment.

Deforestation

Deforestation occurs, even though Namibia has no true "forests", through increased harvesting of wood for housing and firewood.
Description

The problem is expressed in a paper by Geer et al. (1980) given at the National Workshop on Computer Descriptors.

Definition

Deforestation can be defined as land degradation in which permanent removal of forest or removal of growing stock of trees is caused by humans.

Deforestation results from agricultural activities, urbanization, industrial activities, and military operations.

Deforestation can also be caused by natural processes such as wildfires, volcanic activity, and soil erosion.

Deforestation can be measured by the area deforested or the volume of wood removed.

Deforestation can also be measured by the number of species that are affected or the amount of carbon dioxide released.

Deforestation can be mitigated by reforestation, afforestation, and soil conservation practices.

Deforestation can also be prevented by implementing policies that protect forests and by reducing demands for products made from forested areas.

Deforestation is a serious issue and has significant implications for biodiversity, climate, and human well-being.

Deforestation also leads to soil erosion, which can result in decreased agricultural productivity and water quality.

In many cases, deforestation has negative effects on the local economy and human health.

Overexploitation and Soil Degradation

Overexploration of water resources can lead to soil degradation and nutrient depletion.

Excessive harvesting of forest products can lead to soil erosion and nutrient depletion.

Excessive harvesting of forest products can also lead to habitat loss and biodiversity decline.

Excessive harvesting of forest products can also lead to increased greenhouse gas emissions.

Deforestation can also lead to increased water and wind erosion.

Biodiversity and Ecosystem Health

Deforestation can lead to the loss of biodiversity and ecosystem health.

Deforestation can also lead to the loss of ecosystem services such as carbon sequestration, water purification, and pollination.

Deforestation can also lead to the loss of cultural and spiritual values.

Deforestation is a complex problem that requires a combination of policy, economic, and social interventions.

Deforestation is a significant contributor to climate change and has significant implications for human well-being.

Deforestation is a complex issue that requires a comprehensive approach to address.
Overcultivation
Overcultivation is the unsustainable excessive cultivation of crops on the same area.

Causes of Desertification

Direct Causes
Some of the direct causes of desertification include:

Fixed permanent settlements
The development of fixed permanent settlement means that flexible farming strategies are harder to follow. Farmers no longer follow the natural seasonal variations in pasture availability and water and land is not given a chance to recover after heavy grazing or crop cultivation.

In addition, provision of water points in former seasonal grazing areas means these areas are subjected to continuous grazing. Water points erected during droughts counter the natural limits set by environmental confines as livestock are moved to unused water-stressed areas. This limits options for future use.

Absentee farm management
Absentee farm management means that quick, flexible decisions are harder to take and often the owner, who is responsible for taking decisions, is out of touch with daily changing environmental conditions.

Inappropriate fencing
In many communal areas fencing is occurring at a rapid rate. Richer farmers are fencing off areas for their own use and excluding poorer farmers. However these farmers still utilise communal grazing areas before moving to fenced areas. The majority of livestock belonging to poorer farmers are confined to smaller areas.

Inappropriate crop cultivation
Practices of crop rotation and fallowing are replaced by the cutting and burning of trees. This leads to loss of vegetation cover and accelerated erosion. In addition ploughing of land physically disturbs the soil which if it is not planted can be exposed to erosion processes.

Indirect Causes

There are also a number of indirect contributors to the processes of desertification:

Urbanisation
People have been moving to urban areas in search of work and to escape deteriorating conditions in rural areas. Around urban settlements, the
destruction of trees for wood selling for firewood and curios is occurring on a large scale.

National government and economic policies
National government policies or the absence of polices can contribute to desertification. Sectoral planning mainly has adverse effects on the environment as it fails to take cognisance of all components and related side effects (Seely et al, 1994). The impacts people have on the ecosystem are most likely to be governed by the constraints of laws and government policies or the absence of these.

International donor agencies
Donor agencies can contribute to desertification indirectly by supporting unsustainable projects. For example, drought relief and normal rural water supply development have been confused which has sometimes resulted in the provision of boreholes (a development measure) without reference to integrated planning strategies.

The media
The perceptions and understanding of many issues in Namibia are shaped by the media. Droughts have been portrayed as an uncommon occurrence that need urgent emergency action from government. This view overshadows the idea that the individual is as responsible as the government for planning and executing strategies to combat drought and desertification.

Social and socio-economic aspects
Social and economic factors and considerations are significant contributors to desertification. High population growth rates, poverty and lack of alternatives have the potential to create land use practices that are destructive to the environment.
Appendix 5

Water Related Diseases
Appendix B

Water Related Diseases
# Water related disease profile world-wide (adapted from Hardoy et al, 1992)

<table>
<thead>
<tr>
<th>Disease Grouping</th>
<th>Morbidity (per year)</th>
<th>Mortality (per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Waterborne Diseases</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholera</td>
<td>&gt;300 thousand</td>
<td>&gt;3 thousand</td>
</tr>
<tr>
<td>Diarrhoeal Diseases (including diarrhoea caused by salmonella, shigella, campylobacter, <em>E. coli</em>, rotavirus, amoebiasis and giardiasis)</td>
<td>&gt;700 million</td>
<td>&gt;8 million</td>
</tr>
<tr>
<td>Enteric fevers (<em>Typhoid and Paratyphoid</em>)</td>
<td>&gt;1 million</td>
<td>&gt;25 thousand</td>
</tr>
<tr>
<td>Infective Jaundice (<em>Hepatitis A</em>)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polio</td>
<td>200 thousand</td>
<td>25 thousand</td>
</tr>
<tr>
<td>Pinworm</td>
<td>Possibly 1 billion</td>
<td>20 thousand</td>
</tr>
<tr>
<td>Roundworm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whipworm</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Water Washed Diseases</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin and Eye Infections</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scabies</td>
<td>6-9 million blind</td>
<td></td>
</tr>
<tr>
<td>Impetigo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trachoma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leishmaniasis</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Water Based Diseases</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schistosomiasis (Bilharzia)</td>
<td>200 million</td>
<td>&gt;200 thousand</td>
</tr>
<tr>
<td>Dracunculiasis (Guinea Worm)</td>
<td>&gt;10 million</td>
<td></td>
</tr>
<tr>
<td><strong>Water related Insect vector</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trypanosomiasis (Sleeping Sickness)</td>
<td>&gt; 20 thousand new cases annually</td>
<td></td>
</tr>
<tr>
<td>Filaria</td>
<td>90 million</td>
<td></td>
</tr>
<tr>
<td>Malaria</td>
<td>&gt;250 million</td>
<td></td>
</tr>
<tr>
<td>Onchocerciasis (River Blindness)</td>
<td>18 million</td>
<td></td>
</tr>
<tr>
<td>Yellow fever</td>
<td>25 thousand</td>
<td></td>
</tr>
<tr>
<td>Dengue fever</td>
<td>30 million</td>
<td>1-2 million</td>
</tr>
<tr>
<td>Water-related Disease</td>
<td>Cholera</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>100 million - 1 million</td>
<td>Diarrheal Diseases (Including Shigellosis and Other Diarrheal illnesses)</td>
<td></td>
</tr>
<tr>
<td>1 million - 5 million</td>
<td>Enteric Fever (Typhoid and Paratyphoid)</td>
<td></td>
</tr>
<tr>
<td>5 million - 10 million</td>
<td>Invasive Haemorrhagic (Typhoid A)</td>
<td></td>
</tr>
<tr>
<td>10 million - 100 million</td>
<td>Seroi</td>
<td></td>
</tr>
<tr>
<td>100 million - Possible 1 billion</td>
<td>Infant Mortality (Pneumonia and Diarrhoea)</td>
<td></td>
</tr>
<tr>
<td>Possible 1 billion - 6-8 million</td>
<td>Maternal mortality</td>
<td></td>
</tr>
<tr>
<td>6-8 million - 500 million</td>
<td>Maternal mortality (Eclampsia)</td>
<td></td>
</tr>
<tr>
<td>500 million - 10 million</td>
<td>Deceleration Wound</td>
<td></td>
</tr>
<tr>
<td>10 million - 500 million</td>
<td>Water-related Insect Vector</td>
<td></td>
</tr>
<tr>
<td>&gt; 500 million - Causing summer wave</td>
<td>Typhus</td>
<td></td>
</tr>
<tr>
<td>&gt; 500 million - Causing summer wave</td>
<td>Malaria</td>
<td></td>
</tr>
<tr>
<td>&gt; 500 million - Causing summer wave</td>
<td>Yellow fever</td>
<td></td>
</tr>
<tr>
<td>&gt; 500 million - Causing summer wave</td>
<td>Dengue fever</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 6

Livelihood Systems and Resource Use
Appendix 6

Livelihood Systems and Resource Use
Livelihood Systems and Resource Use

This section is divided into:
1. Overview
2. Case Study Findings

Overview

As in most of Namibia, water is the major economic constraint of the region.

In these marginal lands, communities depend predominantly on livestock farming for subsistence and cash livelihoods. Neither this nor other land use practices such as gardens is usually sufficient to meet survival needs, and needs to be supplemented with income from other sources. These include assistance in the form of formal or informal transfers, from employment of themselves or relatives, pensions, food aid, and assistance from kin or neighbours. Thus risks are spread through a variety of income sources and exchange relations. This is one of the significant factors of the pastoral economy which ensures a 'safety net' for individuals or in times of difficulty. The challenge is to produce surplus to allow for exchanges to take place.

Livestock farming is the major economic activity of the area.

Besides subsistence uses, such as meat and milk, livestock are also used for status, occasions such as funerals, and for cash in times of need, such as paying of school fees.

Thus, policies concerning livestock numbers needs to take into account the cultural values of these livestock, as well as their use in food security and risk spreading.

Herds are owned by multiple owners within the family. Children are commonly given livestock at a young age which forms an independent herd in adult life. Men and women are also given livestock from relatives when they marry. Farmers also entrust some of their stock to relatives or employed herdsmen living elsewhere, thus spreading the risks.

Women farmers and female headed households are common throughout Damaraland (Rohde, 1994) . However, average herd sizes of women farmers is only 65% that of men (ibid.). Furthermore, women have less access to jobs and credit, and have the extra burden of child raising. Access to water and grazing and gender inequality are issues that need further investigation.
Appendix 7

PRA Findings
• ‘Weekend’ or ‘absentee’ farmers were found at Lofdal post and Horizon (there may have been others). They worked in the civil service in Khorixas, returning at weekends. They serve to enhance the security of extended rural families and provide a subsistence wage to the herders.

• Herders were found at Lofdal post, Nugas post, Bergville, Potgietersrus and Horizon, depending on food and wages from the farmers for whom they worked. They were employed either by weekend farmers of pensioners. Herders are paid anywhere between N$60-N$150/month, plus food rations (Sullivan, 1996:30).

Expenditure and Relative Priorities

In nearly all 9 communities consulted, school fees were mentioned as the most difficult to meet. Goats were usually sold for cash for this purpose. The network system operated here, whereby one person would assist another in need by selling a goat in order to supply another with cash for school fees.

Opinion was divided among the respondents, however, with women and herders tending to mention food and school fees as their greatest cash problems, while some men from more established communities (e.g. Engelbrecht) mentioned items such as buying of cattle or cash needed for their vehicles, as following on from school fees.

In all cases, food is shared with neighbours and kin who are without.

Clothing, transport, hospital and medicine, followed by household utensils, food for chickens and livestock, seed and paraffin were also mentioned. Wages for the herder was mentioned on one occasion (Bergville), but as a low priority. The group of young men (Tussenby) included funeral expenses, ‘people’s problems’ such as bail, and farm implements.
There exists a disparity in herd sizes. Some stock owners have over 100 cattle or small stock, while others have no livestock whatsoever (1993 Veterinary Services Reports, in Rohde, 1994).

According to Rohde (1994) livestock off-take rates are around 10%, giving the average farmer a cash return of about R1200 per year. The benefits of milk production and the consumption of small stock adds to the calculation of subsistence income.

Livestock markets are few, and transport was cited as a problem. Cattle auctions take place periodically in Khorixas, organised by the Farmer's Unions and speculators (out of hand selling). (Hendrick, pers. comm.). Sales are based on community needs, for example before schools open and during very dry seasons. Farmers also sell and exchange livestock between themselves. Thus livestock provides a form of currency within the informal economy, creating a means of exchange outside of the cash system.

**Case studies (taken from PRA findings)**

The following results emerged from the case studies.

**Livestock**

As expected, Livestock was mentioned as the highest priority resource. Unless otherwise mentioned, the findings applied to all settlements.

- **Goats** in particular provide a safety net in times of need, providing quick cash for emergency items such as food and school fees, as well as milk for tea and children. They were mentioned as providing the largest amount of cash to the community. Their meat is sometimes consumed, particularly in times of need. Other uses mentioned were hides and use for occasions such as weddings and funerals. As with other resources, goats are used in the network system, in order to assist others in times of need.

At Nugas post, however, it was mentioned that goats could not always be counted on as they were sometimes taken to graze elsewhere.

- **Sheep** are sold for cash. The skins of sheep were used.

- **Donkeys** and some **horses** provide the main source of transport in the area. Again, this resource is shared with others in need. In an emergency they are sold for meat or transport, although the cash value is low.
• **Cattle** were considered highly important, and brought in larger amounts of cash. However, they were not as important in times of need as goats. Sales are more difficult than other livestock, prices are often low, and during drought milk supplies cease. Cattle are used for meat, and for occasions such as funerals and marriages.

• **Chickens** and their eggs are used by most communities to supplement their diet. Only Blou post mentioned these as a source of cash.

• **Pigs** were used at Tussenby for food and cash.

**Gardens**

With the exception of Freyer, settlements had small gardens with crops and vegetables. These were not often very productive, however. Inadequate water was cited as a problem, despite the existence of boreholes. In most cases, elephants were mentioned as a problem in that they destroyed crops when they ripened. Many communities had become too discouraged to make much effort with crops. Freyer, for example, had given up since elephants destroyed their garden.

Potgietersrus can be used as an example. Here, the fairly large communal garden grew maize, sunflowers, paw paws, watermelon, lucerne, pumpkins, tomatoes and spanspek. Planting is done at periods during the year when water is available, particularly when the borehole overflows, mainly in December, January and February. The borehole cannot be depended on however, and problems are experienced with the solar pump when the weather is cloudy.

The garden is insufficient to meet the subsistence needs of the community, and cash is required to buy additional food. There are three particularly lean months in winter, when members of the community are often without food. Those with food share when they have.

When harvests are good, in January, February and March, there is sometimes a surplus. Sales produce some cash during these times.

**Additional food**

Other food consists of bought maize meal, milk and some meat from livestock. Children and relatives assisted with additional food at times. Neighbours help one another out when necessary and possible.
Food Aid from the government and the Red Cross

These were mentioned by some of the women in the communities (e.g. Nugas post and Blou post). However, the amount of food provided was considered small and infrequent (every three months).

Exchange Networks

The 'exchange networks' operating in Damaraland means that households depend on a network of others for assistance that is usually, but not always kin related. Foodsharing by neighbours and kin was found to continue to exist.

Natural Resources

All households depend on wood. It is used for cooking and building and occasionally sold.

There was little use made of wild foods and these were of considered as of any significance. The group of herders at Lofdal post use roots and leaves for medicinal purposes, however. For example, Mopani tea for stomach pain, Witgatboom roots for colds, and iHab for coughs.

Blou post was the only community to mention Mopane worms. These provided food and cash from sales.

Formal and Informal Cash Inputs

- Besides cash earned from livestock sales, occasional surplus crops and wood, the following were mentioned as providing cash for the community:

  - Pensions were mentioned in all settlements visited with the exception of Lofdal post, where there were only herders. Pensions were seen as small but reliable. They provide a safety net and are used for cash purposes such as food, school fees and clothing for family members. They were not listed as important as livestock, however. Pensioners receive N$135 per month from the government, adding to the survival stability of rural communities (figures from Rohde, 1994: 4).

  - Working children’s money was mentioned as a resource of low importance to the communities. This was seen as unreliable as children gave only occasionally. This is slightly inconsistent with other findings (e.g. Devereaux and Tapscott, 1995), where this is given higher priority.
Otjiserandu

Date: 17/2/97
Participants: 8 women and 3 men, farmers coming back from grazing areas and visitors aiding the participation at different stages.

Borehole
Lister engine sits underneath 2x15000 litre plastic reservoirs; planks installed under tanks to prevent bulging and cracking of tanks; pumps operational for half day; original pipes in borehole too small and have been replaced with larger ones (27mm); engine breakdown every 2-3 months; maintenance by RWS although reportedly with many delays.

Composition of inhabitants
Women, all wearing traditional clothes, were mostly in the age group 18-23 years with a few older women aged in their 40’s; younger women are well educated having completed Grade 8 in Botswana. The households consist of a variety of combinations such as:
- unmarried women and their children,
- married couples and their children and
- single men and women, couples and children (refer to map)

58 adults and 184 children live at this settlement with the average household size of 14 people.

Settlement
17 minor settlements of 2-5 dwellings, each approx. 100-200m from the borehole; dwellings are either tents, timber structured and clad with corrugated iron or wailing structured from mud packs and stones; women build the homes.

Health
Observation of strong lively children and strong adults; sicknesses mentioned are malaria, fever, diarrhoea, headaches and skin sores.

Differences in Gam from Botswana
Could make and sell craft and participated in community projects eg. building a hall

Present difficulties
No work opportunities/ no fencing for small plots and gardens/ need materials (by women) for craft work eg. grasses for baskets as had in Botswana/ no literacy projects or tanning leather courses.

Resources
Livestock
cattle (milk/meat if dies; sell in Gam; they previously used hides but no curing materials are available),
goats (milk for tea, meat, don’t sell often due to low prices)
donkeys (transport, used for herding)
horses (transport)

Garden
tried maize - unsuccessful due to damage by rats and cattle

Wild fruits
food/ medicines (Devils Claw tree)

Expediture
Items ranked
Food, school, clothing, clinic

Resource network
(refer to network map)
Water obtained from Otjimihama, Oloizombani, Ondenepehi when in need; supplies from Gam

Biophysical observation
Topography flat land
Vegetation (differs according to distance from settlement)
-0-150 paces: heavily browsed bush/soil trampled/only annuals
-200 paces: browsing lighter, more annuals, 60% cover
-300 paces: bushes browsed, grass cover acceptable. 1 species of annuals
-400 paces: increased bushes and Acacia, 1 species annual, dead perennial stumps
-500 paces: bushes less browsed, increased grass species but mostly annual
-600 paces: increased bush percentage/ other herbaceous plants; bush not heavily browsed

Organisations
Water point committee - been set up but people have little idea of what is to be expected; veterinary services visits are too seldom for the farmers
Appendix B

Questionnaire and Experiences of Study Team
Qualifications and Experience of Study Team

Neil de Wet
MFC(BTech) 1983 (University of Cape Town)
Experience in hospitality and retail businesses in SA and UK

Wendy Fidock
BEd (University of Natal)
BEd (Mature Development) 1988 (University of Natal)
Experience in social work and education officer

Peter Healthy
BSc (Civil Engineering) 1989 (University of Cape Town)
Experience as site engineer in SA

Cheryl Jacks
BA 1985 (University of Western) Graduate 1989 (University of Western)
BEd (Science) 1994 (University of Western)
Experience in biological sciences in Namibia

Jane Kippnes
BSc (Exercise & Sport Science) 1986 (University of Cape Town)
Experience in sports science and sport-history research in Tasmania

Bhagath O'Donogue
BSc 1993 (University of Cape Town)
MSc 1995 (University of Cape Town)
Experience in interdisciplinary research in science and business in SA

Talies Rhydyrhyd
BSc 1987 (University of Wales)
PhD 2000 (University of Wales)
Experience in training, tourism, and business in SA

Ann Seltzer
MA Urban Planning 1990 (University of London)
Experience in urban planning, tourism development and environmental planning in Lesotho
Appendix 8

Qualifications and Experience of Study Team
Qualifications and Experience of Study Team

Neil de Wet
MBChB, 1992 (University of Cape Town)
Experiences in hospitals and medical practices in SA and UK

Wendy Gaisford
BSocSci, 1975 (University of Natal)
BSocSci (Hons) Psychology, 1995 (University of Natal)
Experience in social work and as education officer

Peter Hartley
BSc (Civil Engineering), 1993 (University of Cape Town)
Experience as site engineer in SA

Cheryl Jenks
BSc, 1993 (University of Witwatersrand)
BSc (Hons) Zoology, 1994 (University of Witwatersrand)
Experience in ecological research in Namibia

Jane Kibbassa
BSc Botany & Zoology, 1986 (University of Dar es Salaam)
Experience in agriculture and agro-forestry research in Tanzania

Bridget O’Donoghue
Bach. of Architectural Studies, 1983 (University of Cape Town)
Bach. of Architecture, 1988 (University of Cape Town)
Experience in architecture, teaching and business in SA

Talia Raphaely
BJour, 1987 (Rhodes University)
Postgrad. Diploma Management (University of Witwatersrand)
Experience in training, journalism and business in SA

Aah Sekhesa
MA Urban Planning, 1980 (Nottingham University)
Experience in urban planning, housing development and environment planning in Lesotho
Date: 6/2/97
Participants: 5 adult inhabitants

Borehole
Three boreholes serve this post and Halt Post 1. At Halt Post 1 where the father of the farmer lives, there are 2 boreholes; one drilled in 1990 that supplies good yields and is fitted with a diesel engine, another borehole (with brak water supply since 1993) is fitted with a windmill. The 1992/3 borehole on Halt Post 2 only yields sufficient volume for human consumption; maintenance is done by the RWS. During the 2-3 week wait water is obtained from Halt Post 1; minor repairs are fixed by the farmer.

Composition of inhabitants
All inhabitants are related family members; all generations are present:
- main farmer (middle aged) lives with his wife and young child,
- sister-in-law and her husband and young child
- mother of the wives
Two older children from each family live with an aunt in Khorixas while attending school. They return to the Post on weekends. The main farmer grew up at Post 1 where his father and other family members still abide.

Settlement
Settlement occurred from 1993 once the borehole was installed due to lack of water at previous settlement in another region. The dwellings were gradually constructed to the present number of 3, belonging to the grandfather and the two families. The structures are formed in a semi circle focusing on the borehole and the goats kraal. An outdoor gathering place occurs under a tree within the semi circle. The initial house was broken down as it was positioned in a lower lying area and therefore flooded. A burn (earth mound) prevents further flooding to present dwellings. All homes are supported by Mopane tree branches; two are clad in corrugated iron and the third has the solid dung walling and plaster. The grandmother’s garden and chicken house are adjacent to her home (refer to map).

Reliability of resources (refer to Venn diagram)
1. Goats and sheep
2. chicken
3. garden

Expenditure (ranked)
Food, schools, house rental in Khorixas, clothes, hospital

Biophysical
(refer to Transect walk map)
Topography: very flat with very shallow water course
Vegetation: No vegetation around borehole except few trees; herbaceous annuals once once beyond immediate proximity to borehole; annual grasses and numerous low bushes further away; trees fairly heavily browsed and stumps around dwellings; very little perennial grasses; farmer showed how termites build nest on grass mound and eat stump when it is dry.

Fauna: Kudu, jackals and rarely leopard are found

Resource utilisation
Farming practices: stock moved when grazing/browsing is low and only returned when vegetation recovers; there are three fenced camps; the farmer sells stock if conditions very dry in order to buy lucerne to feed other goats; dogs herd goats; impression of rotational grazing but not rigorously practiced; sheep kept close to settlement.

Organisations
Water point committee is not established; conservancies have not been heard of but when explained, the farmer was enthusiastic; radio contact enable the inhabitants to hear when auctions take place.

Resources
Livestock
- 6 cattle
- 200 goats (sold at auctions in Khorixas held 4 times per year)
- 20 sheep (sold at the goats)
- chickens
donkeys
horses

Garden
main garden sized 3x3m.; water insufficient and lack of soil fertility problems; chillies, milies and flowers planted; shortage of water for garden; would like to have a much bigger garden; no produce sold.

Pension
old lady receives but is not shared amongst family members
Resources
1. Goats/sheep
2. Chicken/eggs
3. Garden
4. Pension

- Goat + sheep
  (Mention 4x per yr; heard it over the radio)
- Garden
  Not sold
- Chicken + eggs
  Always there / help
- Pension
  Never accessed

*Cash from goats/sheep.*
BERGUILLE

6-2-97
participant: Cuba

3 posts
1 homestead
8 donkeys
2 horses (dead)

4 cattle
100 goats
40 sheep

outside
kitchen outdoor
chickens

trough
gate
porch

CONTRIBUTION

30-5-97
participant: Cuba (pensioner)

participant: originally from Ovamboland
was Rianuwasmaker until 1974

6-2-97
Bergville Post 1

Date: 6/2/97
Participants: old man

Boreshole
Installed new boreshole on request in 1992. 35m from existing boreshole, due to lack of water yield; water supply and quality good from new boreshole but yield not adequate - only supplies for 30 minutes; consultants used air photos in siting process; had a diesel pump initially but presently have a windmill which was installed in 1996; 2 reservoirs; one water source for livestock and people; the 1993 boreshole had an intermittently good flow at first - at present yield poor (half hr. pumping time). The 1993 and old boreshole's supplies are not adequate to fill reservoirs because of small head to pipe; farmer had to build new trough downhill from reservoir; old man believes a small dam in river would recharge the boreshole - this has been studied and promised by government but not yet implemented; maintenance - repaired by RWS; old man believes he is too old for maintenance training and equipment and tools needed are beyond his means.

Composition of inhabitants
Pensioner originated from Ovamboland; his children work in towns and his wife and children live in Khorixas and return on weekends and holidays.

Settlement
(refer to map).
Erected from homemade bricks (mud, dung, grass) covered with a soil/dung plaster; dwelling is good condition furnished adequately; glass in window frames and wooden door; kitchen located in outbuilding with coal stove.

Health
Observed the old man to be lively and strong; he reported few health problems and uses state hospital.

Resources
(refer to Venn diagram)
Garden two gardens; one sized 11x14 paces, situated near new reservoir, consisting of 3 beds of maize and 1 bed pumpkin; the other planted with big maize plants but eaten by wild animals;
Livestock
7 cattle (milk, hides, cash, kills for funerals, burials and marriages)
40 sheep (cash, hides, karakuli)
100 goats (meat, milk, cash, hides)
8 donkeys (transport, sells for meat)
2 horses
pigeons
wood (fuel, building, sells for cash)
Maize (food)
Pension

Food aid (maize meal, pensions)

Expenditure
(refer to Venn diagram)
Expenses ranked according to most difficult to meet:
1. School, buying livestock
2. Clothing, food
3. Money and food for herder, seed, chicken food, hospital and medicine

Biophysical observations
Topography: hilly rocky terrain; ephemeral river on western edge of boreshole
Soil conditions: around boreshole soil rocky with loamy, loose and permeable soils; virtually no signs of soil fertility although according to farmer there is enough growth in the rangelands after a wet year.
Vegetation: no signs of grass around boreshole; few mopane trees widely scattered approx. 70m. from boreshole; lower branches of trees are browsed; no young saplings, no coppicing trees are visible; no signs of vegetation changes due to recent rains.

Fauna: elephants were last here in 1994
jackals pose a threat for unsupervised livestock
kudu
gemsbok
steenbok

Resource network (refer to diagram)

Resource utilization
farming practices: enough pasture when it rains; no grass cut for dry seasons as grass does not grow high enough; two grazing camps on each side of the road; cattle daily at grazing and return in mornings for water and feeding of calves;

Organisations
Water point committee (refer to diagram) old man is chairman but does not see the logic, he feels if the govt. wants people to pay for water they should ask for the money and not involve a committee; there are 4 posts in Berville, each having a different committee, conservancies - heard of it and likes the idea of farming with wildlife.
Participants: 4 herders, 1 female (wife of herder). This group had heard about the concept (radio). They were asked whether they could foresee any problems or benefits in the idea of Water Point Committees being formed to manage water points.

No problems were foreseen. Electing a representative was not a problem as the group would "choose" their "leader". The discussion was "captured" on papers and points made were cross-checked.

No ranking was done, and points are placed around the central issue as stated by the group.
Lofdal Post

Date: 6/2/97
Participants: 4 male adult herders and 1 woman (wife of herder)

Borehole
Drilled in 1989 but at present not operational due to the pump removed, elephants destroyed windmill; 2 resevoirs: new borehole drilled in 1993 approx 300m. from existing borehole and fitted with diesel pump, connected to reservoir by steel and pvc pipes over river bed and hill; an offshoot pipe supplies drinking water to 210 litre drums positioned close to houses and garden, farmer prefers steel and iron pipes due to pvc persisting in sun and damage by jackals, baboons and elephants; engine pumps 4-5hrs before drying up; 210 litres diesel supplied by governement every 3 months, if excessive water is drunk by elephants, Nature Conservancy buys additional diesel; water is conserved by pipes being repaired and half tyres placed at tap to catch spilled water for dogs.

Composition of inhabitants
Three absentee owners living in Khorixas who visit farm over weekends, 4 herders, one of whom is the son of an owner and operates as manager of the Post has been here since 1992; another herder arrived in 1996 and the third herder has recently arrived from Zambia in 1997 and speaks neither Damara nor Afrikaans; woman, a wife of a herder has 2 small children-recently arrived; one of the children is hers and the other is a relative, the other herders have family who visit at times.

Settlement
(refer to map)
Settlement has occurred since 1992 with slow increase of people and their dwellings up to the present number of 7 permanent inhabitants and 4 dwellings

Health
The 'boklinik' (bush clinic) last visited in 1995, nearest hospital is in Khorixas; immunisation done at hospital or at Lofdal homestead where the mobile clinic visits; polio vaccinations were administered widely at some point; when children get diarrhoea they are treated with medicine from the chemist, local treatments include Mopane tea for stomach pain, roots of Witgatboom for colds, Irab for coughs.

Resources
Livestock
8 cattle
200 goats
2 donkeys
(if pasture increased would like to expand herds)

Food
owners bring over weekends
food aid supplied by govt.

Garden
small garden sized 7x5m near the old reservoir; another smaller garden near the homestead which uses water from the reservoir near the house; maize is grown and at present very small and weak; soils are poor.

cash from absentee owners

Resource utilisation
farming practices-2 camps; practice rotational grazing after every three months; the upper area which was under fallow had new grass between stones/rocks; browsing pressure is high due to goats eating Mopane leaves, grazing enough for the resident livestock, but becomes a problem if other animals are brought in.

Resource network
(refer to diagram)
People visit to and from Renosterberg, Katrina Post, Lofdal homestead, Arbeidsgeenot; water from here used by Lofdal homestead and Renosterberg transport and grazing shared if necessary.

Biophysical observation
Vegetation
no grass visable around the borehole; big Mopane trees on lower side of the borehole with smaller scattered Mopane trees on hillside; no saplings and no coppicing trees visable; no bushes except for a few Acacia plants which are heavily browsed on the lower branches; tree species found scattered on the hillside are Mopane, lhuus, igga, Khara, lhuus (Kaffirboom), no old tree stumps; fallen trees that are knocked over by elephants

Rainfall
no signs of erosion; permeable soils

soil condition
no trampling could be observed because of rocky, coarse ground loamy soils between rocks, no organic matter visable.

Fauna
elephants (47 were here last week, drank from borehole; broke trees but not garden as crops too small-refer to map) jackals which kill stock

Organisations
Water point committee (refer to diagram-perceptions of water committee); have heard of; participants believe people should help each other re. water management; believe people should vote for committee members; nature conservation visits to enquire about elephants; radio contact for local news; conservancy idea has not been heard of.
## TIME TREND - Lofdal Pos

<table>
<thead>
<tr>
<th>YEAR</th>
<th>DROUGHT</th>
<th>BOREHOLE</th>
<th>STOCK</th>
<th>LIVESTOCK OWNERS</th>
</tr>
</thead>
</table>

**Notes to diagram:**

**STOCK AND HERDERS**

Numbers of stock are given in order of owners' arrival at pos.

- First herd is managed by the son of owner, who is the leader of the group of herders and "manager" of this pos.

- Second herder arrived in 1996

- Third herder arrived this year

<table>
<thead>
<tr>
<th>YEAR</th>
<th>DROUGHT</th>
<th>BOREHOLE</th>
<th>STOCK</th>
<th>LIVESTOCK OWNERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>![Pipe symbol] No problems</td>
<td>![Pipe symbol] Good water supply</td>
<td>VELD BETTER</td>
<td>85</td>
</tr>
<tr>
<td>1995</td>
<td>![Pipe symbol] No problems</td>
<td>![Pipe symbol] Good water supply</td>
<td>VELD DRY</td>
<td>185</td>
</tr>
<tr>
<td>1996</td>
<td>![Pipe symbol] Pipes from borehole removed. New pipes installed.</td>
<td>![Pipe symbol] Very dry veld</td>
<td>Deaths of Stock</td>
<td>47</td>
</tr>
<tr>
<td>1997</td>
<td>![Pipe symbol] No problems</td>
<td>![Pipe symbol] Good water supply</td>
<td>Lung sickness deaths affect small herd.</td>
<td>17</td>
</tr>
</tbody>
</table>
LOFDAL POS
6/2/1997
Participants: herders

NETWORK CHART

- Water point: Real water (salty)
  Used for: cattle, gardens, elephants

- Each assists the other with transport
  (It was not asked what other resources, besides grazing, transport of water, is networked.)

- Grazing - the farmers/owners make a plan with other owners to move their stock for grazing in emergencies.
  However, they usually stay here.
Nugas Post

Date: 7/2/97
Participants: 7 members of extended family representing 3 generations (pensioner, middle age, young adults)

Borehole
Prior to borehole and windmill structure installed in 1993, there was a 3-5 m deep well situated close to the river operated by a hand pump yielding the supply of water. Yield small of '93 borehole; PVC tank installed 1996; elephants pushed over windmill in 1993.

Water resource network (refer to network diagram)
Water obtained from natural fountains and Nugas Post 2

Composition of inhabitants
Participants live permanently at Nugas and arrived together. Family members consist of pensioners, their middle aged son, his wife and their young adult sons who work with the livestock; the children attend school and therefore were not present. Other inhabitants work in towns and return over weekends and holiday periods.

Settlement
People moved from Tweespruit Post in 1992 due to need for additional grazing; six dwelling built over past 6 years-3 permanently inhabited and the remainder for impermanent inhabitants; dwellings are timber structured with corrugated iron cladding. The settlement is orientated towards the river and borehole.

Health
Inhabitants visit clinic at Anker

Resources
(refer to Venn diagram)
Livestock 200 goats (majority female 50% pregnant, many kids evident; goats are eaten and sold for cash
5 cattle kept at Nugas homestead
donkeys
Pensions four received from Anker but not reliable due to difficulties in getting there on specific date; used for food, clothing and childrens needs
Garden sized 50x5 m; mostly melons planted; threatened by elephants; if good crop grown then sold for cash
Food aid given to children and pensioners and shared amongst the settlement

Biophysical observations
Rainfall little rain has fallen recently (refer to time trend)
Soil condition hilly topography with rocky ground, parts dusty and well trampled; ephemeral river runs past
Vegetation sparse bush, few Mopane trees (heavily browsed) with thorn bushes; no visible grass

Resource utilization
Farming practices appears unsustainable; livestock moved to natural spring for approx. 2 months for grazing in times of need
Fauna elephants problematic to garden and borehole structure

Organisations
Water point committee heard of in 1996 from extension officer from Anker/Grootberg; people shall accept if govt. wishes users to maintain borehole, but due to lack of funds cannot afford to and would obtain water supply from Tweefontein; no radio contact at post or homestead; Church people visit Nugas homestead approx. every 3 months; no links to agricultural or veterinary officers.
Items mentioned:
- Pensions (obtained from a habit)
- Goats
- Garden
- Drought relief food aid

How much money is earned from each:

- Pension
- Goats
- Garden
- Food Aid

By inverting on different sizes of paper, indicate importance of each resource:

Pension
- Goats
- Food Aid
- Garden

In times of drought which resource is the most reliable?
**RESOURCES**

- Listed it uses.
- Ranked according to importance = size of paper
- " " Reliability in terms of difficulty = closeness to community.
- Cash values = no of botties (rated from 1-3)

**EXPENDITURES**

- Listed
- Ranked according to difficulty in meeting the expenses.

* *

- School
- Food
- Clothing

* *

- Includes own bakkie expenses
- Transport
- Cattle

* *

- Hospital
- Parish
- Church
- Household utensils

* *

- Opinions, particularly regarding food, clothing, cattle, diffused among the group. For eg:

- Some of the men ranked cattle-buying as the most difficult expense to meet.
- However, one woman strongly expressed that her main difficulty was with food, and that clothing was another.
- Cattle were then devoted to middle.
Engelbrecht

Date: 7/2/97
Participants: extended family members

Borehole
Main supplier of water from 1973 drilled borehole, first installed with a windmill thereafter a windmill/diesel combination to ensure constant supply. Yield good supply and quantity, 1993 borehole drilled at request of community, used only in emergencies, situated approx. 800-1000m. from homestead, seems not ever utilised at present windmill pumping into a full 10 000 litre plastic reservoir with overflow running into the ground. Only used if 73 borehole breaks down. Extension officer states people not allowed to turn off windmill as that is how they are broken; maintenance only repair by inhabitants

Composition of inhabitants
Pensioner couple, their children, grandchildren and other relatives. Appeared close knit and affectionate towards each other. Strong maternal grandmother and views expressed by women on resources were heard by men.

Settlement
Approximately 10 households on post, clustered 500m. from 1973 borehole. Water supplied to all households (storage drums); main house has a shower.

Health: Adults and children appeared well.

Resources
(refer to Venn diagram)

Livestock
- 50 cattle
- 300 goats
- 20 sheep
- 4 donkeys
- chickens

Garden
began last year, sized 10 x 7m but threatened by elephants.
Planted maize, chillies, vegetables and banana; manure used.

Sewing machine
enough water but not land to move stock, thus young adults wishing to start farming are unable to. Lack of fencing due to elephants destroying it, therefore animals from other areas move in. Complaints are made to the local Pastor who has them removed.

Cash
pensions relatives working in towns return over Christmas period

Expenditure
(refer to diagram)
Opinions differed amongst group (ranked in order)
1. School, food, clothing
2. Transport, cattle
3. Hospital, paraffine, church, household utensils

Resource Utilization
Farming practices rotational grazing; previously ploughed

Biophysical observation
Vegetation green, short grass growth around borehole due to recent rainfall; big Mopane and few Acacia trees not browsed; area near trough had vigorous dense grass due to water supply from overflowing reservoir; pasture inadequate for 4 families, cattle taken to Brandberg during 1994 drought

Soil condition no organic matter seen on top of soil; no sign of tree growth or coppicing; abundant signs of green grass especially around new borehole

Fauna
elephants drink and leave settlement. Participants feel if permanent dam is provided, elephants would not leave.

Organization
Water Point Committee have not heard of.
<table>
<thead>
<tr>
<th>Year</th>
<th>WATER</th>
<th>GOATS DIED</th>
<th>HOUSE</th>
<th>PEOPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>0</td>
<td>People + Goats arrived at POS</td>
<td>000</td>
<td>00000</td>
</tr>
<tr>
<td>1993</td>
<td>0</td>
<td>Drought + Sickness</td>
<td>000</td>
<td>00000</td>
</tr>
<tr>
<td>1994</td>
<td>00</td>
<td>00000</td>
<td>000</td>
<td>00000</td>
</tr>
<tr>
<td>1995</td>
<td>000</td>
<td>00000</td>
<td>000</td>
<td>00000</td>
</tr>
<tr>
<td>1996</td>
<td>00000</td>
<td>00000</td>
<td></td>
<td>00000</td>
</tr>
<tr>
<td>1997</td>
<td>hopeful for this yr. 00000 No rain as yet.</td>
<td>000</td>
<td>00000</td>
<td>00000</td>
</tr>
</tbody>
</table>

People came from farms.
Borehole
Two boreholes on farm: old borehole provides all the water supply, used to have a diesel pump/windmill combination which the elephants pushed over in Jan 1997; at present have a new diesel Lister engine; yield is good. borehole drilled in 1993, 10m from existing borehole, position determined by a german water diviner; it was drilled, a casing installed but no pump installed; a handpump was drilled and installed approx. 2km from existing infrastructure; no tap in system for human consumption; pipes damaged by elephants the previous night; maintenance serviced by RWS except when damage caused by elephants which is attended to by Nature Conservation; farmers were fixing pipe during visit due to no water available for livestock.

Settlement
Occurred from 1982; settlement consists of 7 homes; more settlers arrived in 1983 and erected dwellings which are well established in that they all have shade and chicken houses; a courtyard created by a series of dwellings act as the focus for the settlement.

Health
Use Kamanjab hospital for serious illnesses; no use made of indigenous medicines; health problems include diarrhoea, measles, flu.

Resources
Livestock: cattle, goats, donkey, chickens
Garden: elephants destroyed it in 1987 and thereafter no crops have been grown.

Resource utilization
Vegetation: no grass visible around the borehole; few trees are heavily browsed on the lower branches; farmer states that pasture is sufficient after rainfall; no signs of new vegetation growth or sapling and coppicing of trees.
Farming practices: no pasture stored for dry periods; livestock left to search for grazing.

Resource network
Water obtained in emergencies from Brandwacht, hand pump, fountain. Water supply used by wild animals.

Biophysical observations
Soil conditions: no signs of erosion although the soils loose, loamy and permeable.

Fauna: elephants who break pipes and destroy fencing (1987)

Organisations
Water point committee have been heard of but not established.
Kamienjob
Lutheran church

Was a hand pump
Boothole: diesel
Homestead- C uma

Brandwagset
If there's a diesel pump
Problem

Old good borehole

Hand pump

Kudus Debra
Elephants also use spring
and borehole
Petrusfontein Post

Date: 8/2/97
Participants: 8 men and 5 women from settlement

Borehole
Borehole drilled in 1993 and equipped with solar panel (7 panel) after application made by inhabitants; yield adequate and only source of water for the settlement; solar panel placed in a frame which lies unsupported on the ground and therefore liable to breakage from being blown over; two boreholes located with assistance of farmer and 1 drilled; PVC tank fills in one day is sunny conditions; there is one source supplying people and livestock; maintenance report to government but takes long to repair, so they fix the breakages themselves.

Composition of inhabitants
Mixture of family members and other peoples; adults in 20-45 year age group participated in PRA exercises; most inhabitants live permanently at Post.

Settlement
Large settlement of approx. 10 dwellings which started in 1993 (refer to time trend). Initial settlers were family members that moved from another Petrusfontein Post. In 1995-1997 newcomers arrived (family members and others) and erected timber structured and clad with earth or corrugated iron.

Health
People appeared well but stomach problems were mentioned due to brak water supply

Resources
(refer to time trend)
Livestock
cattle (milk for fat and cream, meat, cash)
goats (milk, meat, cash)
donkeys (transport, meat, cash)
sheep (meat, cash)
chicken (eggs, meat, cash)

Food aid
area of 10x20 m laid out in near borehole, although not planted due to lack of pipe from water source, threatend by baboons stealing produce

In times of drought the priorities are: (ranked)
cattle, food aid, goats, pensions, sheep, chickens, donkeys
<table>
<thead>
<tr>
<th>Year</th>
<th>Dry Times</th>
<th>Solar Panel</th>
<th>&quot;Petrusfontein Buou Pos&quot;</th>
<th>Time Trend</th>
<th>Goat/Lambs</th>
<th>Cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>Installed</td>
<td>Strong</td>
<td>moved to b/h from another post (Petrusfontein), left mother + sister came with aunt + other men.</td>
<td>Tin house been down</td>
<td>sick every yr ± 100 Goats. ↓ 98 lambs lam Jan 2 lam 6 June 3 Season</td>
<td>over 300 cattle</td>
</tr>
<tr>
<td>1994</td>
<td>Moved south 1yr away. Drought relief food + fodder, water o.k.</td>
<td>more people, drought relief, no graging</td>
<td>more houses</td>
<td>Livestock died in drought, some died, 23 left</td>
<td>moved south.</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>More people</td>
<td></td>
<td>more houses</td>
<td>18 Goats 12 Sheep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>More</td>
<td></td>
<td>livestock increased</td>
<td>increased</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>Rain bad, grazing short</td>
<td>garden planted no rain - no garden</td>
<td>goats drop - eat + sell for school</td>
<td>sell each yr price of amun doesn't increase</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Livelihood Venn Diagram

3 people

Sett
Justice
Paulus

Sett
Justice
Paulus

3 people

Start
Justice
Paulus

Start
Justice
Paulus

3-2-97

Expenditure:

* What spend cash on

- Should one person not be able to

  meet thing, then another person (according to Sett) will sell one of their goods

  to help the other.

- Once else

  When one does not have food,

  they go to another household and ask.

  They give if they have (to share the meal).

- Transport

  If someone needs transport (by donkey) eg

  to take livestock to the auction, if

  they don't have a donkey, someone else

  will help farm them (horses).

Potgietersrus
Potgietersrus

Date: 4/2/97
Participants: farmers their wives and newcomers (6 women and 4 men)

Borehole
Two boreholes serve settlement: the 1992/1993 borehole drilled in close proximity to the old unused borehole and is served by a solar panel although the residents have requested diesel pump for consistent yield; previous boreholes on farm not functioning due to roots grown into pipes; another borehole with windmill serves households in its close proximity.

Composition of Inhabitants
Two brothers, Ebrahim and Noah Garieb the original settlers after the farm was made available due to the Odendaal commission recommendations; arrived from Oulja; their children work in towns and visit during Christmas holidays; there is a lack of permanent middle aged and young male residents; many settlers have arrived since 1986 from Oulja; increased dwellings in last decade; status difference between initial inhabitants and settlers; one herder originally from Ovamboland (only young male adult on farm)

Settlement
(refer to map)
Originally Odendaal farm with standard hipped roof ‘Odendaal homestead’. A public roadway bisects the farm; dwellings erected by inhabitants from timber using mopane trees as the structure and completed with soil/dung/water plaster; timber work is done by the men and the plastering by the women; there is one corrugated iron dwelling of herder

Resources
(refer to Venn diagram)
Livestock: cattle (meat, milk, sold in Khorixas at auctions or out of hand) goats (meat, milk, sold for cash) donkeys (transport, meat in dry times) cash: pensions children working in towns livestock (obtained quickly from goats compared to crops and cattle less reliable/easy to sell) food aid: supplied by the Red Cross once every three months garden: each member of the settlement has a small portion of the garden, the work is shared amongst women and men; used to be a larger garden when the fountain and 3 boreholes were all supplying water, it is planted mainly in rainy season and when borehole has ample supply, i.e. in November; sunflower, paw-paws, watermelon, sweet potatoes, lucerne, pumpkins, maize and tomato are planted at different stages

Importance of resources in hard times (ranked)
1. Goats/ salary for herder/ pension/ money from children
2. Cattle/ donkeys/ firewood
3. Food aid/ garden

Expenditure
(refer to diagram - ranked in order of difficulty)
School, hospital, food, transport, clothes

Resource utilization
farming practices - cattle and goats smell grazing; cannot persuade people to conserve grazing for drier times; farmer feels powerless to conserve grazing with govt. policy of settling people at posts; cannot use posts as a cattle post because of permanent settlers there; cattle/calves left in the kraal; goats and sheep are left to wander as far as they can obtain grazing; cattle leave in the morning and return the following morning for water and to be milked; calves are left in the kraal; goats return in the evening; slaughtering occurs when cash is needed and depending on the size of the herd; need adequate rainfall to cut grass for fodder; although on higher slopes where cattle cannot reach it is sometimes possible.

Resource network
food: sharing of meals takes place within the settlement cash: a farmer would sell a goat for another in order to obtain school fees transport: lending of donkey carts for transporting stock to auctions

Biophysical observation
Topography: hilly, rocky and undulating with ephemeral river tributary bisecting settlement
Vegetation: scattered mopane trees, no grass or trees near borehole, according to E Garieb grass high enough after rain

Organisations
Water point committee established with E Garieb the chairman; attended meeting in 1996 in Khonjas to give views about the govt. policy of cost recovery. E Garieb feels people are not ready for policy although accepts people have no choice; the selling of livestock will have to occur to make payments.
Goats Route to Grape

Old man's house (Kraal)

1937 Windmill

Kraal

Pigs

Homesite House

Peek & Buildings

Pipe to Haive

Diesel Pump

Old Borehole

Trough for Animals

Albaction (160 goats)

Frances inversion

Angelina (24.5 in)

6/2/94

Cheryl, Neil, Ismnael, Boas

TRANSECT WALK (W/rough)

3/11/95

Round Hattswod

Dairy 5 1994

Not installed (Poisonous)

Brown Borehole

1996
Tussenby

Date: 6/2/97
Participants: young adult men, visitors(young men), settlers(middle age and older women). PRA taken in a humorous manner by young men, women silent and offered little information.

Borehole
4 boreholes drilled on farm: pre 1974 borehole installed with diesel pump in 1996; 1997 drilled borehole with windmill structure that supplies the majority of water for settlement; 1994 drilled borehole and fitted with handpump but not used as water is mixed with oil; 1996 drilled borehole is not installed as water reported to be poisonous, maintenance done by govt. although reference made to buying spare parts, 3 week waiting period for repair by RWS; residents reported broken engine Dec 1996 but still not repaired.

Composition of inhabitants
Three young adult men, aged between 18-23 yrs. control the farm; the grandfather of two men managed the farm prior to being hospitalised in Khonixas; grandsons grew up on farm, their father lives on another farm; it is doubtful if grandsons attended schooling as they had difficulty in understanding PRA exercises; an assertive young man has joined the 2 grandsons a year ago and seems to take major decisions; old man of 80 yrs. is a newcomer; his daughter lives in Khonixas; old woman (60 yrs.) lives with grandchildren; middle aged woman; composition of farm different to other visited in that there are no older generation members on farm in controlling positions and a sense of chaos was felt by students and extension officer; there are reports by neighbours of stealing by inhabitants of this farm.

Settlement
Farm previously occupied by white farmer and vacated due to Odendaal commissions report; standard 'Odendaal house' occupied by young men and friends; settlers created timber and earth plastered dwellings and corrugated iron clad structures of their own.

Resources
livestock
24 cattle(meat, milk, cash)
175 goats(meat, milk, cash)
7 donkeys(meat, transport)
5 horses(transport, meat)
pig(meat and cash)
chickens(meal)
wild animals(meat)
garden
only prickly pears grown; manure placed on garden; residents aim to start when there is better water supply
cash
pensions(x4)
Food aid
supplied by the Red Cross

Expediture
(ranked in order of importance)
Animal feed/ food/ school/ funeral goods/ people problems eg. bail/ farm implements eg.oil,spares,diesel

Resource utilisation
farming practice-does not appear to be enough management; report to sell stock in dry season and bank money and buy fodder

Fauna
Kudu, Gemsbok, Warthogs, Jackals, occasional elephants that drink and do not break infrastructure.

Biophysical observation

Topography
hilly, rocky with ephemeral river bisecting farm

Vegetation
few Acacia trees around homestead, which are browsed; there are no bush; near homestead; farmers say rainfall causes ample grass

Soil condition
no obvious erosion signs; soil around homestead trampled; soil appeared sandy and loamy between rocks

Organisations
Water point committee established 1 week previously - no training received
Conservencies have been heard of
Borehole no 5

Date: 17/02/97
Participants: 6 women—all ages and 4 men

Borehole
Borehole drilled in 1993/1994 for quarantine camp; pumps 0600-1300hrs every day; govt. supplies 210 litres per month; farmer believes pipes are too narrow (N1 pipe takes 7 hrs to fill tank whereas N3 pipe would take 3 hrs); diesel pump situated in corrugated clad structure; 2x15000 litre PVC tank on top of a 2m high metal support; washing basin and tap near structure; yield sufficient; rain water in pans used by livestock in season. maintenance: farmer is able and wishes to fix borehole but is threatened by jail if he does; on a previous occasion he fetched a man from Tmunkwe to fix breakage but he was unable.

Composition of Inhabitants
(refer to map)
Households consist of a husband, his wife/wives and children and possibly other family members such as a grandmother, brother and sister. Two families are single parenting by the father— the one wife lives in Gam and the other parent is separate by divorce. The average household number is 11; children of school going age live in Gam and attend the primary school.

Settlement
Settled at either April 1996 or November 1996; different families cohabited in settlement; 6 groups of dwellings belonging to families make up the settlement; women build the houses but have difficulty with earth homes in rainy season due to plaster peeling.

Health
Children suffer from colds; there is no malaria although it exists in the area and no TB.

Present difficulties in Gam
money still in Botswana/no pensions/no suitable grass for craftwork

Resources
Livestock: 600 cattle(milk/sell for cash)
1000 goats(milk)
horses(transport)
donkeys(transport)

Wild food: food, medicine and beer brewing

Food aid

Wood
Fuel/homes
Thatching(fetched from area near Gam)
garden

Expenditure
School(difficult)/ clinic in Gam/ food(difficult)/ clothing materials in Grootsfontein

Resource utilization
Farming practices (info. from one person) the kraals are constructed from 1 type
Acacia using uncut branches and renewed every 8 months; livestock spend nights in
kraal and drink in early morning, young livestock separated to allow to milk for
people; no 'gilialaas' in area.

Resource network
No people from other settlements use their water supply; resources such as food
aid, are shared within the settlement with those who lost cattle.

Biophysical observation
Vegetation: 60% grass to 40% bush; grass heavily grazed; shrubs lightly
browsed; large amount of annuals with few perrenials

Feuna: leopard killed by farmers 3 days prior to our visit due to killing
livestock

Organisations
water point committee are not yet in place but to be established (women not
involved)
OTJOMIHAMA EMERGENCY WATER NETWORK

18.2.07

Otjomuhama and cattle are split between otangapeni and otjomuhama, so grazing is not a problem.
Otjomihama

Date: 18/02/97
Participants: 13 women and 6 men

Borehole
First borehole to be drilled after Gam borehole; drilled depth 125m; good yield-3hrs to pump 30,000 litres; no shelter for pump; one point of source for humans and livestock - at trough which stands knee deep in water; farmer feels that 30,000 litre storage is insufficient; water levels are dropping; (in 1993-32mm pipes installed; in 1994-35mm pipes installed and extended by 8m; 1996-37mm pipes installed and extended by 8m); plastic reservoirs sit on a grid which is not a proper base as bulging and subsequent cracking occurs; 1 tank already been replaced; maintenance by RWS but their slowness caused problems

Composition of inhabitants
All people originated from Botswana, from different areas and belonging to different families; some knew each other previously; there is a strong sense of community within the members of Otjomihama; many children of 1-10yrs are present; 13 family settlements with 187 people comprising of 53 adults and 134 children; households comprise of a husbands, his wife/wives and their children; other family members include a divorced man and single women with her children; the average household number is 15.5 members.

Settlement
(refer to map) There are groups of family settlements approx. 50-100m from each other and situated 100-200m from the borehole structure; dwellings are either tents supplied from the MLRR or new homs erected with a timber structure and walls of a combination of stones and mud; 'patties' laid in a brick fashion; plaster using soil, dung and water is applied once the wailing is completed; grass is used as thatching material.

Health
Outbreak of diarrhoea at present amongst young children; residents want mobile clinic service; they use medicines from indigenous plants; coughs, malaria, eye and skin sores are experienced amongst the children.

Resources
Livestock
- 1500 cattle (milk/sour milk/butter/sell to meatcor for cash)
- donkeys (transport)
- horses (transport)
- sheep
(2000 livestock in total)

Food aid
- maize meal once per month shared amongst settlement

Cash
- from Botswana

Gardens
- recently established but threatened by rats

Expenditure
food/clothing/school/medicine/clinic

Resource network
(refer to resource network map)
Water obtained in need from Otjiserandu, Otangapeni, Otjozombani, Ominguindi and Otjibrinju

Biophysical observation
Vegetation
- farming practices: cattle drink in relays; veterinary services installed
- pen for vaccines which occurs once per year for blackfever; many cattle were killed from 'giftblaar' (poisonous plant)

Organisations
Water point committee has been set up
Veterinary services visit