STATE OF ENVIRONMENT REPORT
ON AGRICULTURE AND LAND RESOURCES

FINAL REPORT

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SUBMITTED BY:

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TABLE OF CONTENTS

Table of Contents .................................................................................................................. i
Acknowledgements ............................................................................................................. vii
Abbreviations ...................................................................................................................... viii
Executive Summary ........................................................................................................... x

PART 1. CONTEXT AND METHODOLOGY

1.1 State of the Environment Reporting and the Objectives of this Report... 1
   1.1.1 Background to State of Environment Reporting .............................. 1
   1.1.2 Aim of SoER on Agricultural and Land Resources ....................... 2

1.2 General Approach ................................................................................................. 2
   1.2.1 Conceptual Framework .................................................................. 2
   1.2.2 Sources of Information, Literature Review, Workshop Process ...... 6
   1.2.3 Constraints ...................................................................................... 7

PART 2. AGRICULTURE AND LAND RESOURCES UTILISATION IN NAMIBIA

2.1 Geo-physical Characteristics of Namibia's Land Resources .................... 8

2.2 The Agriculture and Renewable Natural Resources Sector and its
   Contribution to the Namibian Economy ....................................................... 15
   2.2.1 Introduction .................................................................................. 15
   2.2.2 Agricultural Sector Output in National Perspective .................... 15
   2.2.3 Trade in Agriculture Products ...................................................... 18
   2.2.4 Importance of Agriculture at Household Level ......................... 28
   2.2.5 Conclusions .................................................................................. 30

2.3 Land Tenure .................................................................................................... 31
   2.3.1 Overview and History of Land Tenure ......................................... 31
   2.3.2 The Debate about Land Tenure ................................................... 32
   2.3.3 Indigenous Land Rights ................................................................. 35
   2.3.4 Pastoralist Tenure ....................................................................... 35
   2.3.5 Mixed Farming Areas .................................................................. 36
   2.3.6 Tenurial Security in Mixed Farming Areas ................................. 39
   2.3.7 Colonial Land Acquisition ............................................................. 39
2.3.8 Commercial and Communal Areas............................................. 40
2.3.9 Current Land Tenure Problems............................................. 42
2.3.10 General Problems Facing Communal Farmers......................... 40

2.4 Land Utilisation in Namibia..................................................... 50
2.4.1 Pre-colonial Land Use in Namibia......................................... 50
2.4.2 Land Management Under Different Tenure Systems............... 50
2.4.3 Current Land Use Patterns in Namibia................................ 46
2.4.4 Factors Influencing Land Use Trends.................................. 57
2.4.5 Land Under-utilisation and Over-utilisation.......................... 58
2.4.6 Land Suitability for Agriculture Intensification.................... 59

2.5 Production Activities.......................................................... 61
2.5.1 Livestock Production......................................................... 61
  2.5.1.1 Beef and Milk Production Meat.......................... 61
  2.5.1.2 Small Stock Production.......................................... 64
2.5.2 Crop and Horticulture Production...................................... 68
  2.5.2.1 Rainfed Crop Production........................................ 71
  2.5.2.2 Irrigated Crop Production....................................... 75
2.5.3 Forest Production and Utilisation...................................... 81
2.5.4 Wildlife Production and Utilisation................................... 89
2.5.5 Freshwater Fisheries.......................................................... 90

PART 3. THE STATUS OF NATURAL RESOURCES IN NAMIBIA.............. 92

3.1 Rangelands.............................................................................. 92
  3.1.1 Biophysical Indicators of Resource Status.......................... 93
    3.1.1.1 The Four Fundamental Ecosystem Processes............... 95
    3.1.1.2 Research Programmes.......................................... 104
  3.1.2 Socio-economic Indicators of Desertification and Rangeland
       Degradation.................................................................... 115
  3.1.3 Proximate and Ultimate Causes of Resource Degradation........ 115
    3.1.3.1 Overgrazing....................................................... 115
    3.1.3.2 Overstocking..................................................... 116
    3.1.3.3 Non-flexible Use of Rangelands.............................. 117
    3.1.3.4 Weak Institutional Basis at Grassroots Level............. 117
    3.1.3.5 Lack of Technical Know-how and Services................ 117
    3.1.3.6 Unconducive Frame Conditions................................ 118

3.2 Arable Lands.......................................................................... 119
  3.2.1 Research, Inventory and Monitoring Programmes.................. 119
    3.2.1.1 Soil Surveys....................................................... 119
    3.2.1.2 Agro-ecological Zones.......................................... 119

Agriculture & Land Resources Consortium
State of the Environment Report on Agriculture and Land Resources

3.2.1.3 Water Erosion Hazard Map for Namibia ..................... 120
3.2.1.4 Namibia Early Warning and Food Information System 120
3.2.1.5 Rainfall Records ........................................... 121
3.2.1.6 Farming Systems Research ................................. 122
3.2.2 Biophysical Indicators ........................................ 122
3.2.3 Socio-economic Indicators ................................. 124
3.2.4 The Extent of Arable Land Degradation .................... 126
3.2.5 Causes of Arable Land Degradation ....................... 126

3.3 Forests .................................................................... 128
  3.3.1 Research, Inventory and Monitoring Programmes ........ 128
    3.3.1.1 The Forest Cover Mapping Project .................. 128
    3.3.1.2 The National Forest Inventory Project .............. 131
    3.3.1.3 Forest Permit System ................................. 131
    3.3.1.4 Forest Fire Monitoring System ..................... 132
    3.3.1.5 National Tree Atlas Project ......................... 132
    3.3.1.6 National Botanical Research Institute's Vegetation Mapping Project .... 132
    3.3.1.7 Ad hoc Studies ....................................... 132
  3.3.2 Biophysical Indicators ....................................... 133
  3.3.3 Socio-economic Indicators .................................. 134
  3.3.4 Causes of Forest Resource Degradation .................. 134
    3.3.4.1 Proximate Causes .................................... 134
    3.3.4.2 Ultimate Causes ..................................... 136

3.4 Groundwater ................................................................ 138
  3.4.1 Current Status of Groundwater Resources ................. 138
    3.4.1.1 Introduction .......................................... 138
    3.4.1.2 Perennial Wetland Systems ......................... 138
    3.4.1.3 Kalahari Aquifers .................................. 139
    3.4.1.4 Fracture Aquifers .................................. 139
    3.4.1.5 Karst Aquifers ...................................... 139
    3.4.1.6 Artesian Aquifers .................................... 140
  3.4.2 Pressures and Threats to Groundwater Resources ........ 140

3.5 Wetlands ..................................................................... 142
  3.5.1 Current Status of Wetland Resources ..................... 142
    3.5.1.1 Introduction .......................................... 142
    3.5.1.2 Perennial Wetland Systems ......................... 142
    3.5.1.3 Ephemeral Wetland Systems ....................... 147
  3.5.2 Priority Issues Concerning Wetlands .................... 149
    3.5.2.1 Perennial Wetland Systems ......................... 149
    3.5.2.2 Ephemeral Rivers .................................... 149
3.6 Freshwater Fisheries ................................................................. 151
  3.6.1 Research, Inventory and Monitoring Programmes.................. 151
  3.6.2 Proximate Causes of Change.................................................. 151
    3.6.2.1 Over-fishing ............................................................. 151
    3.6.2.2 Habitat Change .......................................................... 152
  3.6.3 Ultimate Causes of Change ................................................ 152
    3.6.3.1 Breakdown of Traditional Management Systems ................. 152
    3.6.3.2 Failure of State Management Efforts ............................ 152
    3.6.3.3 Population Pressure ................................................ 152
    3.6.3.4 Climate Change ........................................................ 153

3.7 General Discussion of Ultimate Causes of Agricultural and Land 
Resources Degradation .................................................................. 154
  3.7.1 Lack of Environmental Understanding ................................... 154
  3.7.2 Poverty and Population Growth ......................................... 154
  3.7.3 Lack of Policy and Policy Failure ...................................... 155
  3.7.4 Climate Change ................................................................. 156
  3.7.5 Conclusions .................................................. .......................... 156

PART 4. THE ROLE OF SOCIETY AND ITS INSTITUTIONS

4.1 Enabling Policy and Regulatory Environment.................................. 157
  4.1.1 National Policy and Strategy Framework ................................ 158
    4.1.1.1 The Constitution .......................................................... 158
    4.1.1.2 First National Development Plan .................................. 158
    4.1.1.3 Land Policy and Tenure Reform Legislation .................... 159
    4.1.1.4 The National Agricultural Policy .................................. 161
    4.1.1.5 The National Forestry Policy ....................................... 162
    4.1.1.6 The National Drought Policy and Strategy ..................... 163
    4.1.1.7 Environmental Policy .................................................. 164
    4.1.1.8 The Water Supply and Sanitation Policy ......................... 165
    4.1.1.9 The Food Security and Nutrition Policy for Namibia .......... 167
    4.1.1.10 Resettlement Policy .................................................. 167
    4.1.1.11 Freshwater Fisheries Policy ...................................... 168
    4.1.1.12 Industry Policy ........................................................ 168
    4.1.1.13 Others .................................................................... 169
    4.1.1.14 The Limits of Policy-led Development ............................ 170
  4.1.2 Legislative Framework ......................................................... 172
    4.1.2.1 Ministry of Agriculture, Water and Rural Development .... 173
    4.1.2.2 Ministry of Environment and Tourism ............................ 177
    4.1.2.3 Customary Law ........................................................... 178
    4.1.2.4 Discussion ................................................................. 179
4.2 Supporting Institutions and Services ................................................................. 180

4.2.1 Government Institutions ........................................................................... 180
4.2.1.1 The Ministry of Agriculture, Water and Rural Development ..................... 181
4.2.1.2 The Ministry of Environment and Tourism ................................................. 186
4.2.1.3 The Ministry of Fisheries and Marine Resources ........................................ 188
4.2.1.4 The Ministry of Lands Resettlement and Rehabilitation ............................ 188
4.2.1.5 Inter-ministerial Structures ....................................................................... 189
4.2.1.6 Local Government Structures .................................................................. 191

4.2.2 Parastatals and Statutory Bodies .................................................................. 192
4.2.2.1 Agribank ................................................................................................. 192
4.2.2.2 Meat Board of Namibia ........................................................................... 192
4.2.2.3 The Namibian Agronomic Board ............................................................... 193
4.2.2.4 Namibia Development Corporation ......................................................... 193
4.2.2.5 Development Fund of Namibia .................................................................. 193

4.2.3 Non-Governmental Organisations ............................................................... 194

4.3 Agricultural and Land Resource Management Technologies and Practices .................................................. 195

4.3.1 Community Based Natural Resource Management .................................... 195
4.3.2 Community Forestry ................................................................................... 196
4.3.3 Range Management .................................................................................... 196
4.3.3.1 Introduction .............................................................................................. 196
4.3.3.2 Sustainable Improvement of Livestock Production .................................. 197
4.3.3.3 Rotational Resting Under Normal and Good Rainfall Years ....................... 197
4.3.3.4 Strategies of Livestock Movement .............................................................. 198
4.3.3.5 Indigenous Livestock ............................................................................... 199
4.3.3.6 Feed Supplementation ............................................................................. 199
4.3.3.7 Resettlement of Large Communal Farmers to Title Deed Areas ............... 200
4.3.3.8 Livestock Marketing as a Way of Tracking ................................................ 200
4.3.3.9 Alternative Income Generating Activities ............................................... 201
4.3.3.10 Frame Conditions .................................................................................. 201
4.3.3.11 Alternatives for Capital Accumulation .................................................... 201
4.3.3.12 Local Investment Packages .................................................................... 202
4.3.3.13 Institution Building on Communal Land ............................................... 202

4.3.4 Arable Land Management .......................................................................... 202
4.3.4.1 New Staple Crop Cultivars ....................................................................... 202
4.3.4.2 Crop Diversification ............................................................................... 202
4.3.4.3 Draught Animal Power ........................................................................... 202
4.3.4.4 Soil Fertility Management ...................................................................... 203
4.3.4.5 Small-scale Irrigation .............................................................................. 204
4.3.4.6 Large-scale Irrigation .............................................................................. 204

4.3.5 Freshwater Fisheries ................................................................................... 205

4.3.6 Land Use Planning ...................................................................................... 206
PART 5.  INDICATORS FOR MONITORING THE STATE OF THE ENVIRONMENT FOR AGRICULTURE AND LAND RESOURCES

5.1 Introduction .......................................................................................................................... 207
5.2 Process for Defining Indicators .......................................................................................... 209
5.3 Criteria for Defining Indicators .......................................................................................... 217
5.4 Suggested Indicators ............................................................................................................ 218

Indicator 1: Security of Tenure ............................................................................................... 219
Indicator 2: Rangeland Condition Index .................................................................................. 222
Indicator 3: Sustainable Irrigation Development ..................................................................... 223
Indicator 4: Forest and Crop Area Change .............................................................................. 228
Indicator 5: Maintenance of the Hydrological Function of Wetlands .................................. 235
Indicator 6: % GDP Spent on Agriculture and Land Resources Research, Extension and Training ................................................................................................................. 238
Indicator 7: Population Pressure Indicator .............................................................................. 244

References
List of Figures

1.1 The Pressure-State-Response Framework .................................................. 4
1.2 Conditions for Sustainable Agriculture and Land Use .............................. 5

2.1 Rainfall Map ......................................................................................... 11
2.2 Vegetation Map .................................................................................... 13
2.3 GDP Composition, 1998 ....................................................................... 16
2.4 GDP Composition, 1999 ....................................................................... 17
2.5 GDP Composition, 1998 ....................................................................... 19
2.6 Contribution of Agriculture to GDP ....................................................... 20
2.7 Growth in Agriculture in Perspective ...................................................... 21
2.8 Composition of Growth in Agriculture ................................................... 22
2.9 Contribution to Total Export Earnings, 1997 ........................................... 23
2.10 Agricultural Products Imports for 1998 .................................................. 25
2.11 Import Reliance for Staple Foods, 1991 – 97 ......................................... 27
2.12 Land Tenure map ............................................................................... 54
2.13 Cattle number in commercial and communal Farming Areas of Namibia for December 1988 to December 1998 .............................................. 61
2.14 Cattle marketing through various outlets in Namibia from 1987 to 1997 .......... 62
2.15 Average producer price of beef carcasses at export abattoirs (excl. NCA abattoirs for 1996 and 1997) .......................................................... 62
2.16 Total annual milk production in Namibia from 1990 to 1999 ....................... 63
2.17 The relationship between producer price and real producer price for fresh milk in Namibia from 1990 to 1999 .................................................. 64
2.18 Sheep numbers in Commercial and Communal Farming Areas of Namibia from December 1988 to December 1998 .......................................... 65
2.19 Goat numbers in Commercial and Communal Farming Areas of Namibia from December 1988 to December 1998 .......................................... 65
2.20 Average auction price of lamb carcasses at all RSA markets for 1996 and 1997 .............. 66
2.21 Pelt production relative to the national Karakul herd .................................... 66
2.22 Real change in pelt prices since 1989....................................................... 62
2.23 Marketing of pigs at butchers in Namibia from 1987 to 1997 ....................... 67

3.1 The four major ecological zones of Namibia (DRFN, 1996) ......................... 93
3.2 The rainfall isohyetal map of Namibia (Dept of Water Affairs, 1994) ............... 95
3.3 Effective and non-effective water cycles (Savory, 1999) ............................ 96
3.4 The location of vegetation plots where data on erosion status and capping of topsoil were recorded (Strohbach, 1999 Map produced by Agro-ecological Zones project) .................................................. 98
3.5 The extent of bush encroachment in Namibia (Bester, Van Eck and Koelling, 1999) .... 99
3.6 Good and poor mineral cycles (Savory, 1999) .......................................... 101
3.7 The basic energy pyramid (Savory, 1999) ................................................ 102
3.8 Energy flow above and below ground (Savory, 1999) ................................... 103
3.9 Summarised vegetation composition of Volk Plot 720 ................................. 111
3.10 Summarised vegetation composition of Volk Plot 739 ................................. 111
3.11 Summarised vegetation composition of Volk Plot 757 ................................. 112
3.12 Change in the crown cover of some selected tree species (average of all relevés) on Erichsfelden .............................................................. 112
3.13 Change in the crown cover of some selected shrub species (average of all 113 relevés) on Erichsfelden .............................................................. 113
3.14 Change in crown cover of some selected dwarfshrub species (average of all 114 relevés) on Erichsfelden .............................................................. 113
3.15 Change in the crown cover of some selected perennial grass species (average of all relevés) on Erichsfelden .............................................................. 114
3.16 Change in the crown cover of some selected annual grass species (average of all relevés) on Erichsfelden .............................................................. 114
List of Tables

2.1 Nutrition and Agriculture ........................................... 29
2.2 Multiple farm ownership of land held in various commercial farming districts of Namibia .................. 51
2.3 Number of farms having 0-30 cattle in the commercial farming districts of Namibia in 1991/1992 ................. 51
2.4 Estimates of under-utilised land in Communal Areas of Namibia (in millions of hectares) ......................... 59
2.5 Namibian grain producer types .................................... 69
2.6 Rural household welfare indicators in Kavango Region ................................................................. 69
2.7 Rural household welfare indicators in Caprivi Region ........................... 69
2.8 Rural household welfare indicators in Kavango Region ..................... 70
2.9a Total (Irrigated and Rain-fed) Coarse Grain Production in Thousand Tonnes ............................................. 73
2.9b Total Production and Price of Crops ................................ 74
2.10 Hectares planted to different crops during 1998/99 ............................................................... 79
2.11 Characteristics of the three main vegetation classes .................. 82
2.12 Estimated consumption of wood products in Namibia 1990 ................ 82
2.13 Estimated annual economic value of forest resources exploitation (1996) ....................................... 83
2.14 Estimated annual economic value of forest resources exploitation (1996) ....................................... 90

3.1 Types and degree of soil erosion in different places of Namibia (Stroshbach, 1999) .................................. 97
3.2 Degree of capping of the topsoil in different places in Namibia (Stroshbach, 1999) ......................... 98
3.3 Transpiration losses (kg/day) from an area of 500 bushes/ha for four different species in the Molopo area of South Africa (de Klerk, 1988) ........................................... 100
3.4 Summary evaluation of potential per agro-ecological zone (De Pauw & Coetzee, 1999) ...................... 110
3.5 Annual rainfall figures for Oshakati for the 91/92 to 92/93 seasons and percentile and % of mean figures ... 121
3.6 Annual rainfall figures for Rundu for the 91/92 to 96/97 seasons and percentile and % of mean figures ........... 122
3.7 Cost per household of replacing crops lost due to lack of manure ................................................. 124
3.8 Summary of vegetation types and their areas in the Kavango Region .................................................. 129
3.9 Summary of vegetation types and their areas in all Regions mapped .................................................. 130
3.10 Namibia’s Main Storage Dams ........................................ 147

5.1 Change in closed forest area ........................................... 229
5.2 Change in open forest area ............................................. 230
5.3 Change in cleared land area ............................................ 230
5.4 Change in cultivated land area ......................................... 231
5.5 State of Forests in Southern Africa ................................... 234
5.6 RET Indicator Data Set .................................................. 239
5.7 RET Indicators Data Set - RET Recurrent Expenditure Spent on Personnel ........................................... 240
5.8 RET Indicators ............................................................. 240
5.9 Extension Expenditures as a Percent of AgGDP Mean Levels for 1980, 1985 and 1990 ...................... 241
5.10 Extension Expenditures as a Percent of AgGDP, Mean Levels for 1980, 1985 and 1998 Categorised by Per Capital Income Levels ...................................................... 241
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We hope that together we have contributed in a small way to sustainable development and environmental awareness in Namibia.
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<tr>
<th>Abbreviation</th>
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<td>Agro-ecological zones</td>
</tr>
<tr>
<td>AgGDP</td>
<td>Agricultural GDP</td>
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<td>AG</td>
<td>Attorney General</td>
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<td>CBNRM</td>
<td>Community Based Natural Resources Management</td>
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<td>CBO</td>
<td>Community Based Organisation</td>
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<tr>
<td>CEC</td>
<td>Cation Exchange Capacity</td>
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<td>Desert Research Foundation of Namibia</td>
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<td>Directorate of Veterinary Services</td>
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<td>Department of Water Affairs</td>
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<td>Environment Assessment Policy</td>
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<td>FED</td>
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<td>GDP</td>
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<td>Government of the Republic of Namibia</td>
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<td>ICRISAT</td>
<td>International Crop Research Institute for the Semi Arid Tropics</td>
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<td>IMSCLUP</td>
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<td>MAR</td>
<td>Mean annual runoff</td>
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<td>NEPRU</td>
<td>Namibian Economic Policy Research</td>
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<td>NEWFIU</td>
<td>Namibia Early Warning Food Information Unit</td>
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<td>Non-government organisation</td>
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<td>SARDEP</td>
<td>Sustainable Animal and Range Development Programme</td>
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<td>SOER</td>
<td>State of Environment Report</td>
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EXECUTIVE SUMMARY

Part 1  Context and Methodology

This State of the Environment Report is one of a series covering different sectors produced under the auspices of a Ministry of Environment and Tourism project entitled "Information and Communication Service for Sustainable Development in Namibia".

Within this context, the aim of this particular State of Environment Report is to support sustainable and responsive policy and strategy formulation, and implementation, by reviewing a comprehensive range of disciplines addressing the state of the country's agricultural and land resources. In addition, the report introduces a number of criteria for on-going environmental monitoring in terms of a number of sustainability indicators. An important key to the success of the State of the Environment Reporting initiative will be the effective communication of findings to various stakeholders so as to inform the national development process.

The report is structured around the so-called "pressure-state-response" conceptual framework, which has been adopted for all Namibian State of the Environment reporting. This aims at systematic coverage, from an holistic perspective, of sustainability issues. It is based on analysis of the relationships between human activity which puts pressure on natural resources, the changing state of the natural resource environment resulting from human activity, and human societal activity responding to this changed state, so as to maintain and restore its status as a provider of essential resources. Further, the report adopts a model for the response component of this framework which proposes that sustainable agriculture and land resource use is not only about appropriate technologies and management practices but also about supporting institutions and services which empower resource users to implement improved technologies and practices, and about an overall enabling policy and regulatory environment.

Part 2  Agriculture and Land Resources Utilisation in Namibia

This part of the report, covering the "pressure" component of the conceptual framework, describes key land tenure and land use issues, and agricultural production and land resource utilisation industries, and how these have developed over time. Activities are divided into the livestock and crop production, and the forest, wildlife and fisheries production and utilisation sub-sectors.

To set the scene the report commences with a brief account of the biophysical characteristics of Namibia's land resources. It then looks at the contribution to Namibia's economy and society of the country's agriculture and renewable natural resources sector by considering its relationship to national development objectives and a number of macro-economic and socio-economic indicators. A careful reading of this section should throw light on the questions: to what extent are the agriculture and the renewable natural land resources sectors a potential route to economic growth and employment and a route out of poverty, and hence to what extent should society allocate resources to the development of which sectoral activities?

At the outset, the report addresses one of the fundamental determinants of agricultural and land management in Namibia, and hence a key national issue, that of land tenure. A historical perspective is adopted which reveals that land management under different customary tenure systems is both flexible and pragmatic. It challenges the widely-held perception that customary tenure systems do not provide sufficient tenurial security to motivate sustainable resource management, and notes the socio-economic benefits of broad-based access to land resources. It argues that future societal responses to the urgent political issue of land reform should be based on a sound analysis of the complex evidence, rather than on simplistic preconceptions. It is of concern that although new and forthcoming legislation covering conservancies, water points and forests recognises that an important incentive to communities to manage their land and natural resources sustainably is that they are able to make decisions on resource use, and to exclude people from using their resources, new land legislation makes no provision for land and natural resource users to obtain property rights on a community basis to these resources.
Land use in Namibia is determined by a combination of factors, not least those of land tenure systems, biophysical characteristics of land resources, and socio-economic characteristics of land users. The report looks at important features of historical and existing land management practices, under commercial, communal and state managed systems. Current land use patterns are described, and an analysis of land use trends, considering in particular issues of land under-utilisation and over-utilisation, is presented.

Given the preceding discussion of broad land tenure and land use patterns prevailing in Namibia, the report goes on to describe systematically the country's main agricultural production and resource utilisation activities. An account is given of the current status of the livestock and crop production (both rainfed and irrigated) sub-sectors, and the forest, freshwater fisheries and wildlife production and utilisation sub-sectors. This includes coverage of inputs, human activities and outputs, and an assessment of the importance of these activities to Namibia's economy and society at the national, regional and household levels. The ecological and geographical dimension of these activities is also addressed. Comprehensive and up-to-date information on agricultural resources utilisation is provided and future trends are suggested. Analysis of the consequences of the pressure on the environment which agricultural and land resource use represents is presented in the following part of the report.

Part 3 The Status of Natural Resources and Causes of Change

The report provides background information on the current agricultural and land resources environment, considering the physical, ecological and socio-economic characteristics of the natural resource base, and how these are changing over time.

The status of natural resources is discussed according to broadly defined land use types and resources: arable land, rangeland, forest land, groundwater and wetlands, and freshwater fisheries. Throughout, the focus is on the changing status of natural resources. This status is evaluated in terms of identifed sustainability indicators, both biophysical and socio-economic.

Having described the changing status of natural resources, as far as existing information allows, the causes of change are then discussed. Causes of change are disaggregated and categorised as either proximate or ultimate causes. Proximate causes relate to resource management and mismanagement practices, while ultimate causes related to factors influencing the adoption of resources management practices, such as lack of environmental understanding, poverty and population growth, and policy failure, as well as natural factors such as climate change.

Sustainable use of rangeland resources depends on the maintenance of four fundamental ecosystem processes: the water cycle, mineral cycle, energy cycle, and community dynamics. Various threat to these and important related research initiatives are described. Biophysical and socio-economic indicators of rangeland degradation are noted. Proximate causes of rangeland degradation, including overgrazing, overstocking, non-flexible use of rangelands, as well as ultimate causes including weakly developed farmer institutions and farmer support services, and lack of technical knowledge, are identified.

The mere fact of low-input continuous cultivation of arable soils with high sand and low clay and silt contents and low and fragile soil organic matter contents, as well as high temperatures and infrequent but heavy rainfalls, implies that nutrient and organic matter loss is rapid. Maintenance of low but stable crop yields, however, suggests that soil nutrient equilibria also stabilise rapidly. The two major threats to such equilibria are the loss of biomass in the system, and structural damage and soil erosion. Wind erosion is identified as a significant problem in some areas greatly compounded by tree cutting, while inappropriate cultivation practices lead to problems of pulverisation and ploughpan formation.

Deforestation is proceeding at a rapid rate in areas of high population density. Use of wood for fuel, building material and so forth causes degradation of forest status, while clear-felling is required mainly for crop cultivation purposes. In both cases, it is not the utilisation of the forest resource per se that is at fault, but rather its unplanned nature and unsustainable levels.
Groundwater is of crucial concern to the agriculture sector. The report describes the country's main aquifers and important threats to their status as providers for agriculture. The greatest concerns are identified as aquifer depletion and pollution, as well as threats to environmental demand. The latter refers to the issue of failure of aquifers to continue providing for the processes and services essential for the maintenance of natural ecosystems, upon which agriculture in turn depends.

Wetlands, including ephemeral wetlands, provide essential support to some two thirds of the country's population that lives in close proximity to them. Having described the main perennial and ephemeral wetland systems, and their relationship to agricultural and other livelihood systems, the report identifies threats posed by, amongst others, population increases, changing tenure systems, increased sedentarisation of livestock and people, and inappropriate farming practices along the country's limited areas of wetland and river margins.

Freshwater fisheries resource have declined markedly due to overfishing resulting from unsustainable practices such as the use of dragnets and fine mesh gill nets for commercial exploitation purposes. Changes in ecosystems, including destruction of fishes' habitats, invasion of alien species, and reduced and inadequate floods are also degrading the status of fisheries resources.

It is concluded that, the environmental crises facing much of Namibia does threaten sustainability; but too often its extent has not been carefully analysed, and its causes have been mis-diagnosed. Also, to characterise all environmental change as degradation is unhelpful. Quantifying the value of degradation is really only possible with data on the long term nature of degradation which does not always exist currently. Sustainable development requires that an holistic view is taken. Where forests have been replaced by productive fields or grazing, or by roads and urban settlements, for instance, change cannot necessarily be referred to as degradation, except in a narrow sense. Further, much of what is sometimes characterised as resource degradation is often so only in the short-term. Changed resource-use practices coupled with rare climatic events (for instance, years of exceptionally high rainfall) can be expected to see a reversal of some processes of degradation over the longer term.

Much change, no matter how temporary, has socio-economic impacts. The benefits of changes in the status of natural resources tend to be reaped by the better-off minority, while an increasing number of poor people lose their access to these resources and consequently become resource-poorer. With a less productive resource base they currently have no way out of their poverty. This, it could be argued, is not the result of the change in the status of natural resources, but of the failure of the country's political economy to come to terms with that change.

It should be a general rule of thumb that traditional land use systems are as good a place to start to look for sustainability as any. These are usually dynamic and resilient, and they offer many practices that can be improved upon to assure sustainability in the face of increased population densities and other ultimate threats. It is important that we learn more about the status of our natural resources and the processes which threaten them so as to be able to manage them sustainably on an informed and rational basis. It is hoped that a description of resource status change, and the analysis of causal relationships with proximate and ultimate factors seen as responsible for these changes, will enable us to see more clearly how we can better manage our resources. It should help us to identify what actions we can take to deal with the problems that can upset the balance between productivity and sustainability that we should strive for in the management of our agricultural and land resources.

Part 4 The Role of Society and its Institutions

Developing sustainable agricultural and land use systems which are adapted to Namibia's marginal agricultural environment and arid, drought-prone climate requires inputs on a number of levels. These cannot be dealt with in isolation. Development interventions must look at all these levels in combination if their work is to be of real benefit.

This section of the report examines society's response to changing agricultural and land resource status in Namibia. It starts with a description of:
State of the Environment Report on Agriculture and Land Resources

(i) national policies, strategies and legislation;
(ii) organisations (including those in the public sector, parastatals, non-governmental organisations, community-based organisations, and the private sector); and
(iii) resource-conserving technologies and practices.

The report describes society's institutional set-up for responding to change, initially in the form of a catalogue of its numerous components, and a brief description of their respective aims focussing on sustainability objectives. Priority attention is given to certain components according to the degree of influence they are perceived to have on the issue of sustainable resource utilisation.

In describing the national policy and strategy framework, the report outlines a range of the key government policy statements directly relating to agricultural and land resource management. These include, amongst others, the Constitution of the Republic of Namibia, Namibia's First National Development Plan (NDP1), national land policy, agriculture and forestry policy, and environmental and water policy. Pertinent areas of policy contradiction, policy failure, policy gaps, lack of strategy, and strategy failure are identified and discussed.

It is concluded that the mere existence of government policy statements is of little significance as an indicator of societal response to environmental change. Instead, it is proposed that certain key policy statements are isolated, and the degree to which they are being implemented is considered in terms of the existence of strategies, budgets, and other specific implementation milestones. For example, in this report, the provision of research, extension and training support services to farmers has been selected as an indicator for future monitoring.

The report proceeds to discuss key legislation deemed to be of significance in terms of societal response to the changing state of the agricultural and land resources environment, and which aims to enhance sustainable agricultural and land resources management. It contains a review of relevant legislation being administered by the Ministry of Agriculture, Water and Rural Development, the Ministry of Lands, Resettlement and Rehabilitation, and the Ministry of Environment and Tourism.

It is noted that, as in the case of policy statements, the mere existence of legislation which aims to regulate and control resource use is of limited significance, particularly where the legal system and property rights are not well developed as in much of Namibia. In this case, it is increasingly recognised that improving sustainable resource use can be more effectively attained through the use of economic instruments and education, rather than attempting to control and regulate.

In assessing societal response to environmental change in terms of the organisations and institutions established to direct that response, the report considers a network of relevant actors. The report reviews the key governmental, parastatal, non-governmental, and community-based actors, as well as the coordinating and policy-making institutions, and the sectoral and co-operative mechanisms, all of which together aim to achieve the common objective of the sustainable management and utilisation of Namibia's natural resources. This review focuses on the assessment of the influence, potential and actual, of the institutions in question on the sustainability of resource utilisation.

Sustainable utilisation of agricultural and land resources in Namibia requires that resource users adopt appropriate, resource-conserving technologies and management practices. They must make the best use of the limited natural and other resources available to them in such a way as to ensure that those resources continue to be available to themselves, to future generations, and to their neighbours. Given the unpredictability of the rainfall (and other factors such as pestilence and floods), this requires technologies and practices which minimise the risk to the farmer of losing resources, be they natural resources such as grazing or soil fertility, or economic resources such as labour and other inputs, in the event of a poor season. At the same time new technologies should fulfill other socio-economic objectives including increasing productivity and income generation, and in the subsistence sector, decreasing labour requirements, particularly of women. Traditional strategies and "best practices" for sustainable resource utilisation should be encouraged, and used as the basis for improving the sustainability and productivity of farming other land use systems. Important areas of innovation currently being promoted in Namibia, which the report discusses, include: community-based natural resources management, various range management practices, crop cultivar and type diversification, improved cultivation technology, soil fertility management, agro-forestry, irrigation, and post-harvest technologies.
Part 5  Indicators for Monitoring the State of the Environment for Agriculture and Land Resources

To ensure the sustainability of development efforts, societies need to monitor environmental change and, on the basis of an understanding of environmental processes and causal relationships, reform those of its activities which impact negatively on sustainability, and reinforce those which impact positively.

State of the Environment indicators aim to increase public awareness of critical changes. They are a means of making often complex issues accessible to decision makers on both an individual and societal level. As such, this part of the report starts by emphasising the point that the process of identifying and institutionalising indicators is as important as the end product. The process is therefore recorded, and early ideas for indicators noted. Some of these may warrant revisiting in future as the capacity of monitoring systems develops. Ultimately, indicators were selected on the basis of the following criteria:

(i)  **Degree of relevance** to the main issues which determine the state of the environment.

(ii) **Availability and scientific reliability** and acceptability of base-line data necessary to measure the indicator, and ease of acquisition and processing of data necessary to monitor the indicator in future.

(iii) **Utility of the indicator** for decision makers in terms of it being understandable and its relevance agreeable to users.

Indicators with which to monitor changes to the environment due to agriculture and land use practices have been selected as follows:

INDICATOR 1: SECURITY OF TENURE

Security of tenure indicates the extent to which the users of land based resources feel secure in the use rights which they enjoy. It provides a proxy for incentives or disincentives to make medium- to long-term investment in natural resources enhancement or preservation. Assuming that viable technologies, access to appropriate inputs and extension advice, household labour and financial resources are available, tenure security is likely to contribute significantly to more sustainable land use practices. Data to measure this indicator will have to be obtained through regular surveys in different regions of the country.

INDICATOR 2: RANGELAND CONDITION INDEX

The Rangeland Condition Index is an indicator of the extent to which rangeland condition is improving or declining. Rangeland is measured as a condition score (percentage or index) in relation to the potential for that area. Four processes in the rangeland ecosystem are measured:

a)  Water cycle (soil surface condition)
b)  Mineral cycle (micro-organisms in soil)
c)  Energy flow (vigour, density, composition)
d)  Community dynamics (composition, ecological status, bush encroachment)

This indicator is most useful at the local level.

INDICATOR 3: SUSTAINABLE IRRIGATION DEVELOPMENT

This is a composite indicator including, initially:

a)  land area used for irrigated crop production. This shows the extent of investment in irrigation infrastructure, which may be considered a significant enhancement of natural resources available for agriculture and

b)  An assessment of progress towards the establishment of irrigation scheme management boards giving users responsibility for large-scale irrigation scheme infrastructure. The presence of an
irrigation board would indicate the likelihood that farmers are employing good irrigation management practices.

INDICATOR 4: FOREST AND CROP AREA CHANGE

This indicator measures changes in absolute and percentage terms in the area of land in the northern communal areas (a) with forest cover, (b) that has been cleared for cultivation, and (c) that is actually cultivated. This indicator of changing pressures on land resources will give an indication of the degree to which:
- forested areas are diminishing
- cleared land is increasing
- cultivated land is increasing
- cleared land is being used for cultivation

INDICATOR 5: MAINTENANCE OF THE HYDROLOGICAL FUNCTION OF WETLANDS

Water supply, both in terms of quantity and quality, whether below or above ground, needs to be maintained if the products and services provided by wetlands are to continue to play an important role in agricultural production in Namibia. Given the assumption that water quantity and quality determine to a large extent the products and services (in terms of agriculture) provided by wetlands, this indicator would provide a direct measure of a wetland systems ability to continue to supply those goods and services.

INDICATOR 6: PERCENTAGE GDP SPENT ON AGRICULTURE AND FOREST RESOURCES RESEARCH, EXTENSION AND TRAINING (RET).

This indicator measures the percentage of primary agricultural GDP and total GDP, and of GRN expenditure spent on agricultural and forest resources research, extension and training service provision. Its purpose is to monitor government expenditure on agricultural and forest resources-related RET, in comparison to other government services and in relation to the sector’s contribution to GDP, and international norms. RET services are one of society’s key means of facilitating its “response” to the changing status of natural resources, as well as in determining the nature of production “pressures” on the natural environment.

INDICATOR 7: POPULATION PRESSURE INDICATOR

The indicator on population pressure has been taken from the SOER on the Socio-Economic Environment in Namibia. (Urban Dynamics Africa, Trend Line 1999). This indicator consists of a number of variables: - population density, % population dependent on agriculture, % population using firewood for cooking and an aridity index, all of which directly affect agriculture and land use.
PART 1. CONTEXT AND METHODOLOGY

1.1 State of the Environment Reporting and the Objectives of this Report

This report has been undertaken by a Consortium consisting of Namibia Resource Consultants (NRC), Stubenrauch Planning Consultants (SPC) and Namibia Economic Policy Research Unit (NEPRU) fielding 11 consultants, each specialists in their own fields, in response to an award issued by the Directorate of Environmental Affairs in the context of a Government of Finland supported project entitled "Information and Communication Service for Sustainable Development in Namibia", following competitive tender.

State of the Environment Reports (SOER) covering three defined sectors [Socio-economy, Fresh Water, and Industrialisation (including energy, mining, transport and processing)] have already been prepared under this project. Four remain to be completed - Agriculture and Land Resources (this study); Marine Resources; Biodiversity, Parks and Tourism; and Institutional Framework.

It may be noted that a considerable body of State of the Environment Reporting documentation has recently been generated both internationally and nationally. State of the Environment Reporting has been adopted by many countries. Lessons of particular relevance to Namibia's situation can be learned from the experience of Zimbabwe and Australia in particular. Those interested in more information on the international experience of indicators of sustainable development are referred to the library of the Directorate of Environmental Affairs, In the Ministry of Environment and Tourism, and the following two websites: http://www.unep.ch/earthfindicat.htm and http://llsd.ca/measure/comindex.asp.

This brief introduction outlines the context and methodology adopted in the reporting process.

1.1.1 Background to the State of Environment Reports

Agenda 21, the international action plan for sustainable development, adopted at the United Nations Conference on Environment and Development in 1992, called for national governments to provide environmental information for reporting on progress towards sustainability. This international initiative complements timeously Namibia's own independent need to undertake such actions.

Namibia's economic growth and socio-economic development in the primary, secondary and tertiary sectors continues to be significantly dependent on the exploitation of natural resources. As Namibia enters its tenth year of independence its national development policies and strategies are, for the most part, well set. Indeed, progress in policy and strategy implementation is advanced in several areas.

Given Namibia's reliance on natural resources, two important questions at this stage are:
• how environmentally sustainable are government's policies and strategies?
• how responsive are these policies and strategies to changing environmental conditions?

To answer these questions information needs to be generated covering a comprehensive range of natural resources and their uses.

The aim of this State of Environment Reporting initiative, therefore, is to support sustainable and responsive policy and strategy formulation, and implementation, by reviewing a range of disciplines addressing the state of the country's agricultural and land resources, by establishing criteria for on-going monitoring of the resources in terms of a number of sustainability indicators, and by communicating findings to various stakeholders, so as to ensure that this monitoring takes place and informs the national development process.

To summarise, the objectives of the SoER initiative are:
• to increase awareness of environmental conditions and trends in relation to resource use, and implications for development;
• to facilitate on-going monitoring of development processes in terms of sustainability;
• to inform environmentally sensitive decision-making.
1.1.2 Aim of SoER on Agricultural and Land Resources

This SoER aims to produce two main outputs. The SoER will provide a comprehensive review of the utilisation and status of agricultural and land resources based on available data. It will gather information on the changing situation, with a focus on the impact of human activities on natural resource sustainability. But equally, the SoER will contribute to raising awareness of the condition of natural resources, and the process influencing that condition, so as to influence human activity towards sustainable resource utilisation. This will be accomplished by:

- identifying key issues where insufficient information is available to monitor the natural resources situation;
- defining indicators for monitoring environmental sustainability of agriculture and land resources utilisation;
- providing baseline data against which several indicators of sustainable resource utilisation can be monitored over time;
- advocating that such monitoring is undertaken in an effective, efficient and on-going basis.

The issue of indicators of natural resource status and sustainable resource utilisation is a particularly innovative output expected of the SoER. It is hoped that indicators which represent clearly and relatively simply the status of complex processes will be valuable as an efficient means of focussing data collection and for monitoring and analysis of resource use. They are also useful for the purpose of communication of findings to a wide audience.

The report has adopted a specific interpretation of the term "agricultural and land resources". By way of explanation it may first be useful to give a typical internationally recognised definition of the word "land". The United Nations in 1994 defined land as:

"a delineable area of the earth’s terrestrial surface, encompassing all attributes of the biosphere immediately above or below this surface, including those of the near surface, climate, the soil and terrain forms, the surface hydrology (including shallow lakes, rivers, marshes and swamps), near-surface sedimentary layers and associated ground water and geo-hydrological reserve, the plant and animal populations, the human settlement pattern and physical results of past and present human activity (terracing, water storage, or drainage structures, roads, buildings etc.). (FAO. 1998).

The above definition reflects and ecological rather than administrative conceptual approach to land. The point is however that land is a multi-faceted concept which is usually defined holistically. Likewise, the basic functions of land can be defined as follows:

- to provide food, fibre and fuel and other materials or human use (productive function);
- to provide biological habitats for plants, animals and micro-organisms (biodiversity function);
- to act as both a source and sink for gases which control the energy balance (energy balance function);
- to influence the hydrological cycle by acting as store and enable the flow of water both ground and surface water (hydrological cycle);
- to act as buffer, filter or modifier of chemical pollutants (environmental function);
- to provide physical space for transport, settlements, industry, recreation (space function);
- to store and protect evidence from the historical or pre-historical records (storage function).

Deterioration of land status is impaired ability of the land to carry out the above functions. With this in mind, and further to the understanding gained from the SoER Project Implementation Unit concerning the scope of other SoER activities, the actual definition of agricultural and land resources to be adopted has been agreed. The term agricultural resources is to be comprehensively defined, and includes: rangeland, arable land, water, forest, and freshwater fisheries resource utilisation. On the other hand, the term land is defined to cover land resource utilisation issues mainly as they pertain to agriculture (as defined). In other words, issues of mineral resources, national parks, transportation, and urbanisation, for instance, will not be addressed in this report.

While it is clear that a primary interest of the Information and Communication Service for Sustainable Development in Namibia project is to avoid gaps in coverage of relevant issues, there is also concern that, from an efficiency point of view, there may be significant areas of overlap in the different SoERS
being commissioned by the project. One question is whether issues covered in other SoERS (for example, water resources in the SoER on "Freshwater"; forestry and freshwater fisheries resources in the SoER on "Biodiversity, Parks and Tourism"; and socio-economic indicators in the SoER on the "Socio-economical Environment") should be considered anew or whether information from existing reports should be used.

This SoER on Agriculture and Land Resources has adopted a pragmatic approach to ensure that the best possible information is gathered in as efficient a manner as possible. Hence, it has been found necessary to give relatively thorough treatment to forestry issues and, to a lesser extent, freshwater fisheries issues. On the other hand, this report deals with water issues only insofar as they relate directly to land use and agriculture. The SoER report on water resources is otherwise a fully comprehensive one, the findings of which are not repeated here.

1.2 General Approach

1.2.1. A conceptual framework

The SoER process assumes that one of the objectives of environmental management is sustainable resource utilisation. To this end, the following definition of sustainable resource utilisation has been adopted by the SoER Agriculture and Land Resources report:

Resource use which meets today’s livelihood needs, without preventing the needs of neighbours or future generations from being met; this is achieved by continuous adaptations to a changing environment, so as to protect and enhance the stocks of natural, physical, human and social ‘capital’ available to themselves and to future generations.¹

In considering the State of the Environment, as regards agricultural and land resources, the report has used the so-called "pressure-state-response" conceptual framework, which has been adopted for all Namibian State of the Environment reporting. This is a framework which is conceptually simple and, it is hoped, attractive to prospective readers. It describes the relationship between human activity putting pressure on natural resources, the changing state of the natural resource environment resulting from human activity, and human societal activity responding to this changed state, so as to maintain and restore its status as a provider of essential resources. The framework is illustrated in Figure 1.1.

While this figure is self-explanatory, the critical concept of societal response merits particular consideration. The analysis and definition of indicators of societal response implies that we know what that response should be. In other words, it requires that we must first have a clear idea about the nature of responses which will lead to sustainability. But, in many fields of land use this is a matter of on-going theoretical debate and practical experimentation. There are few examples of models of successful sustainable agricultural and land resources systems in the sorts of ecological and socio-political environment found in Namibia.

It is proposed to argue for a model of sustainability, as represented in Figure 1.2, overleaf. This model proposes that sustainable agriculture and land resource use is not only about appropriate technologies and management practices but also about supporting institutions and services which empower resource users to implement improved technologies and practices, and about an overall enabling policy and regulatory environment.

Figure 1.1 The Pressure-State-Response Framework

**Human Activity**
- Livestock Production
- Crop Production
- Forest, Veld and Fisheries Utilisation
- Other Land Uses

**Status of Natural Resources**
- Water, soils, vegetation, wildlife, fisheries, land use

**Societal responses**
- Policy, strategy, legislation
- Service organisations
- Sustaining local organisations
- Resource conserving technologies

**RESPONSE**
Figure 1.2  Conditions for Sustainable Agriculture and Land Use

- Resource conserving management practices & technologies
- Sustaining institutions & services
- Sustainable agriculture & land use
- Enabling policy & regulatory environment
1.2.2. Sources of information, literature review, workshop process

The methodology adopted in preparing this report was to a large degree determined by the process adopted by the overall SoER project. It involved the following phases.

**Phase 1: Inception and Planning**

The main aim of this phase was to reach agreement between the Consultants and the Project Task Force on a clearly defined basis for undertaking the assignment. This involved the elaboration of an annotated table of contents for the final SoER report as well as the following activities:

- Study of the background to, and requirements of, the State of the Environment Reporting nationally and internationally.
- Review of all previous Namibian SoER reports and databases.
- Elaboration of key concepts and a theoretical framework for the study.
- Preparation by team members of short proposals on the Data Acquisition Phase of the project in relation to the SoER content areas assigned. This involved drawing up a list of stakeholders/key informants in terms of (a) individuals and organisations, (b) key reference literature able to provide information/data including published and unpublished materials, and to inform on recent and on-going initiatives, project and programmes of relevance to the study.

**Phase 2: Data and Information Acquisition**

This phase consisted largely of data and information acquisition, and involved the compilation of a comprehensive set of existing data, including archival and library records. Interviews were conducted with key informants and experts covering the different fields of interest to the analysis of Namibia’s agricultural and land resources environment. A systematic search of the available literature both in Namibia and internationally was conducted. Since much of the required information was found to be not available from institutional sources (i.e. libraries), but was rather in the hands of various individuals, key informants were requested to assist. Key informants were also used as primary sources to update, and if necessary, clarify, the information available from the literature. Indeed, it has been found that much of the information available in the literature is of limited value, particularly regarding the status of natural resources and analysis of change.

This phase of the assignment also included an “Indicators Workshop”, the purpose of which was to discuss the concept of SoER indicators, and undertake a preliminary identification of potential indicators. This in turn informed the on-going data acquisition process and enabled it to focus on more critical issues.

**Phase 3: Analysis and Projections**

In this phase, the team reviewed the data acquired in the preceding phase. Phases 2 and 3 were not strictly sequential. Rather, a process was adopted in which data acquisition lead quickly to review and analysis, which in turn informed direction and focus for further data acquisition all in an iterative fashion. In this phase agricultural and land use issues were prioritised in terms of their relationship to environmental resource consequences, including degradation. Indicators were developed for those issues deemed of major concern.

**Phase 4: Reporting, Workshop and Write-up**

This phase involved preparation of a draft final report for presentation at the workshop, and thereafter finalisation.

_Agriculture & Land Resources SoER Consortium_
1.2.3 Constraints

The strength of the analysis and interpretation of the state of the environment depends to a large degree on the strength of the data on which it is founded. Whilst the Consortium is confident about the data availability related to the "pressure" and "response" components of the "pressure-state-response" model, there is reason for concern about the quality and quantity of data available on natural resource stocks, and on environmental conditions and trends, which comprise the "state" component.

It was found that there is a lack of scientifically objective, resource-specific, quantitative short and particularly long-term data on state of the environment indicators in relation to agriculture and land resources. The question of time in our arid and semi-arid climate is a particular difficulty; to identify trends, and in particular, to be able to determine causal relationship in our environment, needs long-term data series. These are notably lacking. The complexity of such issues partly explains the failure of scientists to research the nature of environmental resources status, and the rates and causes of status change in Namibia.

The Consortium believes, however, that Namibia's data situation is tenable. While it is clear that more data would be beneficial, it is suggested that more efficient collation and use of existing data should also be pursued. We hope that the SoER Agriculture and Lands will facilitate the attainment of this objective.
PART 2. AGRICULTURE AND LAND RESOURCES UTILISATION IN NAMIBIA

This part of the report, covering the "pressure" component of the conceptual framework, starts with a brief outline of Namibia's geo-physical circumstances. This gives an initial indication of the resource base and the opportunities and constraints it poses for land use in the country. Following this is an account of Namibia's agricultural economy, based mainly on macro-economic analysis. This shows the importance of the contribution agriculture currently makes to the national economy and national development objectives. Later sections of the report either draw on these initial descriptions or elaborate on it in specific areas.

To complete the analysis of the pressures put on agricultural and land resources by human society there follows a discussion of key land tenure and land use issues, and a description agricultural production and land resource utilisation industries, and how these have developed over time. Production and utilisation activities are divided into the livestock and crop production, and the forest, wildlife and fisheries production and utilisation sub-sectors.

2.1 Geo-physical Characteristics of Namibia’s Land Resources

Geophysically, Namibia is divided into three distinct regions. The Namib desert from which the country derived its name, the Central highlands and the Kalahari region. Namibia covers an area of 824,269 square kilometres.

Demographic characteristics
The total population is 1.6 million with an annual growth rate 3.2 percent. The life expectancy is 59.1 years for men and 62.8 years for women. Fertility rate is 5.4 for the country but higher in rural areas (6.3) and lower in the urban areas 4.0 (NPC Household Income and Expenditure Survey 1993/94).

Population distribution
Namibia is sparsely populated with a density of 1.7 persons per square kilometre. About 72 % reside in the rural areas and 28 percent in urban. These figures fluctuate as people move in response to employment opportunities and in search of land resources such as grazing and water. Despite having one of the lowest overall population densities in the world (its 1.7 million people live overall at about 2 persons per square kilometre), Namibia suffers increasing pressure on and consequent risks to its land and water resources. Regionally, there are large variations in population density, with heavy concentrations, reaching 100 persons per square kilometre in parts of the northern communal areas NCAs, while the Karas region in the south has 0.4 persons per square kilometre (Namibia Household Income and Expenditure Survey 1993/94). Perhaps a better measure of population density is agro-climatic population density (Binswanger & Pingali, 1988). This considers the number of persons per million kilocalories of production potential estimated, for developing countries, at the intermediate technology level. Using this measure, Namibia as a whole is the only country in sub-Saharan Africa that has already reached a density of more than 250 persons per million kilocalories of production potential. It has been projected that Botswana will not reach this density until the year 2023 and Zimbabwe until the year 2032.
Population structure
The country has a young population. More than 42% of the population is under the age of 15. 53% are aged 15-64 and 5 % are above 65 years. Some regions have fewer young people than others. Khomas, where the capital is situated has 32% and Karas has 15% under 15 years of age but Ohangwena has 50% under 15 years, while Omusati has 48% under 15 years, both of these regions are in the north of the country where rainfall is relatively higher (Namibia Household Income and Expenditure Survey 1993/94).

Ethnicity
Namibia is a multi-ethnic society, made up of different language groups. Oshiwambo speaking people make up 56.6 percent and are concentrated in four northern regions (Oshangwena, Omusati, Oshana Oshikoto). The next language group is the Nama/Damara 12.5%, Kavango 9.7%, Afrikaans 9.5%, Herero 8%, Caprivian 4.7%, Bushmen 1.9%, German 0.9%, English 0.8% and 1% classified as others (Namibia Household Income and Expenditure Survey 1993/94).

Equality issues
The country has one of the most skewed income distributions. The annual per capita income ranges from US$ 65 for the poorest blacks to US$ 14,000 average for whites. About 5% of population control 72% of GDP. Ownership of productive assets such as land is in the hands of few people. More than 85% of the total population has access to only 40% of the total land while 2% of the population owned 44% of the total land (Namibia Household Income and Expenditure Survey 1993/94).

General history
South Africa introduced its policy of separate development following the Commission of Inquiry into South West Africa under the leadership of F. H. Odendaal. This commission recommended that the country be split into a number of separate tribally demarcated homelands. The policy recommendation of separate development is often referred to as the Odendaal Commission and was implemented in Namibia as the Native Reserve Act of 1953.

Owing to the implementation of the Odendaal commission's recommendation as mentioned above, land in Namibia is divided into three tenure systems which describe their use, namely:
- Commercial land is under private property regime or freehold tenure
- Communal land is under common property regime
- State land is under public property regime

These forms of tenure existed before independence and are still in place.

The commercial land consists of 36.2 million hectare (44%) of the total land and is held under freehold tenure. It consists of 10,919 farm units, as registered at the office of the Surveyor General belonging to about 4,200 farmers. The commercial farmland occupies between 54% and 74% of agricultural land in Namibia.

Ethnic homelands, which are the present day communal lands comprise 33.5 million hectare (40%) of the total land, and is used communally by about 1,000,000 people (70% of the population). Communal lands in theory belong to the state and are used communally by different tribes around the country. The role of the state in this respect is that of custodian (Brown, 1993). Communal farmers produce mainly for subsistence purposes though this is changing with communal farmers introducing new breeds of cattle to produce marketing.

The right of use is by virtue by residence in the communal area or some accommodation with traditional authorities practising jurisdiction over the land.

State land comprises of 15% of the total land and is held in the possession of the state. It is mainly used in ways such as diamond exploration, national parks and wildlife conservation.

Climate
Namibia is the most arid country south of the Sahara. There are three desert system occurring; the Namib in the west, the Karoo in the south and the Kalahari in the east. The average rainfall is low, and ranges from 100 mm per year in the south-west to 700 mm per year in Caprivi.
The following rainfall regimes are found in Namibia:
- 15% of the country (coastal strip) is arid desert receiving on average 50mm of rain per annum.
- 40% of the country is arid savannah receiving on average between 100mm and 300mm of rain per annum.
- 37% of country is semi-arid receiving on average between 300mm and 500mm.
- Only about 8% of the country (the Caprivi Region) receives more than 500 mm (Ministry of Agriculture, 1995).

Please refer to the rainfall map overleaf. In addition, it is important to recognise that high evapotranspiration rates, with most rain falling when temperatures are high, mean that most of the country are moisture deficit areas. This puts serious limitations on biomass production and rainfed cropping. This situation is exacerbated by periodic droughts.

The are no inland perennial rivers. The only perennial rivers are only those that form natural borders with its neighbours. The Kunene, Kavango, Zambezi and Kwando-Chobe in the north and the Orange in the south.

**Rainfall**

Rainfall in Namibia is sparse and variable. It is not unusual for deviation from the mean to exceed 30% and it is also common for a season to record half or double the mean precipitation. Droughts are common and below average rainfall often occur for period longer than 2 years.

**Fog**

As a result of the cold Benguela current the sea surface coastal belt temperatures are lower than those offshore, where higher evaporation occurs. When the relatively warmer moisture comes in contact with cooler air above the coastline, condensation occurs and fog is formed. Precipitation from fog is highest on elevated land 20-40km from the coast. Fog suppresses evaporation and plays an important role on the ecological functioning of the Namib Desert (DRFN 1999).

**Temperature**

The highest temperatures occur in Caprivi and in Orange river basin. On average, the maximum temperature across the country varies from 31°C to 40°C and can reach as high as 48°C at some localities. On average the coldest months minimum temperature across the country vary from 2°C to 10°C but may reach as low as −10°C at some inland locality localities (DRFN, 1999).
Mean Annual Rainfall

Mean Annual Rainfall (mm)

<table>
<thead>
<tr>
<th>Range</th>
<th>Color</th>
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</thead>
<tbody>
<tr>
<td>0 - 50</td>
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<tr>
<td>50 - 100</td>
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<td>600 - 650</td>
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</tr>
<tr>
<td>650 - 700</td>
<td></td>
</tr>
<tr>
<td>&gt; 700</td>
<td></td>
</tr>
</tbody>
</table>

Source: Ministry of Agriculture, Water & Rural Development
Department of Water Affairs

Agriculture & Land Resources SoER Consortium
Water resources
Namibia is dependent on three major types of water sources:

- Ground water, which supplies about 57% of country's needs
- Perennial rivers, which supply about 25% of country's needs used by villages and towns close to the rivers.
- Large surface water reservoirs which store seasonal flood water and account for 20% of total water needs

It is estimated that of the rain that falls in Namibia 83% evaporates, 2% is run-off 14% is used by vegetation and only about 1% is available for groundwater recharge (DFRN1999).

Vegetation
Namibia's steep north-east-to-west climatic gradient, plus its varied soil types and landform, largely determine the distribution of its vegetation characteristic and the vegetation zones. Annual rainfall determines the three main vegetation zones of Namibia: desert, savannah, and woodland. Temperature and seasonality of rainfall, plus topography and soil, influence the 14 major subdivisions of these vegetation zones.

- Desert vegetation zone
The desert or the Namib can be subdivided into true Namib [Northern, Central and Southern Namib] and Succulent Steppe vegetation zones. The Succulent Steppe lies within and is determined by Namibia's winter rainfall area. Succulent shrubs, mainly in the family Mesembryanthemaceae, typify this vegetation zone. Perennial grasses such as Stipagrostis sabulicola characterise the Namib mobile dunes, while annual herbs and grasses including other Stipagrostis species occur on gravel plains.

The desert fringe, which including inselbergs and the Namib Escarpment, forms a transition zone between desert savannah, termed the Semi-desert/Savannah Transition Zone. The mountainous Kaokoveld, in the north-west escarpment zone, is classified as Mopane Savannah by Giess.

- Savannah vegetation zone
Most of Namibia is covered by Savannah, especially thorny shrub and Highland Savannahs which dominate the central highlands, while Dwarf Shrub Savannah covers the Southern Inland Plateau. Camelthorn (Acacia erioloba) and Mixed Tree and Shrub Savannahs are largely confined to the Kalahari sandveld, and Mopane Savannah dominates the northwest of Namibia, east of the escarpment.

- Woodland vegetation zone
Two types of woodland are distinguished in Namibia. Forest Savannah and Woodlands cover the moist northeastern region, with tropical trees such as Baikiaea plurijuga, Burkea africana, Lonchocarpus cepassa and Terminalia sericea. Riverine Woodlands are azonal and associated with the continuous moisture supply along river drainage lines. Virtually all rivers are lined with woodlands. Permanent rivers harbour lush, diverse vegetation; the ephemeral riverbeds support trees and shrubs such as Faidherbia albida, Salvadora persica and Ziziphus mucronata.

Please refer to vegetation map overleaf.
Vegetation Types (Giess 1970)

Vegetation
1. Northern Namib
2. Central Namib
3. Southern Namib
4. Desert and succulent steppe
5. Saline desert with dwarf shrub savanna fringe
6. Semi-desert and savanna transition
7. Mopane savanna


Agriculture & Land Resources SoER Consortium
Agro-Ecological Zones
An Agro-Ecological Zones map for Namibia has been produced dividing the country into 69 agro-ecological zones (see chapter 3.1.1.2 for a detailed description of this project). The same project has produced a growing period zones map indicating 11 growing periods of Namibia. The growing period zones follow the rainfall distribution pattern. It is clear that areas of low rainfall like most places in Namibia have short or no growing periods and those of high rainfall have long growing periods. The production of the Agro-Ecological Zones is a step in the right direction because it will act as a guide for land use planning activities and in formulation of land management practices. Awareness of the Agro-Ecological Zones should place land use planners in a better position to decide which land area is suitable for what land use and zone it for that specified usage.
2.2 The agriculture and renewable natural resources sector and its contribution to the Namibian economy

2.2.1 Introduction

This chapter looks at the contribution to Namibia's economy and society of the country's agriculture and renewable natural resources sector, through considering its relationship to national development objectives and a number of macro-economic and socio-economic indicators. A careful reading of this section should throw light on the questions: to what extent are the agriculture and the renewable natural land resources sectors a potential route to economic growth and employment and a route out of poverty, and hence to what extent should society allocate resources to the development of which sectoral activities? Answers to these questions at the level of policy makers and land users will in large part determine the pressure put by agriculture and related activities on the natural environment.

Agriculture has been and still is a key income provider for the majority of Namibians. However, in terms of output and contribution to national economic growth the performance of the agricultural sector is not so significant. The agricultural sector is for the purpose of analysis in this report defined as both commercial and communal agriculture as well as meat processing as an agro-industry. In 1998, the agricultural sector contributed a mere 9% to the Gross Domestic Product (GDP). This stands in no relation to the number of households and individuals dependent on agriculture as a source of income. In regions with high population densities, it is common that 60% of the employed labour force is employed in primary sector activities, including agriculture. A core feature of the agricultural sector in Namibia is the skewed relationship between agricultural output and the number of people relying on agriculture for their livelihood.

An analysis of the macro-economic data inevitably obscures the differences in importance of the agricultural sector at individual household level. Acknowledging this limitation, the macro-economic analysis offers an additional perspective in support of the decision-making process on the allocation of resources at sectoral and household level.

Of importance in the evaluation of the information provided in this section, is the variance in data quality and availability. While macro-economic data is often perceived as "hard and reliable", the data at household level often lacks statistical reliability and due to its high collection costs is not updated as often as macro-economic data. These data features tend to dominate the analysis with more emphasis on the macro-economic rather than the household level impact of the sector. This tendency is difficult to circumvent, leaving only a second-best solution of placing a cautionary note.

In this section the following relations are reviewed:
- contribution of the agriculture to the Gross Domestic Product, overall economic growth, total export earnings;
- key product groups for imports, the reliance on imports of staple foods and the potential for import substitution in the agricultural sector;
- the importance of agriculture at household level in terms of employment, nutrition, poverty and income equalities.

2.2.2 Agricultural Sector Output in National Perspective

i) Contribution to GDP

In 1998, the agricultural sector (see definition above) contributed a mere 9% to the Gross Domestic Product (GDP). This comprises of 5% for commercial agriculture, 3% for subsistence agriculture and 1% for meat processing. The total GDP (at market prices) for 1998 is valued at 16.8 billion. This includes import duties and other taxes on products. All industries at basic prices were valued at N$14.8 billion. This is the figure used in the GDP composition analysis below.

Refer to Figure 2.3 overleaf.
FIGURE 2.3

GDP COMPOSITION, 1998
National Accounts (CBS)

- Commercial Agriculture
- Fishery Products
- Other Manufacturing
- Subsistence Agriculture
- Mining & Quarrying
- Meat Processing
- Fish Processing
- Electricity, Water & Construction
- Services
FIGURE 2.4

GDP COMPOSITION, 1998
National Accounts (CBS)

- 54%
- 20%
- 17%
- 5%
- 3%
- 1%

- Commercial Agriculture
- Subsistence Agriculture
- Meat Processing
- Other Primary Production
- Other Secondary Production
- Tertiary Sector
Compared to other sectors the agricultural GDP is small. The manufacturing sector which is regarded as underdeveloped in Namibia, contributed in 1998, 16.3% to the GDP (this includes meat processing). The services sector contributed the most (54.4%). This includes Government services (26.9%), tourism (2.5%), transport (4.1%), trade (7.4%) and financial services (10%).

Refer to Figure 2.4.

Even compared to the other activities in the primary sector, namely fisheries (4.2%) and mining/quarrying (12.6%), the agricultural sector's contribution is relatively limited.

Refer to Figure 2.5 overleaf.

In terms of value added production in agriculture – i.e. the down-stream processing of agricultural products – the same can be observed. Meat processing contributes only 1% to total GDP as compared to 5.8% from fish processing. Much of the output of the livestock/small stock sub-sectors leave the country alive or in a semi-processed state (e.g. fresh, chilled or frozen) without any value addition.

Refer to Figure 2.6 overleaf.

Over the 5 year period 1994-98, the total contribution of the agricultural sector to GDP has decreased from 10.7% in 1994 to 8.9%. A slight, though distinct downward trend can be observed for the period under review, partly due to drought episodes.

Economic Growth

Refer to Figure 2.7 overleaf.

Taking growth in the agricultural sector in perspective, no direct relationship between the performance of the agricultural sector and the performance of the national economy can be established. During the five-year period 1994-98 the agricultural sector has experienced a highly erratic growth pattern, mainly due to adverse climatic conditions and the de- and restocking of livestock during and after periods of drought. While growth of the national economy was positive during the period under review, the growth in the agricultural sector varied from a high 23.3% to a low and negative 11.1%.

Refer to Figure 2.8 overleaf.

The different activities in the agricultural sector contribute to growth in varying degrees. The most fluctuating in terms of its contribution is communal agriculture, experiencing growth rates between a high 95.5% in 1994 to a low and negative -20.8% in 1998. The commercial agriculture's growth rate fluctuated between -16.3% and 15.8%. Growth in meat manufacturing was relatively stable at around 2.6% with a low rate of 1.3% in 1998 only.

At present, the agricultural sector is no driving force for economic growth in Namibia.

2.2.3 Trade in Agricultural Products

i) Exports

Refer to Figure 2.9 overleaf.

The trade statistics published by the Bank of Namibia do not allow for a detailed analysis of agricultural exports as meat and fish exports are combined. "Food and live animals" contributed in 1997 some 27% to total export earnings. This is a substantial share compared to the other key export earners: manufacturing (11%), diamonds (41%) and other mineral products (20%). Total exports amounted to N$6.3 billion in 1997.
FIGURE 2.6

Contribution of Agriculture to GDP
1994-98 National Accounts (CBS)

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<tbody>
<tr>
<td>Meat Processing</td>
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<td>0.7</td>
<td>0.9</td>
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<td>3.2</td>
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<td>2.5</td>
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<tr>
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<td>5.5</td>
<td>4.3</td>
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</tbody>
</table>
FIGURE 2.7

Growth in Agriculture in Perspective
1994-98 National Accounts (CBS)

<table>
<thead>
<tr>
<th>Year</th>
<th>Overall GDP</th>
<th>Agriculture</th>
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<tbody>
<tr>
<td>1994</td>
<td>6.3</td>
<td>23.3</td>
</tr>
<tr>
<td>1995</td>
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<td>1996</td>
<td>2.1</td>
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<tr>
<td>1997</td>
<td>2.6</td>
<td>-11.1</td>
</tr>
<tr>
<td>1998</td>
<td>2.4</td>
<td>-6.1</td>
</tr>
</tbody>
</table>
**Composition of Growth in Agriculture**

**1994-98 National Accounts (CBS)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Agriculture</th>
<th>Agriculture: Commercial</th>
<th>Agriculture: Communal</th>
<th>Manufacturing: Meat</th>
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<tr>
<td>1994</td>
<td>23.3</td>
<td>1</td>
<td>95.5</td>
<td>2.8</td>
</tr>
<tr>
<td>1995</td>
<td>-1.8</td>
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<td>1996</td>
<td>9.9</td>
<td>15.8</td>
<td>1.7</td>
<td>2.6</td>
</tr>
<tr>
<td>1997</td>
<td>-11.1</td>
<td>-16.3</td>
<td>-2.7</td>
<td>2.5</td>
</tr>
<tr>
<td>1998</td>
<td>-6.1</td>
<td>4.8</td>
<td>-20.8</td>
<td>1.3</td>
</tr>
</tbody>
</table>
About 17% of Namibian beef is exported to the European Union under the Lome IV preferential trade access conditions, while most meat and a considerable number of cattle and small stock is exported to South Africa. Fresh, chilled, frozen and processed meat as well as live animals are important export products for Namibia. These exports present a good opportunity for expanded value added production. While the export of live animals is support by rationale considerations in that the rearing of the heifers in Namibia would put unsustainable pressure on the available grazing land, the export of unprocessed meat may be more difficult to justify. Possibilities for further downstream processing need to be explored and introduced where economically viable.

The available statistical data is not sufficiently disaggregated to reveal the contribution of the "new high-value agricultural exports" to total export earnings. These include table grapes and melons and a number of other high value fruits, vegetables and meat products such as dates, betacarotene, various nuts and their oil, asparagus, ostrich meat and products and devil's claw. While these products are as yet of no importance for total export earnings, they may present a viable alternative to traditional agricultural production. In the discussion on the role of agriculture in the Namibian economy, the advantages of high value, cash crop and animal production need to be highlighted.

More economic use of Namibia's most limited natural resource – water;
It is a continuation of a natural resource based activity, close to farmers' hearts, knowledge and experience;
The value added per ha of arable land is higher than for traditional farming activity;
Using appropriate marketing channels it will generate more cash income;
This type of agronomic and animal production is generally highly labour intensive compared to traditional farming activities;
The production targets niche markets either (1) in terms of the exclusivity of the product or (2) because of a seasonal competitive advantage whereby the Namibian harvest is either a little earlier or later than when major international competitors enter the overseas market (mainly Europe) or (3) both. This makes this sub-sector less vulnerable to adverse market developments;
Namibia is naturally endowed with a number of plant and tree species which prove to be of high value in the pharmaceutical and beauty products industry (e.g. devil's claw, jojoba, aloe, marula nuts, etc.) which if properly managed could provide an alternative or supplementary source of income for rural people. Competitive advantages in terms of natural climate and soil conditions should lead the choice of agricultural production;
The exploitation of the 'new, high value cash crops and animals' will promote regional economic development, leaving people in their natural habitat though occupied with an alternative to traditional farming.

Source: Urban Dynamics/TRENDLINE, 1999

Diversification into high value cash crops and meat products could provide a good alternative to traditional agriculture.

ii) Imports

Refer to Figure 2.10 overleaf.

In 1998, agricultural imports constituted some 20% of total imports. Total imports amounted to some N$10.8 billion.

---

1 Interesting to note is the establishment of a Cotton Task Team in MAWRD to promote cotton production. During the 1997/98 marketing year, 6,000 tons of cotton were produced. Cotton has been identified as a crop with promising potential for its resistance to drought. (NEPRU 1999) A model business venture in this emerging sector is a local company that uses melon and other seeds collected by a group of individual women in Northern Namibia to press oil of high, export quality. Demand for the oil has already been established in the UK. (Urban Dynamics/TRENDLINE 1999)
Key product groups for import are:
- processed meat (4.9% of total imports)
- dairy products (4.1%)
- grains (1.7%)
- vegetables (1.6%)
- sugar & sugar products (1.6%)
- animal fodder (1.1%)

While import substitution for some of these products could be pursued in developing a more diversified, less vulnerable agricultural sector this is definitely not possible for all products.

- The imported processed meat consists for 50% of sausages, mainly made out of pork. Namibia has no pig industry of significance. The production of pork in Namibia has decreased steadily due to the high costs of transport of feed.

- The Namibian dairy industry has already taken note of the opportunities for expansion. Various new products have been launched over the past few years and plans for the establishment of a UHT milk factory are in an advanced stage.

- Import substitution for grains (wheat, maize, rice) is not a sustainable growth strategy for the sector given the current high reliance on import of white (and yellow) maize and the vulnerability to drought of grain production. Moreover, they are low value crops. Instead of expansion of wheat and maize production, Namibian farmers should rather consider the downsizing of staple food production combined with the exploitation of high value cash crops. This would be in line with the national policy of food security (as opposed to food self-sufficiency). This policy promotes the generation of adequate funds through increased exports in order to finance the import of food stuffs from the cheapest source, at world market competitive prices.

The reliance on staple food imports has increased from 50% in 1991 and 1994 to 70% in 1997. Namibia only produced 30% of its total maize requirements in 1997. The country appears in no position to pursue import substitution for maize.

Refer to Figure 2.11 overleaf.

- Vegetables can be produced in many parts of the country. Obstacles to growth in this sector appear to be (1) a lack of qualified personnel to ensure quality control and (2) access to proper marketing channels. While some local producers have managed to penetrate the market and secured supply contracts with a supermarket chain, the large players in the retail market continue to rely on South African suppliers for their vegetable deliveries. There is definite opportunity for diversification into vegetables in selected areas of the country.

- For sugar and sugar products there may at present be little prospect in terms of import substitution, unless earlier plans for sugar plantations along the Okavango river are revived.

- The production of animal fodder of various residues should be explored. A more integrated approach to production is to be encouraged exploiting the various side- and by-products to the maximum, provided this is done in a cost effective, and price competitive manner without instituting protective measures.

There may be opportunities in the substitution of a number of other products reflected in Figure [8] but these will need to be explored on a case by case basis.
FIGURE 2.11

IMPORT RELIANCE FOR STAPLE FOODS, 1991-97
Agricultural Statistics Bulletin (MAWRD)

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%


■ White/Yellow Maize Imports
□ White/Yellow Maize Production
2.2.4 Importance of Agriculture at Household Level

i) Agriculture – Employment

In most rural areas the percentage of the economically active population employed in agriculture, be it in wage employment or self-employed, is 60% or more. This is an important statistic for the development of the sector. The majority of working people in the rural areas is dependent on agricultural production for their livelihood. In the urban centres the employment opportunities in the services sector and manufacturing offer an alternative and so the mining areas.

The extent to which the Namibian people who live in this arid country with variable rainfall are dependent on agriculture presents both an anomaly and a challenge for the development strategy for the sector.

While Namibia may not have a comparative, competitive advantage in agricultural production per se, the fact that the majority of its people in one way or another depend on agriculture for their livelihood will strongly influence agricultural policy and interventions in the sector for many years to come. However, it also challenges the conventional approach to agricultural production of seeking higher production levels of traditional products (maize, wheat, livestock and small stock). A more innovative development strategy will be required if Namibia is to manage its natural resources in a sustainable manner over the years to come. A phased introduction of new, higher value crops and animals that allows adequate adjustment time for the farmers should be promoted. Such strategy should go hand in hand with (1) increased production in industry, be that based on natural resource inputs or not, (2) increased involvement of local communities in tourism development, (3) increased service delivery by economic actors in the rural communities and (4) a diversification of skills. The promotion of SME businesses would be in support of all these. Only a multi-faceted development strategy will effect the desired change in reliance on agriculture as a source of income for too many people in Namibia.

**Multi-faceted Development Strategy for Economic Development**
- phased introduction of high value cash crops and animals
- increased local value added production
- SME development
- increased involvement of local communities in services sector (including the tourism sector)
- skills development

ii) Agriculture – Household Food Security

Subsistence farming contributes over 51% of household income in the rural areas of Namibia as compared to 27% from wages, 5% from business income, 14% from pensions and 3% from cash remittances (UNDP 1999, TB2.7).

The percentage of malnourished children in a community could be used as an indicator for household food security. One would expect access to subsistence farming to positively contribute to household food security. The data however does not confirm such a direct relationship. In fact most of the predominantly rural regions have a high percentage of malnourished children in their communities. The high level of malnutrition in the Khomas region may be explained by the large influx of migrants to the peri-urban squatter settlements. There is no immediate explanation for the high level of malnutrition in the Hardap region. For the Hardap region this is the only component of the Human Poverty Index that is far above the national average.
Table 2.1: Nutrition and Agriculture

<table>
<thead>
<tr>
<th>Region</th>
<th>% of Malnourished Children (1997)</th>
<th>% of Economically Active Persons employed in agriculture, hunting, forestry and fishing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohangwena</td>
<td>19</td>
<td>73</td>
</tr>
<tr>
<td>Omusati</td>
<td>15</td>
<td>74</td>
</tr>
<tr>
<td>Oshikoto</td>
<td>14</td>
<td>61</td>
</tr>
<tr>
<td>Oshana</td>
<td>19</td>
<td>41</td>
</tr>
<tr>
<td>Okavango</td>
<td>19</td>
<td>74</td>
</tr>
<tr>
<td>Caprivi</td>
<td>11</td>
<td>70</td>
</tr>
<tr>
<td>Kunene</td>
<td>4</td>
<td>65</td>
</tr>
<tr>
<td>Ongwedja</td>
<td>6</td>
<td>37</td>
</tr>
<tr>
<td>Khomas</td>
<td>22</td>
<td>63</td>
</tr>
<tr>
<td>Eronko</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Omaheke</td>
<td>9</td>
<td>58</td>
</tr>
<tr>
<td>Hardap</td>
<td>24</td>
<td>36</td>
</tr>
<tr>
<td>Karas</td>
<td>17</td>
<td>24</td>
</tr>
</tbody>
</table>

Source: UNDP 1999, TB2.4

Another indicator confirming the absence of a strong, immediate relationship between access to subsistence farming and food security have been the recent experiences of the Drought Relief Programme. Food shortages and a scarcity of pasture for livestock and wildlife hit all regions and at least 625,000 persons during the 1992/93 drought. The most critically affected regions were Caprivi, Okavango, Kunene, Hardap and Omusati, Ohangwena, Oshikoto and Oshana. During the 1992/93 drought some 250,000 people received food under the Drought Relief Programme. Again in 1996/97 180,000 people received drought food relief while in 1998 a group of 170,000 people was targeted.
(Urban Dynamics/TRENDLINE, 1999)

iii) Agriculture – Poverty and Income Inequalities

There are many ways to measure poverty as there are many different factors at play causing poverty. Poor people are unable to meet their basic consumption needs, suffer poor health, lack basic education, skills and literacy and are voiceless and powerless in society. The low level of economic growth and employment has been singled out as the main cause for poverty in Namibia. Given limits to agricultural production in Namibia, economic growth and employment in the non-agricultural sectors is required to provide incomes and reduce poverty. (NEPRU, 1999(2)) Improved access to land and increased agricultural production are only one dimension of the response strategy to poverty in Namibia.

Poverty and income inequality in Namibia are closely intertwined. The richest 1% of households earn more than the entire poorest 50% of households, while the richest 10% of households receive 65% of total income. (NEPRU, 1999(2)) The Gini coefficient – a widely accepted measure of income equality with a value of 0 for complete equality and higher values marking increasing inequality – was measured at 0.7 for Namibia in 1996. This indicates extreme inequality. Inequality in turn is closely linked to the inequality in access to land. 150,000 communal farmer households occupy 42% of the land whereas 4,200 commercial farmers own 43% of the land. (NEPRU, 1999(2))

Real economic growth – i.e. the growth of the GDP adjusted for the population growth – has averaged at only 0.5% per person per year during the period 1990-98. Formal and informal employment is low with an unemployment rate estimated at 25-35% of the labour force. The combined rate of unemployment and under-employment is as high as over 60%. (NEPRU, 1999(2)) Growth in the agricultural sector is not going to alleviate poverty at the required level of impact, especially with the current low levels of production. With the majority of Namibians involved in agriculture in one way or another delivering a mere 9% of total economic output, a serious constraint for agricultural development become apparent. While dedicated efforts need to be directed at improved access to extension services for subsistence farmers, improved access to land, improved access to agricultural inputs and improved access to credit, the capacity of the agricultural sector to
significantly reduce poverty and inequality is limited. Alternative, innovative routes for economic development have to be explored and exploited with determination.

2.2.5 Conclusion

In the above sections an attempt has been made to address the two key questions set out in section 2.2.1:
- to what extent are the agriculture and the renewable natural land resources sectors a potential route to economic growth and employment;
- idem, a potential route out of poverty.

While the importance of agriculture as a key source of income to the majority of Namibian cannot be underplayed, the agricultural sector is not going to lift Namibia to another level of development and reduced poverty and inequality. Supply side measures for the communal (and commercial) agricultural sectors are a necessity and should be implemented with dedication. However, the limits of agriculture sector led growth are clear, and are primarily the result of environmental constraints. A development strategy towards a higher economic growth path benefiting all Namibians should not promote increased production from traditional enterprises where this requires putting increased pressure on the natural environment. Rather, it is suggested that a sustainable development strategy should focus on increased production in non-traditional agriculture and non-agricultural activities. The key pillars of the recommended development strategy are:

- phased introduction of high value cash crops and animals
- increased local value added production
- SME development
- increased involvement of local communities in services sector (including the tourism sector)
- skills development.
2.3 Land Tenure

2.3.1 Overview and history of land tenure

The state of the environment is not a new concern to politicians and administrators. Official discourse on environmental change in Namibia seems to have started in the 1930s. In their own way, colonial officials had devised 'indicators' for environmental change, based on a plant succession model. In addition, they saw a direct link between land degradation and land tenure, more specifically 'communal' tenure.

As early as the 1930s and 1940s, that is barely fifteen years after 'native reserves' had been set aside for some indigenous communities, reserve superintendents began to sound warnings about an impending ecological disaster. The view began to spread among colonial officials that large areas in the reserves set aside for pastoralists, were 'rapidly becoming a desert'. These concerns about the seriousness of land degradation were based on observable changes in range eco-systems. In Ovitoto, for example, a Senior Agricultural Officer observed that 'dubbeltjies' germinated there and went on to argue that

while this type of vegetation does supply grazing of sorts...it is nature's last ditch stand as regards vegetation. Immediately above the 'dubbeltjies', as far as natural plant succession is concerned, come the *aridias* (steekgras) and, as what other grazing remains consists of 90% 'steek' grass, it is fairly obvious that the resource generally is on the verge of disaster as regards grazing.

In his opinion, disaster had already struck in north-eastern portion of the reserve, which he described as being beyond redemption, serving no further purpose for grazing.

Invariably, overgrazing as a result of overstocking was identified as the main cause for such land degradation. In 1949 the Assistant Chief Native Commissioner was of the opinion that

the bad effects of this overstocking could be seen all around where they were sitting. The area was rapidly becoming a desert. This must be stopped at all costs, not only in their own interests but in the interests of their descendants.

Responsibility for overstocking was ascribed entirely to reserve farmers, who 'have not disposed of surplus stock'. Part of the solution to improve land use, therefore, was to urge reserve farmers to reduce livestock numbers. Reserve superintendents were urged to convey to stock owners in the reserves that they should dispose of their stock and that there was no point in accumulating more. Should they not succeed to keep stock numbers to reasonable levels, the Administration would compel them to do so.

While officials refrained from blaming 'communal' land tenure directly for the observed degradation of communal land, the solutions they proposed to solve this problem suggest very strongly that land tenure was being regarded as the fundamental problem. Apart from inducing farmers to dispose of livestock, colonial officials saw the long term solution to this problem in land tenure reform. They felt that reserve farmers had 'to change their farming methods'. As land was limited, 'they had to produce more on it'. The changes contemplated involved the introduction of fenced camps in order to facilitate rotational grazing.

The identification of 'communal' land tenure as the main cause of land degradation and the assumption that communal land enclosures were the solution to this problem continued to enjoy widespread support.

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2 SWAA A 50/473 Vol.1 Extract from Minutes of Meeting held at Ojiluto Native Reserve by the Assistant Chief Native Commissioner on 14 October 1949. He was referring to 'all the Herero reserves such as Waterberg, Epuleho, Otjohorongo (now part of Kunene region, WW) and Ojiluto'.
3 A 158/149 Vol.1 Senior Agricultural Officer (Natives) to Director of Agriculture Windhoek, 14.1.1949 p.4
4 SWAA A 50/31 Vol.1 Conference of Welfare Officers held at Windhoek on 25th October 1943, p.2
5 SWAA A 50/473 Vol.1 Extract from Minutes of a Meeting held at Ojiluto Native Reserve by the Assistant Native Commissioner on the 14th October 1949
6 SWAA A 158/73 Vol.1 Chief Native Commissioner to Magistrate Gobabis, 6.1.1950
7 SWAA A 50/31 Vol.1 Conference of Welfare Officers held at Windhoek on 25 October 1943, p.2
8 SWAA A 50/223/1 Notes of a Meeting held...at Okakarara in the Waterberg East Native Reserve on 26 and 27 May 1947, p.10
9 SWAA A 50/31/7/1st Kloek Hoef Natuurlike Kommissaris Kantoor, Windhoek: Rets Rapport Nr.26(i): Algemene Rapport oor Waterberg Oos Natuuremrreservaat, 14.6.1948, p.1

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In the mid-1960s, for example, the Five Year Development Plan (South West Africa, n.d.[1966])\(^1\) which followed the Odendaal Commission, considered 'proper pasture rotation as a prerequisite for optimal utilisation of available resources' in the reserves. This, the Plan proposed, could ultimately only be attained by the introduction of a large scale fencing programme. With the erection of fences, grazing camps can be given the necessary rest periods during certain times of the year and thus offer more abundant and better grazing to animals.\(^1\)

In the late 1970s and the 1980s official fencing schemes similar to the Tribal Grazing Land Programme (TGLP) in Botswana were implemented in Okamatapati, the south eastern portion of former Ovamboland and, just before independence, in the Kavango Mangetti. The perception that 'communal' land tenure was the direct cause of land degradation and that fencing the only conceivable solution attained a veneer of scientific respectability, when the then Minister of Agriculture and Nature Conservation expounded on these views at the 24th Congress of the Grassland Society of Southern Africa in Windhoek 1989. According to him the main problems with communal land tenure were that:

- the system does not make provision for any form of initiative;
- no provision is made for private ownership;
- optimal utilisation and conservation of the land is impossible. (Diergaardt, 1989)

Concerns about environmental change were also voiced with regard to freehold land. In 1949, for example, the Long Term Agricultural Policy Commission observed that a position has been reached with regard to the conservation of the natural resources of the country within two generations of civilised occupation which calls for positive action on the part of the State and citizen alike, if the future of farming and thereby the political economy of the Territory are to be assured. (South West Africa, 1949: 38)

The primary cause of such degradation was once again ascribed to the observation 'that many farmers keep more stock than the carrying capacity of their land' (South West Africa, 1949: 23). The Commission identified erosion as a big problem and attributed its causes to interference with the vegetative cover through grazing, burning and the cutting of bushes and trees (Ibid.: 39).

After careful assessment, the Commission rejected the possibility of setting aside reserve grazing to relieve grazing pressure on commercial farms. It argued that such an option 'will only encourage the selfish farmers to continue overstocking their farms' (Ibid.: 23). Instead, it expressed the opinion that the adoption of proper grazing management was essential to conserve soil and pasture and that grazing camps were essential to achieve this. The Commission recognised that the development of camps and thus improved farming methods depended on a large scale fencing programme. While it found the subsidisation of fencing materials impractical, it nonetheless recommended that the provision of reasonably priced materials be considered. 'The importance thereof to the national interest may at any time warrant the establishment of a State supply service' (Ibid.: 49).

In conclusion, what this brief historical discussion reveals very clearly is a consensus amongst colonial officials that private ownership of fenced and padocked units of land are a precondition for improved farming methods. While the farming sector commonly - but misleadingly - referred to as the commercial farming sector operated under freehold title from its inception, the debate as to whether to subdivide and fence communal land or not continues unabated.

2.3.2 The debate about tenure security

At the heart of the debate on land tenure and specifically 'communal land' tenure, agricultural productivity and environmental sustainability is the issue of tenure security. The principle that sustainable resources and land management depend to a large extent on the land tenure regime prevailing in a particular area is accepted by now. It may be useful at the outset, to define what is understood by 'tenure'. Tenure in its broadest meaning refers to

\(^1\) It should be mentioned here that this five year plan is probably the only official attempt before independence to define agro-ecological regions in Namibia and estimate the carrying capacity of different regions. Apart from Adams and Wamer (1990) it has never been used in any academic or applied research.

\(^{11}\) Ibid, para 550

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the manner in which access to resources may be obtained and the conditions under which they may be used; as well as the nature and extent of public interest over those resources (Okoth-Ogendo, 1996: 88).

The concept of tenure is most often used in relation to 'land tenure', suggesting a simple and relatively straightforward notion of rights, in the sense that once access rights to land have been obtained, rights to all the products and resources on that land follow automatically. In reality, this hardly ever occurs in 'communal' land tenure systems. Instead, many different rights are normally associated with a single piece of land. More specifically, tenure regimes normally prescribe access to 'essential and life-sustaining products such as fodder, wood, water, and wild game' (Ibid.: 96). Not all tenure issues, therefore, concern land, but rather access to products of the land.

The multitude of rights associated with a single piece of land is commonly referred to as a bundle of rights (Riddell, 1986: 2; Bruce, 1986: 5). Under communal tenure systems, bundles of rights are divided between individuals and the wider group, neither of whom are holding the full range of rights.

It is important to recognise that all the rights that make up a bundle are the result of social relations amongst people and are an expression of the expected behaviour of others in response to decisions an individual or household takes regarding a particular piece of land. Cultural and social factors are thus important determinants of tenure systems, in that such systems 'represent the network and obligations which individual members of a community owe to each other and the quality and quantity of rights they may individually or collectively appropriate' (Okoth-Ogendo, 1996: 88).

One fundamental dimension of any right in a bundle, thus, is people and their relationships to each other. A second important dimension is time. This dimension is particularly important in natural resources enhancement programmes, as positive results of particular interventions such as afforestation, for example, often take a longer time to materialise than it takes most agricultural crops to be harvested. All tenure systems have mechanisms for the transfer of tenure rights and usually also determine how long particular rights last. Rights of a relatively short duration are not likely to encourage individuals or households to make any long-term investments, as their chances of reaping the benefits are slender.

Finally, space is an important dimension of any right. Rights normally define the spatial dimension of use. While this may seem straightforward, the situation is often quite complicated, in that the same space can be used by different people for different purposes at different times. An example of this is crop land in the northern regions of the country. Before harvesting, the crop land is the private land of a household. Once the harvest has been completed, the whole community has access to the plot to graze their animals on the stover that is left behind.

Characteristically, rights to land and resources are structured hierarchically from the individual producer to ward level to tribal level. Rights to land and land-based natural resources may thus be subject to the customary rights of a traditional authority, a lineage or family group and the rights of incoming populations, which may be utilising land as a result of alliances and contractual obligations to their hosts. Temporary access to land may also be negotiated by groups, e.g. to graze the stubble after harvesting (Quedraogo and Toumoulin, 1999: 2). The degree of homogeneity in specific regions will determine the degree to which tenure systems are integrated into the social organisation. In settings with a high degree of homogeneity in terms of culture, language and ecology, tenure regimes tend to be more closely integrated than in heterogeneous areas (Okoth-Ogendo, 1996: 96).

The division of rights between individuals and the wider community has led many observers to conclude that communal tenure situations are characterised by an absence of ownership. Lane and Moorehead (1995: 117) point to the important distinction between 'property' and 'non-property'. This clarification is important in view of the continued confusion between 'open access' and 'controlled access' resources. 'Open access' regimes, they remind us, are not subject to any tenure rules and are therefore not owned by anyone. Under 'controlled access', resources are generally managed by some institution or other like the state (protected areas, reserves); communities (communal property) or individuals (private property).

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12 Unless stated otherwise, the following is based on Riddell, 1986 and Bruce, 1986.

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It is widely believed by economists and environmentalists that land and natural resources will only be conserved when land is held under private ownership and when the security of tenure is protected by the State (Maxwell and Wiebe, 1998: 18). Common property regimes have hitherto been condemned as impacting negatively on the conservation of natural resources (ibid.). However, recent research has shown that natural resources held under common property regimes can be managed sustainably (Ibid.: 18). Most land-based resources are held under ‘controlled access’ systems. In Namibia, as elsewhere in Africa, such systems are commonly referred to as communal land tenure systems.

A common feature of customary forms of tenure is that they allow for considerable flexibility. On the one hand they are open land tenure systems in the sense that they play an important role in securing the livelihoods of people in situations of low or no economic growth (Thiesenhusen, 1991: 3). Under most customary tenure systems, every member of a community has rights of access to land (Wiley, 1993b: 4). Customary systems thus allow for high degrees of un- and/or underemployment, and thus provide a safety net for rural people. In that sense they ‘serve as a spontaneous welfare system’ (Thiesenhusen, 1991: 4).

On the other hand, customary tenure systems provide livestock herders with considerable mobility. This is possible because ownership groups are not territorially distinct, but have overlapping and potentially conflicting rights to different categories of resources (Lane and Moorehead, 1995: 117).

To summarise, there is a tendency to argue that environmental change and in particular land degradation is the outcome of a tenure system ‘that gives no long-term interest in the land and thus encourages them to exhaust rather than conserve it’ (Bruce, 1993: 37).

Two points can be made in this regard. In the first instance, indigenous tenure systems have been able to recognise the need for long-term exclusive rights for farmers. The enclosure of communal land in Namibia is a manifestation of this (Cox et al, 1998). Whether such tenure change happened in the interest of improved natural resources management or simply the enrichment of individuals remains a moot point for as long as no empirical research exists into the socio-economic and environmental effects of enclosures.

The second point is that enhanced tenure security does indeed ‘offer the freedom of action and economic incentive to conserve resources’ (Bruce, 1993: 38). In and of itself, however, it will not affect the sustainability of land utilisation. Without access to appropriate technology to increase agricultural production while enhancing the environment and other conducive factors such as markets, for example, tenure security will achieve little. ‘If the freedom conferred by ownership is coupled with ignorance of proper land use practices and ecological stress, it provides only the opportunity to degrade the resource’ (Ibid.).

An important implication follows from this: not all environmental change and in particular resource degradation is a tenure problem. In situations where population growth outpaces available technologies to maintain and increase agricultural output, problems of environmental change may be the result of inappropriate land use. In such situations, new inputs and agricultural techniques are needed to solve the problem, rather than a change in land tenure (Bruce, 1986: 26).

Insecurity of tenure in Africa is often ascribed to its short duration. However, rules of indigenous tenure systems may not necessarily be responsible for insecurity. Some of the causes for tenure insecurity listed by Bruce (1993: 40) include:

- abuse of power by traditional land administrators in hierarchically structured systems;
- ineffectiveness of traditional authorities in enforcing indigenous tenure rules in situations of socio-economic and political change which have undermined their authority;
- competition for land by different groups;
- land grabbing by political and economic elites;
- arbitrary government action by taking without compensation or granting concessions to land which are inconsistent with indigenous rights.

A final comment concerns the importance of distinguishing between indigenous tenure rules and the institutional framework required to enforce such rules. An analogy may illustrate the point: legislation passed to combat crime is relatively ineffective. More often than not this is ascribed to a lack of capacity to enforce the provisions of various Acts, rather than inadequate legislation. The same
applies to tenure. As we shall see, most regions of the country have sets of tenure rules to control grazing patterns, collect "velkos" etc. However, it would appear as if traditional authorities are increasingly losing their authority to implement and enforce indigenous rights. Enhanced tenure security then may not necessarily require tenure reform so much, as the development of local level resource management structures (von Maltitz and Evans, 1998: 567).

2.3.3 Indigenous land rights

The historical dimension of indigenous tenure is widely regarded as important for getting a fuller perspective on tenure change and its relationship to natural resource management. This report suggests that it is vital to consider the historical record in some detail, because resource tenure is widely considered as a key factor determining agricultural land management practices. Further, it is frequently assumed that indigenous tenure systems are static and unable to adapt to changing environmental and socio-economic circumstances. Reference to 'traditional' land rights is thus not helpful to conceptualise tenure (Bruce, 1986: 10).

Indigenous tenure may change as a result of one or several of the following factors:

- innovation in agricultural technology;
- change in population densities;
- extended drought and famine;
- the evolution of centralised political structures;
- conquests; and
- migration (ibid.).

It should be added, that the sedentarisation of former pastoralists in so-called native reserves by previous colonial administration is likely to have affected indigenous tenure regimes.

While it is desirable to have a better understanding of tenure change in Namibia, the lack of reliable historical information precludes an exhaustive discussion of this topic, particularly in view of the sometimes significant regional differences that exist. However, some material exists which makes it possible to get a better handle on local tenure systems. Even if it is not possible to present a comprehensive picture of tenure in Namibia, the discussion will illustrate that the general concept of 'communal' tenure comprises a range of different local tenure systems, which sometimes differ significantly.

2.3.4 Pastoralist tenure

Given the climatic conditions of central Namibia, a high level of mobility and flexibility was required to adjust to the unpredictable distribution of rainfall and hence grazing and surface water. Pastoralists had to disperse widely over the country in small groups in order to utilise natural resources most effectively. Movements were determined by the unpredictable distribution of grazing and water. Herero pastoralists, for example, have frequently been referred to as inveterate nomads. A missionary likened them to the Bedouins, living a 'constantly nomadic life. They move from place to place with their herds, depending on the conditions of the pastures' (Werner, 1998: 28).

Amongst other things, this flexibility manifested itself in the fact that central Namibia did not have any fixed boundaries with regard to grazing areas, either amongst different language groups or within them. Land belonging Herero pastoralists, for example, was defined very simply as all the land where their cattle grazed.

Boundaries to grazing areas were not only defined by the availability of resources - water and grazing - but also by competing claims to these resources by other pastoralists. Such competition was often violent, having frequently led to small-scale wars. Although generally described as tribal wars in the colonial literature, more recent research has shown that many of these conflicts centred around access to land and water.

While boundaries were permeable and flexible, Namibia was divided into broad areas of jurisdiction. The area utilised by Herero pastoralists during most of the previous century, for example, was roughly bounded by the Swakop and Kuiseb rivers in the south, the Ovambo kingdoms in the north, and stretching as far east as Lake Ngami. To the south of this boundary Nama speaking communities...
farmed mainly with small stock. Areas of jurisdiction thus also corresponded broadly to different types of farming, each adapted to particular environmental conditions.

Under such tenure conditions, pastures were not 'owned' in any narrow sense of the word, although some control over access to pastures was exercised by controlling access to water. Pastoralists who either came upon good water or invested labour in procuring it by digging wells, for example, could exercise limited control over access to such water. Anyone wishing to water his/her herds in an area first had to obtain permission from the person who had moved into the area first. 'By requesting such permission, a later arrival expressed his recognition of the other's first rights' (Vivelos, 1977: 112).

The development of more centralised political structures prior to formal colonial rule affected tenure patterns. Although no detailed historical research exists to elucidate this process, indications are that increased political power gave rise to notions of land ownership by incipient chiefs, albeit as trustees of the community. A manifestation of this can be found, for example, in proposals put forward by Chief Mahero in 1876 to sell some of the land perceived to fall under his authority to Europeans favourably disposed towards him (Adams & Werner, 1991: 10). The remainder of the land was to have been set aside by him as a reserve for Herero pastoralists. Although the deal never came off, it suggests the development of new concepts of land rights and powers over land.

Pastoralist communities in Namibia did not have traditional leaders in the conventional sense before the advent of colonial rule. With regard to the Ovahero, homesteads 'were basically nomadic herding units, each politically autonomous' (Vivelos, 1977: 111). Wealthy individuals could acquire some power over other herd owners and those without livestock, by controlling natural resources and in particular access to water as stated above. For as long as grazing land was relatively abundant, such control was rather weak. Households which were dissatisfied with the actions and demands of a particular 'owner' of water could always move away and join another household.

However, increasing population pressures on the land as well as the influence of long-distance trade produced more centralised political structures during the last century. The gradual increase in ostrich and elephant hunting, as well as cattle trading particularly with the Cape of Good Hope, heightened competition for pastures and other land-based resources. The need to defend trade routes encouraged the gradual centralisation of political power in the hands of incipient chiefs. Thus, by the 1870s the area known as Hereroland had become 'divided' into nine major principalities or chieftaincies, while twelve Nama and Oorlam chieftaincies with clearly defined boundaries and Baster territory around Rehoboth had been identified in the south of the country (Adams & Werner, 1990: 10).

After 1884, German colonialists reinforced the gradual centralisation of powers regarding land, as they needed a single person — a chief — to sign so-called protection treaties. In essence these treaties meant that indigenous Namibian communities were dispossessed of their land. Communal pastures increasingly gave way to fenced parcels of land owned by German colonialists. Needless to say, this severely limited the mobility of pastoralists. The process of land dispossession culminated in a bloody revolt in 1904, during which large numbers of indigenous people were killed by German colonial forces. As a result, the social and political structures which had existed before the turn of the century were completely destroyed. In addition to such mass destruction, a decree issued by the German colonial authorities in 1907 stipulated that the acquisition of land or land rights by 'natives' needed the permission of the colonial Governor (Werner, 1998: 47).

2.3.5 Mixed farming areas

The mixed farming areas in the north and north east of the country were not affected in the same way by colonial rule as the pastoralist areas further south. The often powerful, centralised political structures of the mixed farming communities enabled them to resist colonial domination and land dispossession more effectively in the early years of colonialism. Communities in mixed farming areas were hardly affected by land dispossession.
The availability of recent historical material on the mixed farming areas in the north and northeastern regions is highly uneven. The following section will, therefore, focus on what is known today as north-central regions.¹³

The Report presented by the Government of the Union of South Africa to the Council of the League of Nations concerning the administration of South West Africa for the year 1929 described land tenure in the north-central regions in the following way:

Each tribe inhabits a well-defined area in which it carries on an independent system of government. There is no such thing as individual ownership of land as understood in our law. The chief is the undisputed ruler over the whole tribal area and the land is regarded as his property, though he administers it for the benefit of his subjects. No native may reside or cultivate land within a tribal area without first becoming a member of the tribe. (Union of South Africa 1930: 99)

These ‘independent systems of government’ did create ‘clear differences in rules to land tenure and land use within Ovamboland’ (NEPRU 1991b: 549), and to some extent these differences reflected the differential impact that colonial domination had had on indigenous communities. In the Kwanjama and Ombalantu communities, for example, former Kings had been replaced by councils of headmen (Union of South Africa 1930). Nevertheless, despite some regional differences, land tenure in all eight communities of former Ovamboland was broadly structured along two categories of land (Republic of Namibia, 1991):

- Settled or inhabited land (shilongo) on the one hand and uninhabited land or bush areas (ofuka) on the other; and
- Residential, arable and grazing land.

In the inhabited areas or shilongo, land for cultivation and residence was allocated through a hierarchy of traditional leaders. In pre-colonial and early colonial times, ‘the Chiefs or Kings of the various communities in Ovamboland had the ultimate right to allocate land in the inhabited parts within their jurisdiction’ (Republic of Namibia 1991: 555). However, in some parts, allocation rights had been transferred to headmen. For example, among the Kwanjamas, who, after the death of King Mandume Ndumfayu, did not have a King, eight principal headmen exercised the rights of the chief in respect to land allocations.¹⁴

Where Kings still existed, their territory was sub-divided into a number of ‘districts’ under the authority of ‘headman-councillors’ (later referred to as senior headmen by colonial officials), who were ‘responsible to the tribal council.’ Districts, in turn, were composed of several wards or omikunda (omukunda, sg.). Omikunda were granted to people who could afford to pay a certain amount of cash or cattle. Upon payment, the new ‘owner’ became a headman with certain rights and responsibilities. Apart from ‘exercising native administration and judicial authority’¹⁵ in their omikunda, headmen were entitled to ‘sell’ portions of their omikunda to individual homesteads (Hinz, 1996: 31). The sizes of omikunda varied, but ‘comprise[d] anything from 10 to 100 or more kraals [homesteads].’¹⁶

Generally, the payment for land applied only in the inhabited areas or shilongo, and changed according to the degree of land pressure. In the less densely populated parts of the north-west, payments were lower than in the Cuvelai area. In the 1920s, allocation fees for residential and arable plots were applicable in the Ndonga, Ongendjera, Ukumbi and Ukualuthi areas. No payments were required in other communities. Payments depended on the size of the plot, ranging from ‘two goats or sheep to three or four Pounds Sterling in Ukualuthi ... to one or two head of cattle in Ondonga ...’ (Republic of Namibia 1991: 551). As pressure for land increased and settlement extended eastwards, payments followed, and payments for land in the eastern Kwanjama area were reported for the first time in the late 1940s (Republic of South Africa, 1991). It appears to have been

¹³ This material is drawn from Cox et al 1998.
¹⁶ Ibid.
the custom in the Ndonga area that 'should it become necessary to eject an allottee before he has reaped at least one crop this payment must be refunded.'

In general, payment of a fee ensured access to residential and arable land and use rights which can best be described as being a sort of permanent usufruct, subject to good behaviour and loyalty to his chief.\(^{18}\) With the exception of manula trees, the rights of heads of homesteads 'included not only unlimited use of the land itself, but also rights of first access to waterholes, wells, and trees on or near the plot' (Republic of Namibia, 1991: 554).

Within the inhabited area (shilongo) a waterhole situated in a cornfield or closely contiguous, access to the corn field. The occupier of such field becomes the occupier of the waterhole. This right cannot be alienated; the accession is complete.\(^{19}\)

The ownership of waterholes outside a field was determined by the 'importance of the man who made it or caused it to be made':

If he was an important, rich or influential person, the waterhole is inalienable and accordingly his relatives cannot inherit it. The rights over it pass to the person who succeeds him, i.e. the person who is appointed in his place.\(^{20}\)

While use rights of allocated land were extensive, the latter could not be allocated to anyone else by the head of a homestead, 'be it through sale, gift or inheritance' (Republic of Namibia 1991: 554).

Upon the death of the head of the homestead, the headman of the omukunda could reallocate the land against a payment (Hinz 1996).

With these rights to residential and arable land also came certain responsibilities regarding the protection of resources and the protection of persons using the resources (see republic of Namibia 1991 for more details). Indeed the colonial administration found these responsibilities so extensive that it felt it necessary to change them.

Available written records reveal very little about land tenure arrangements regarding grazing land. The section dealing with this issue in the report to the League of Nations in 1930 devoted only four lines out of two pages on the subject, stating simply that:

The grazing grounds are common to all members of the tribe both in the inhabited and the uninhabited portions of the tribal area. The chief alone has the right to reserve any place for grazing. (Union of South Africa 1930: 99).

During the early part of this century the north-central regions had large reserves of unused land. Interstital areas between different polities were kept as long as possible for grazing purposes. In addition, herd owners made use of cattle posts in the bush or ofuka. Much of the land in the study area was considered to be waterless and thus could not be settled or used on a permanent basis, and utilisation was limited to seasonal grazing. This was observed in the mid-19th century when the traveller Charles John Andersson visited the Ndonga area. Although the inhabitants were known 'to be possessed of vast herds', he found no cattle at their homesteads as a 'general scarcity of water and pastureage in Ondonga compelled them to send the oxen away to distant parts.'\(^{21}\)

Despite the long distances to most cattle posts, rights of 'ownership' were exercised in some cases. Given the importance of water, ownership rights to a cattle post 'usually hinged on ownership of the water supply which sustained the site as a cattle post' (Kreike, 1994: 25). It had also been noted that: 'well established cattle posts (with waterholes) have definite owners ... [while] at other posts the first man on the post each year acquires the right of user. Every new waterhole dug in the bush belongs to the man who digs it.\(^{22}\)

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\(^{17}\) NAO Vol.9 2/12 Native Tribal System of Land Tenure in Ovumbland, nd [1929], p.5.

\(^{18}\) Ibid, p.3.

\(^{19}\) A 450 Vol.9 2/38 Typed manuscript of sections of the Tribal Customs of the Ovambo, nd, p.31.

\(^{20}\) Ibid.

\(^{21}\) CJ Andersson, Lake Ngami, p.190

\(^{22}\) A 450 Vol.9 2/38 Typed ms of Section of the Tribal Customs of the Ovambos, nd p.32
More generally, while the ‘owner’ of a waterhole at a cattle post had the right to satisfy his needs first, ‘the water itself is incapable of ownership.’ It could not be alienated by sale, for example, but could be passed on to heirs (Kreike 1994). Neighbours were allowed to draw water, ‘provided that they have assisted in the annual opening up and cleaning of the waterhole after the rains.’ In fact rights to a waterhole often lapsed through continued disuse and neglect (Kreike 1994).

2.3.6 Tenure security in mixed farming areas

Historical evidence suggests that customary tenure to residential and arable land was reasonably secure, although colonial records display a certain ambiguity regarding tenure security. This was undoubtedly influenced by the desire of the colonial administration to obtain more control over the process of land allocation.

In north-central region, powers of eviction varied from community to community. In some instances such as Ukwambi, headmen were denied the right to evict households from their land. In other areas, headmen, as the allocating authority, had the authority to evict heads of households from their plots (Republic of Namibia 1991). Reasons for eviction included instances where ‘an individual proves a disturbing factor in any section of the tribe’, where ‘an allottee is not able to cultivate his fields to the same extent as did his predecessor’ or is guilty of ‘disloyalty or treason. In such cases the individual is ordered to leave the tribe and forfeits all his crops, including corn already reaped by him’ (Union of South Africa 1930: 99-100).

In pre-colonial times, Chiefs and headmen were said to have been ‘frequently influenced by bribes and political considerations to deprive individuals of their land under false accusations’ (Union of South Africa 1930: 99; Republic of Namibia 1991: 558). These instances were cited by the colonial administration as a way of demonstrating that land tenure was insufficiently secure. In subsequent attempts to make ‘tenure of land as permanent as possible’, the South African administration introduced restrictions on the powers of traditional leaders to evict people. In those cases where Kings no longer existed, headmen were:

required to refer any questions of ejectment to the offices of the Administration, because it has been found that although many of them are capable and efficient administrators, they lack the sense of responsibility of a chief, which makes them too easily influenced.’ (Union of South Africa 1930: 99).

Government intervention appeared to have some effect on ejectments: in the late 1920s the Administrator reported that evictions ‘seldom happen today’ (Union of South Africa 1930: 100). Indeed, one analyst has argued that ‘this [was] the one area where the colonial administration actually restricted the powers of Chiefs and headmen’ (Republic of Namibia 1991: 558).

2.3.7 Colonial land acquisition

The anti-colonial revolt in 1904 and its aftermath, specifically provisions which subjected rights to land by indigenous communities to the approval of the colonial administrator, laid the foundation for a distribution of land structured along racial lines. After 1915, the Union of South Africa obtained the League of Nations mandate over then South West Africa. In terms of this mandate, all land held by the previous administration was transferred to South Africa. In due course, the new colonial government set up the Native Reserves Commission in 1920 to make recommendations on the setting up of so-called native reserves. Between 1923 and 1926 a total of ten reserves were proclaimed, totalling approximately 2.24 million hectares. The Native Reserves Commission observed that this land was ‘infinitesimal in comparison with the area occupied by Europeans or available for European occupation’ (Quoted in Werner 1993: 143). In carrying out its brief, the Commission was observing ‘the general principle of segregation’ and recommended the removal of any black settlements - referred to as ‘black islands’ - from what was considered to be ‘essentially European areas’. It also recommended that the renting of land to black farmers be prohibited (Werner 1998: 102).

23 Ibid.
24 Ibid.
By the late 1920s, therefore, the South African government had set up a classical tenure dualism. Over the next few decades, approximately 43% of the land area in Namibia was to become surveyed land, to be registered and owned under freehold title. Another 42% was 'set aside' for indigenous communities as 'native reserves' or communal areas as they are known today. The remaining 15% consisted of proclaimed areas and desert.

2.3.8 Commercial and communal areas

The exact impact which colonial rule had on local tenure systems is not well researched and thus not satisfactorily understood. A widespread view is that a plethora of colonial enactments and regulations divested traditional authorities of powers over land and resources by transferring them to various offices of the state (Fuller & Turner, 1995: 7). The result was that the colonial state systematically undermined customary forms of land and natural resource management, opening the way not only for communal range enclosures but also environmental degradation.

In order to obtain a better understanding of the possible effects of colonial legislation on local tenure systems, it is useful to distinguish between an indigenous or local land tenure system on the one hand, and an institutional framework for the implementation of such rules on the other. It is the contention here that the colonial administration did change the institutional framework for customary tenure without necessarily having had any significant impact on local tenure systems. More specifically, successive colonial governments not only invented and consolidated headmen in pastoralist societies, but also invested them with powers over land and natural resources which they did not have in precolonial times. As the brief historical discussion above indicated, the most important decisions with regard to access to water and grazing were made by communities of users, and not any central political authority. If anything, colonial policies and legislation undermined the authority of pastoralist communities to make those decisions.

Reserve policy and administration pursued two broad objectives. In the first instance, it sought to guarantee communal access to grazing, and secondly, it sought to subordinate traditional leaders by incorporating them into the colonial administrative system as minor administrators. This meant that formal powers over reserve administration and land allocation had to be vested in the colonial administration.

The Treaty of Peace and South West Africa Mandate Act of 1919 vested powers in the Administrator of South West Africa to set up 'native reserves' subject to certain restrictions. He was also authorised to alienate land set aside as a 'native reserve' and issue title to it. Section 16 of the Native Administration Proclamation (Proc. 11 of 1922) reiterated these powers of the Administrator and authorised him in terms of section 20 to approve regulations, inter alia, for 'the establishment, management and control of native reserves in rural areas'.

In 1924 the Native Reserve Regulations (GN 68/1924) were promulgated in terms of the Native Administration Proclamation of 1922. These represented the first formalisation of reserve administration. According to these regulations, magistrates had general control over reserves in their districts. Subordinated to them were reserve superintendents, who were in charge of individual reserves. Reserves themselves were to be subdivided into wards, each ward under the control of a headman. While headmen were ostensibly in control of wards, the Native Reserve Regulations vested all management powers in reserve superintendents. The allocation and control of rights to communal land and natural resources were also formally centralised in the reserve superintendent. The Regulations distinguished five different rights, including:

- rights of access to reserves;
- residential rights;
- grazing rights;
- rights to wood; and
- access to water.


26 Native Reserve Regulations (GN 68/1924), sections 1 and 2.
Rights of access were to be controlled at different levels, depending on the skin colour of the applicant. Only the Administrator could give permission to 'Europeans' to erect buildings in reserves. In all other cases, however, the reserve superintendent was responsible for granting rights of entry. In terms of section 9(f), headmen were not permitted 'to give permission to any one to reside in the Reserve without the previous consent thereto of the Superintendent'. Permission from the latter was necessary not only for temporary residence in a reserve, but also for any reserve resident leaving a reserve. Movement from one reserve to another had to be authorised by the magistrate of the district. Section 27 authorised magistrates, subject to the approval of the Administrator, to order 'an undesirable person to leave a reserve'.

The erection of buildings in reserves required the consent of colonial officials: in the case of whites, the Administrator had to give his consent, while the approval of the reserve superintendent had to be obtained by black people wishing to erect buildings in a reserve. Reserve superintendents were charged with the allocation of sites. In terms of section 11:

The Superintendent shall allot a site\textsuperscript{27} to any native permitted to reside in the Reserve and it shall be lawful for him to transfer any resident to some other site should it become necessary so to do [sic]. No native shall change his residence without the sanction of the Superintendent in writing.

The role of headmen in allocating residential sites was limited to making sure that 'every hut or dwelling is duly registered' and to 'notify the Superintendent of the erection, abandonment or disappearance of any hut or dwelling'.

The Native Reserve Regulations did not deal with grazing rights in any great detail. Section 9 stipulated that

\begin{flushleft}
\textbf{The Superintendent shall not}
\end{flushleft}

shall not make any allotment of land, either to newcomers or by way of redistribution of land already occupied, nor shall he under any circumstances deprive any person of any land of which such person shall be in occupation except upon the express order thereto of the Superintendent.

Instead, the 'allotments of land' were the responsibility of the superintendent in terms of section 3 of the Regulations. In addition, the superintendent of a reserve had the power to prohibit for any period to be fixed by him the grazing of animals or any particular species of animal in any portion of the common grazing ground in such reserve ... [for the better preservation of the grazing therein].

Any person disobeying any such prohibition was guilty of an offence.\textsuperscript{28}

Finally, the Native Reserve Regulations tried to ensure communal access to water. Section 25 made it an offence to 'wilfully obstruct in any way the approaches to public watering places in any Reserve or obstruct the use of water therein ...'

No significant amendments were made to the Native Reserve Regulations and the other legislation cited until the late 1960s. The latter effectively relegated traditional leaders to 'position(s) of subordinate administrative officers, with no independent authority over the allocation of land in the "native reserves"' (Hubbard, 1991: 8). It is the contention here, however, that with regard to land, the legislation discussed above merely formalised a situation in which chiefs and headmen traditionally had very few powers, if any. Customarily, communities of resource users were the central institutions with regard to land management.

It would appear that the powers of communities to allocate access to water and grazing were not affected by colonial legislation. None of the legislation discussed above explicitly repealed any customary laws with regard to grazing in the communal areas. Although it could be argued that Regulation 22 of Government Notice 68/1924\textsuperscript{29} placed restrictions on the rights of communal farmers

\begin{footnotesize}
\begin{enumerate}
\item The Afrikaans version of section 11 refers to 'building site' rather than just 'site'. See Kaputuza and Another v Executive Committee of the Administration for the Hereros and Others, 1984(4) 295, p.307 f.
\item Native Reserve Regulations, section 22.
\item Regulation 22 of GN 68/1924 provided that the Superintendent of any reserve 'may for the better preservation of the grazing therein prohibit for any period to be fixed by him the grazing of animals ... in any portion of the common grazing ground'. Utzengisa and 3
\end{enumerate}
\end{footnotesize}
to graze their cattle wherever they wished, section 11 dealing with the allocation of ‘sites’ did not affect their grazing rights.

In the only recent court case concerning the legality or otherwise of fencing communal land, a judge concluded in the 1980s that grazing rights in the Herero reserves continued to be acquired under Herero customary law (Kaputwa et al., 1984: 318). Evidence submitted to the court suggests that until the early 1970s, communal farmers did not need the permission of a headman if they wanted to move with their cattle to a new, uninhabited place. The only requirement in terms of section 11 of the Native Reserve Regulations was that they had to inform the reserve superintendent of such a move. However, failure to do so did not affect the rights of such farmers to the land to which they had moved. They continued to have clear rights to grazing on the communal land at that place. By reason of the fact that they were the first persons to farm there, these rights were, under Herero customary law, superior to those of other residents of the reserve in question in the sense that others wishing to farm there would first have to approach them (Ibid.: 296).

Headmen also did not have any powers regarding the movement of reserve residents within a reserve. Instead, a person ‘who wished to move to another place in the reserve required only the permission of the local residents to do so’ (Ibid.: 301). Once such permission had been obtained, the headman concerned was informed as a matter of courtesy. In cases where people moved to land which was uninhabited, no permission was needed (Ibid.: 304-305).

Slightly different rules applied to strangers wishing to settle in a reserve. According to Headman Nguvauma II:

[If a stranger to the reserve wished to settle in Epukiro, he first approached the leader of the area where he intended settling. The headman would then instruct him to obtain the permission of the people living in that area. After that he would be told to go to the office of the superintendent to get a ‘permit’ to move his ‘goed’ (presumably his cattle) (Ibid.: 304).

The brief discussion above suggests that neither headmen nor superintendents exercised any powers in the allocation of grazing land. Section 11 of the Native Reserve Regulations, which stipulated that only the reserve superintendent could make allocations of ‘sites’, was ‘more honoured in the breach than in observance’. Customary rather than common law governed the access and use of grazing in the Herero reserves. Under Herero custom, ‘no formalities were required for the movement of stock or change of residence’ (Ibid.: 306).

It can be concluded from these examples that native reserve legislation did not fundamentally affect customary practices regarding the allocation and utilisation of grazing land until the 1970s at least. After a review of colonial legislation in the north-central and north-eastern regions, Hinz (1995: 51-52) also came to the conclusion that the various transfers of general law ownership of communal land did not automatically affect customary land law by curtailing the traditional mechanisms to allocate land according to customary law.

2.3.9 Current land tenure problems

It has been pointed out above that colonial intervention in the social and economic development of Namibia has produced a stark tenurial dualism in Namibia. Roughly half the non-state land continues to be held under freehold title while no freehold titles can be obtained in the other half. Conceptualising this duality in terms of title and non-title land is more useful in a tenure context than the common reference to a commercial and a communal sector. In the latter description, a particular production system is compared with a specific tenure regime. Put differently: commercial production can happen under several different tenure regimes, and is not dependent on freehold title. There is broad agreement that while the distinction between subsistence and commercial agriculture continues to blur, the tenurial dualism has broadly persisted.

Attention has been drawn to the fact that the concept of communal tenure is not particularly useful in discussing land tenure. The concept conceals more than it reveals in the sense that a number of


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different local tenure systems are subsumed under it. These can be classified as communal only to the extent that access to land is based upon membership of a group (Bruce quoted in Lane and Moorehead 1995: 117). This does not imply, however, that all resources are being used communally.

This section will summarise available data on local tenure systems as they are operating in Namibia at the moment. This discussion does not claim to be exhaustive. The intention is to describe tenure systems so that their influence on land management can be considered from an informed point of view, rather than from a point of view laden with over-generalisations and biases, as tends to prevail in certain circles.

North-central region

No comprehensive study of land tenure in north central regions exists. It is possible, however, to piece together a reasonably representative picture based on recent fieldwork carried out in the eastern Oshikoto region (Cox et al, 1998).

Jurisdiction over land allocation and other customary matters in the Ndonga area is held by senior headmen or councillors who in turn constitute the tribal council. This is presided over by the King. Each senior headman is at the head of a district or oshikango. Several headmen are under him each responsible for a number of villages or omekunda and their village headmen (Ibid.: 68).

Each level in this hierarchy has its own specific responsibilities vis-à-vis land allocation. A senior headman may allocate land used for cropping and residence, but not for grazing. Grazing land is considered to belong to the whole community (Ibid.).

When a family decides to construct a homestead at a cattle post it has to consult with their prospective neighbours to ascertain whether there is sufficient space to accommodate their livestock and whether they would be accepted. Once this has been done, the senior headman must be approached with a request to settle and to pay a fee.

Unsettled grazing land is handled differently. By virtue of such land being regarded as the property of the tribal authority, they regard it as their responsibility to allocate grazing rights to individuals to graze animals. Settlements normally do not have exclusive rights to grazing, but reciprocal rights of access prevail.

Control over water frequently facilitates de facto control over grazing, especially during the dry season. Those who have constructed hand-dug wells or pits are considered to be the owners of such wells, and have to give permission before anybody else can make use of them.

Kavango

Regardless of the provisions of various native reserve regulations and proclamations, the allocation of communal land remained the responsibility of traditional authorities in their respective areas of jurisdiction. Five sub-regions have been identified in Kavango each under the jurisdiction of a chief (hompa). The chief appoints headmen and sub-headmen, after they have been elected by local inhabitants (Yaron et al, 1992: 188).

The land allocation procedure differs slightly for residents and non-residents of an area. In the first case, an allocation of land can be made by the local headman together with the local community, taking into consideration available space and grazing grounds. For non-residents the procedure is similar, except that if the majority is in favour of a new person settling in an area, the decision is referred to the chief headman, who may consult with the chief of the region before making a decision (Ibid.).

Land disputes are generally brought before a traditional court, comprising the headman and his/her councillors or heads of homesteads in the respective area. A ruling is made based on the evidence presented. Cases which cannot be resolved by the headman and his court are referred to the chief (Ibid.: 189).

A survey conducted by NEPRU for the National Land Conference in 1991 revealed that approximately 40% of respondents favoured the continued allocation of land by traditional leaders. 50% stated that would have preferred government to allocate land (Cited in Ibid.). Although based

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43
on a relatively small sample, this suggests that traditional leaders may at that time have lost some of their legitimacy amongst farmers with regard to land allocations.

While the legitimacy of traditional leaders seems to have been declining with regard to customary allocations, a new land administration structure came into being in Kavango in response to changing land tenure requirements. As in some other communal areas, demands by certain sections of the population to fence off grazing land increased gradually in Kavango. In order to deal with this issue, each sub-region set up a Land and Farming Committee in the late 1980s to advise traditional leaders on the allocation of large blocks of grazing land. More specifically, they were tasked by Central Government to draw up allocation plans for land allocation in southern Kavango to be used for commercial farming purposes (Ibid.: 189). Little is known on the activities of these Land and Farming Committees. Should the proposal to establish Land Boards be passed by Parliament, these Land and Farming Committees would seem a good starting point to develop Land Boards.

While ultimate authority over land issues resides with the senior customary authority, routine management decisions are decentralised, resting with small social units consisting of those who have an active interest in using resources. It is not uncommon for pioneer settlers to obtain permission from senior tribal authority before settling in a new area. However, once settled, any additional settlers need to be vetted by the first settled (Behnke 1998c: 28-29).

Concerns have been raised regarding the wisdom and environmental sustainability of establishing big ranches in parts of Kavango. However, land pressure on grazing areas away from the river is low, which has led one observer to note that a veritable open frontier situation exists in the region (Behnke, 1986b: 18). Behnke concludes from this that it will be difficult to convince farmers to conserve their land if plentiful grazing is available elsewhere so that they can afford to abandon their unproductive land (Ibid.: 19). However, while large tracts of land are available for grazing, the lack of ground water limits the utilisation of these pastures.

Northern Kunene
Pastoralism among the Himba depends on spatial mobility and is characterised by independent movements of livestock camps and households (Bollig, 1999: 7). Local tenure systems make this possible.

Northern Kunene is divided into separate jurisdictions under a headman or senior headman. Bollig (1999: 6) differentiates four different types of land, each with different tenure rules applying. Land in categories one and two comprise villages with reasonable gardening opportunities and reliable water sources nearby. In both cases, graveyards can be found. For most places in these two categories of land, an owner can be named, and any decisions regarding the management of land have to be brought to his attention.

Zone three usually consists of cattle posts which are utilised during the dry season. No gardening opportunities exist here and water resources are limited. Zone 4 are grazing reserves with very little if any water, usually far away from major population centres.

The latter two zones are managed jointly by the men of a community. Springs are owned communally and managed on that basis. According to Bollig, management decisions consider the type of usage of a water point (cattle, humans, calves etc.) and the time of usage. A hand dug well on the other hand, is owned by the household who dug it (Ibid.: 6-7).

Behnke's research in Etanga development area suggests that jurisdictions remain fairly constant over extended periods of time. Home villages also seem to display a stable composition. Despite well defined jurisdictions over specific areas, borders between them are permeable. People and stock move regularly outside their home areas in search of water and grazing. Rights to these resources must be negotiated with host communities. Communities thus control critical key resources rather than demarcated territories (Behnke, 1998a: 2) Final authority over land decisions, however, rest with the Senior Headman. Usually he does not look for problems, but waits for disagreements being brought to him (Ibid.: 35).
Omaheke and Otjozondjupa
Reference has been made above to the fact that customary tenure rules continue to prevail in the Herero communal area. What they entailed has been sketched at a very general level. Recent fieldwork by Ute Stahl (1999) sheds more light on some specific features of the local tenure system.

Households in her study area are highly mobile, and livestock farming is highly commercialised. Each village ‘owns’ a specific territory, with boundaries roughly demarcated. Each village has an assembly which takes decisions on communal matters. More specifically, all land rights issues fall within the purview of the village assembly: opening up of cattle posts, allocation of resources to farmers who want to settle on village land or ask for temporary permission to graze their animals during droughts. Traditional leaders are informed of decisions, but have no active part in them, except when conflicts need to be mediated (ibid.: 6).

Village land is divided into different zones for grazing purposes. While all households have access to this grazing, each household is urged to drive its cattle in a specific direction. Such zoning pertains mostly to areas close to the village, where lactating cows and calves are normally held. This area is more tightly controlled than more remote pastures, and many villagers have fenced off small camps (ozokamba). Such fencing, although the subject of intense conflicts at times, normally involves land which has been allocated to households for grazing.

These camps are said by villagers to be 'like a good herdsman' (ibid.: 9). Camps represent one strategy to counteract 'open access' situations by facilitating several management functions ranging from protecting their animals against straying and theft, to improving conditions for breeding livestock, securing seasonal grazing for vulnerable and/or more valuable animals, and saving labour under conditions where skilled herdsman are hard to come by.

Tenure security is not so much threatened by an absence of rules as an institutional framework that finds it increasingly difficult to enforce these rules in face of a non-existent policy and legal framework. In addition, the lack of herdsman causes livestock to stray - intentionally and unintentionally - onto the pastures of another household or another village. Despite the existence of village boundaries and tenure rules governing access to land and resources, therefore, the situation is characterised by 'open access' rather than commonly managed property.

Stahl (1999: 19) draws attention to the differences between small camps adjacent to villages and large scale fencing of ranches. Frequently those farmers who find it difficult to fence off a small camp near their village but have the means to enclose a large piece of land would resort to this option. These farms have often been established in remote areas, where the control of traditional leaders was weak or non-existent. Significantly, the majority of farmers interviewed by Stahl reject the option of communal land being fenced for private use, but approve of an 'altered commons' where village land is being fenced off to protect against incursion from outsiders (ibid.: 23-24).

The south
In the south of the country communal land is made up of both fenced and surveyed land, as well as unfenced land. The same applies to the communal land in southern Kunene Region. This situation was brought about by the fact that in the late 1960 the South African government added in excess of 200 privately owned farms to these communal are in an attempt to consolidate them into what were destined to become homelands. These surveyed farms were fenced and are still registered in the Deeds Office as state property. Although originally fenced, many fences are in a state of disrepair, and do not always serve the purposes they were designed for. However, in some other instances fences have been maintained and are used to keep outsiders from using grazing (Fuller and Turner 1995: 16).

Access to land in the south is obtained through customary institutions. Newcomers to the communal area have to apply to the stamraad (tribal council), the highest tribal authority, for permission to settle in the area. It is not quite clear whether a subordinate tribal council can grant permission to a newcomer to settle without having consulted the senior council. In matters of concern to a subordinate council, however, the senior council in Berseba will consult with the former. Similarly, problem cases which cannot be solved by

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30 Unless specified otherwise, the following is based Werner 1996.

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the sub-ordinate council will be referred to the senior council for attention. Evidence suggests that in some areas newcomers have to go through the subordinate council first. The latter will establish whether the household or person can be accommodated with all his/her stock. Should this prove possible, an approval will be sent to the stamraad in Berseba.

Applications to settle in the Berseba area are considered through a process of consultation and investigation. For example, the stamraad will try to establish from its counterpart in the applicant's ward where exactly he/she comes from and what the reasons for his/her application are. On the basis of such information, the stamraad will then discuss the merits of the application with their respective constituents.

The procedure outlined above also applies to potential investors who would like to obtain a piece of land for tourism development for example. An application for land will be considered by the stamraad and members of the community affected. The applicant will have to explain why such land is needed and how the development will benefit the community.

Family members wishing to return to their home areas do not have to obtain permission to farm. It is expected, however, that they inform the stamraad of their intention to settle in a specific area. Although no formal permission is required, family members are expected to inform the community where they intend to settle and how many heads of livestock they intend to bring into the area.

While family membership is an important mechanism to obtain access to land, it is no guarantee of success. Family members wishing to settle may have to negotiate their rights with the community, who in turn can refuse to grant grazing rights if the area cannot accommodate the livestock numbers of a relative. In all applications, the size of herds seems to be the main criterion for approving or rejecting applications to settle in the area. This applies to both family members and newcomers. Another criterion seems to be the character of a newcomer. If it is known that the applicant has been found guilty of stock theft, for example, his/her application is not likely to be approved.

Disputes regarding land utilisation do occur, albeit not very often, and consist mainly of households trespassing on other households' land within a ward or households from other wards grazing their livestock without prior permission. In the Ganigobes ward, for example, small stock farmers from as far as Bethanie regularly bring their stock to graze in the western portions of the ward. In the Vaalgras area, it was mentioned that households of the area sometimes graze and water their stock at posts belonging to other households in the same tribal area.

Dispute resolution follows three broad stages. The first step normally consists of giving the trespassing households a chance to explain their reasons for bringing stock into the area without prior permission. If their reasons are found to be legitimate, a temporary solution will be negotiated. An example of this are farmers who have left their own areas as a result of drought. In such cases, temporary grazing will be negotiated, normally until rains have fallen in the area of origin of the needy households. If a particular stamraad feels that it cannot provide grazing to other communities or that sufficiently good rains have fallen in the areas of origin of trespassers, it will explain this to the latter with a request to leave the area.

In most instances this approach is successful. However, more serious disputes defying negotiated solutions do occur as well. In such cases, the subordinate stamraad will forward the matter to Berseba. The senior stamraad in turn will also try to solve such disputes through negotiation. Should this prove impossible, the matter is handed over to the police.

Small stock farmers in the Berseba ward are practising limited transhumance within their respective sub-wards. The community of Ganigobes-Soutpunt, for example, moves its small stock over limited distances within the sub-ward. As indicated above, mobility across the fairly narrow confines of sub-wards is restricted by customary rules of access.

Water in the Fish River does not seem to be an important source of water any longer. This may partly be ascribed to the fact that it does not run all that frequently. When the river is in flood, only communities directly adjacent to it make use of it. Although its water is regarded as belonging to everybody, no seasonal rights of access to the river for communities further afield have been recorded, as it is uncommon that communities other than those next to the river bring their small stock to the river for watering. This can probably be ascribed to the fact that communal farmers in the area obtain water from boreholes which are dotted across the pastures.
No permission seems to be needed from the *stammaad* for the establishment of gardens along the river. Ganhobes still has a small garden next to the river, which is under-utilised, however. Within the perimeter of the garden, individual women have small plots which they cultivate.

**Rehoboth**

The land tenure system in Rehoboth incorporates both title and non-title aspects. Even before German settlers arrived, Basters allocated land by issuing *erf* and *plaaspapiere* to parcels of land. Although not properly surveyed, most of the land was demarcated in various ways. *Erf* and *plaaspapiere* (literally: farm papers) were entered into a register. For these reasons Rehoboth was credited with having had the first cadastral system of sorts in the country (van den Heuvel, 1986). The sale of wood or grass from a farm, or its sale, hire or transfer even to a burgher, could only happen with the approval of the Raad or Council (South West Africa, 1930).

Three different forms of tenure can be identified in the area: privately owned land, communal land and state owned land.31 Approximately 58,000 hectares of land are regarded as communal land, compared to 1.223 million hectares which is held as private farms. In many cases, however, private farms have been subdivided into undivided shares which can be registered in the Rehoboth Deeds Office. An undivided share simply means that some people have inherited a right to a small part of the farm, without this being fenced off or necessarily divided in any other way.

This process has led to a situation where in excess of 90% of farms were regarded as too small by the Rehoboth Second Tier Authority in the 1980s to constitute economic units, and legislation was enacted to promote the consolidation of farm units.

**San or Bushmen32**

Inherited land rights among the Ju/wasi in north-eastern Ojozondjupa Region are based on reliable sources of water. The rights are individually owned and acquired by descent. Land rights are inherited from both parents and involve the rights to use specific resources of water and bush foods. These resources and the land immediately surrounding them constitute a nlore, which loosely translated means territory.

Nlore rights are inalienable, and members of the Ju/wasi community cannot alienate them in any way. They also cannot be transferred to a spouse. Women, however, can own nlore rights in their own right. While a husband living with his wife in her nlore all his life is entitled to use the resources of her nlore, he can not acquire nlore rights.

Rights to specific resources such as bush foods and water rest with the owners of a nlore. However, Ju/wasi could move freely through the Nyae Nyae area, hunting and gathering bush foods as they passed through. Only if they wished to remain for a significant period was it necessary to ask the resident group. If resources did not allow the accommodation of additional people, they were refused permission.

Hunting territories are not known in Ju/wa land tenure. The main reason given by Marshall for this is that game migrates, and it is therefore impractical to establish tenure rights on 'waterless land and shifting migration routes'.

Nlore rights weaken with generations. The strongest rights exist where parents have lived in a nlore. Weaker right are inherited from grandparents and great grandparents. It is difficult to exercise nlore rights in a nlore in which a family has not lived for three generations.

However, nlore rights do not disappear altogether. During extended droughts many Ju/wa groups exercise attenuated nlore rights by moving to permanent waters in the major nloresi.

Land rights are reinforced or newly acquired through marriage. Marriages are therefore often arranged when children are very young.

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31 This section is based on Adams and Werner 1991.
32 This section draws heavily on Marshall, n.d. Appendix 1.
Very few noresi had definite boundaries and thus were open. This corresponded to the need of people to move and share resources of other groups when their own water dried up.

Tenure security among the Ju/wasi is perceived to be threatened by a number of factors.

In the first instance, and this is true for all communal areas, their access to land is not protected by the Constitution. This means in effect that the state could use some of their land to promote tourism or any other business without adequate compensation. That this is not a far fetched argument is illustrated by reference to an attempt by government in 1997 to expropriate certain rights to land in Kavango enjoyed by the Kxoe community.

Secondly, Ju/wasi communities fear that their land and water will be seized by Herero pastoralists. Such fears were heightened when a decision was taken by government to settle Herero repatriates from Botswana at Gam. Related to this point is a fear that government may decide to develop the area into commercial farms in the long run.

2.3.10 General problems faced in communal areas

Fencing
The most prevalent problem facing small-scale farmers in the communal areas concerns the issue of land enclosures. The phenomenon of communal land enclosure started in the 1970s. In the 1980s government officially surveyed and allocated fenced farming units in Okamatapati, Ovambo and Kavango Mangeti (Cox et al, 1998; Werner, 1994).

In many communal areas, fences create a variety of problems for farmers. A recent study in Oshikoto (Cox et al, 1998) identified the following problems:
- seasonal grazing is affected negatively in that the remaining diminishing unfenced land area is increasingly insufficient to support the livestock population;
- the privatisation of wellsites and boreholes restricts access to water for livestock from surrounding cattle posts and livestock in transit;
- herd owners are fined by borehole 'owners' when cattle stray onto fenced land; and finally
- fences blocking access to more distant, seasonal grazing areas (Cox et al, 1998:77).

The net result of fencing in the Oshikoto Region is that increasing pressure is being exerted on the few areas remaining open to access by the general population (Cox et al, 1998:78)

Research from Otjozondjupa seems to confirm that the provision of boreholes by the state since the 1960s impacted negatively on dry season grazing. Cattle posts or ozohambo gradually became settled and utilised permanently as a result of permanent water points. In the case study presented by Stahl (1999) villagers used to trek their animals to cattle posts at Okamatapati, some sixty kilometres away. Since piped water was made available, the area was fenced and thus became inaccessible as cattle posts. Stahl suggests that the only compensation farmers could find was to manage dry season grazing better by fencing it off (Stahl 1999: 10-11).

Payment for water
As was discussed above, control over water frequently leads to control over access to pastures. This seems to be even more so in some areas that have been fenced. In eastern Oshikoto, exclusive rights to a borehole can in effect limit access to grazing by limiting access to the borehole. This has led to the observation that ‘fencing is less about grazing control than about controlling access to water’ (Cox et al 1998: 77).

One problem area that has been identified with regard to government boreholes is that property rights often lie within two separate jurisdictions. In eastern Oshikoto, for example, the Ndongo Tribal Authority has allocated rights to fence grazing land, while many of the fenced areas contain boreholes which belong to DWA. To some extent, this problem arose as a result of the fact that DWA often sited boreholes with no regard or knowledge about pre-existing rights to wells.

An issue that has not received much attention is the effect which government’s rural water policy is likely to have on resource tenure generally, but access to grazing in particular. Evidence from
Caprivi suggests that the requirement of communities to make financial contributions towards the provision of water is leading to a redefinition of village boundaries. More specifically, 'community boundaries are redefined to include only those who actually make the contributions, notwithstanding the diverse kinship and affinal linkages with people in neighbouring villages'. This in turn may strengthen the legitimacy of those controlling communally owned water points (Sikana and Kamwi, 1998: 19-20).

Property rights
It has been argued above that communities will not be able to manage natural resources responsibly on a collective basis without clear rights to these resources (Behnke 1998: 15). While the state has transferred limited use rights of natural resources to rural communities in the form of conservancies, for example, such communities still do not have any property rights over land as such. They consequently lack legal powers to exclude or include outsiders in utilising their natural resources. While the National Land Policy White Paper alludes to community ownership of land and natural resources, the Communal Land Reform Bill does not address this issue at all.

Conclusion
Several conclusions can be drawn from the limited data available on communal area tenure:
- Land tenure policy needs to recognise regional differences in land tenure systems. It is therefore more appropriate to refer to local tenure systems rather than 'communal' land tenure.
- Each region and production system seems to have a land tenure system which defines rights to land and natural resources. Such tenure systems have their individual strengths and weaknesses. An important distinction to keep in mind is that between tenure and the institutional framework necessary to enforce its provisions. Problems in land management are usually blamed on inadequate tenure systems. However, very often tenure is not to blame but rather an inadequate institutional framework which is unable to implement the rules and regulations laid down by local tenure.
- Interventions for more sustainable natural resources management thus need to identify the problems very clearly. What may be perceived as a tenure problem can sometimes be solved by strengthening local institutions.
- While tenure to arable plots and residential sites in communal areas is reasonably secure, the situation with regard to grazing rights is less secure. No attempts are being made by government to extend property rights over grazing to communities of users, despite the fact that the latter are expected to take on full responsibility for the provision of water, for example.
2.4 Land Utilisation in Namibia

2.4.1 Pre-Colonial land use in Namibia

Before colonial times, the inhabitants of Namibia were largely nomadic in nature, hunter-gatherers and stock herders. The nomadic lifestyle allowed people to be highly mobile in response to the unpredictable rainfall of the country. With the establishment of commercial farms the nomadic lifestyle was restricted (Brown, 1993).

Similarly, in pre-colonial times, pastoral groups practised seasonal migration. In the wet season cattle were kept near the homestead and in the dry season cattle were taken to resource refuges called cattle posts. This seasonal migration and herd movement allowed pastoralists to exploit patchy vegetation of high nutritional value and natural water springs. In the northern part of the country crop the semi-sedentary mixed farming communities of the Bantu tribal groups practised crop production alongside animal husbandry.

Hunter-gatherers like the pastoralists also used to move from place to place in search of seasonal fruits, tubers and vegetables.

In pre-colonial times the duties of politics and land administration were performed by traditional leaders such as king queen, paramount chief or captain, who exercised authority over their traditional tribal groups (Hangula, 1994).

These traditional authority systems were first weakened by the German colonial occupation, which was marked by a number of wars against indigenous groups. Because of these wars, the tribal groups which used to be together and under one leadership were scattered around the country without leadership structure and some fled to the neighbouring country of Botswana (Tottermeyer, 1993).

Traditional authorities were further weakened by the South African Native Reserve Act of 1963 which forced various ethnic groups to develop separately and to do so in separate geo-political units based on assumed cultural, political, socio-economic and ethnic differences. Leaders in those reserves were appointed depending on their subservience to the colonial rulers. Owing to their subservience to the colonial rulers, many traditional leaders had lost influence in their respective communities, more so in matters connected to land administration (Tottermeyer, 1993).

2.4.2 Land management under different tenure systems

Due to the country’s aridity, livestock farming is the major agricultural activity. Small livestock (sheep, goats) are mostly reared in the south and western part of the country while large stock (beef cattle) is more dominant in the east and central. Maize is cultivated commercially but at a limited scale in the Grootfontein/Otavi area. Wheat is produced under irrigation at Hardap irrigation scheme. Rain fed crops, millet and sorghum are produced in the north of the country mainly for subsistence.

Commercial land management

Concerning management, commercial farmers manage their livestock in the enclosed ranches according to the grazing potential set by the department of agriculture. The grazing potential is differs by region. For example the arid south region, which receives between 150mm and 300mm of rainfall per year, has a grazing potential of 24-50 hectares of land per large animal per year. The semi-arid, which receives between 300mm and 500mm of rainfall per year, has a grazing potential of 12-15 hectares of land per large animal per year. And the semi-humid region, which receives between 500mm and 700mm of rainfall per year, has a grazing potential of 8-12 hectare of land per large animal per year (Ministry of Agriculture 1991).

Commercial farms are large and an individual may own up to as many as 12 farms. The average farm size differs from district to district. In the North where the average rainfall is 500 mm per year the average farm size is in extent 4,000-6,000 hectare. In the East and Central, the average farm size is of 8,000-10,000 hectare, in the drier South the average size farm is 10,000-12,000 hectare in extent.
Historically, commercial farmers have been supported with all necessary inputs such as access to loans, veterinary services, extension and marketing facilities, in contrast to the communal farmers who were neglected. Owing to this past neglect farmers in the communal areas were handicapped though the present government agriculture policies pay more attention to communal farmers than to commercial farmers when it comes to accessing facilities such as extension technical services, and research, the communal areas are still severely underdeveloped in terms of credit facilities and markets.

<table>
<thead>
<tr>
<th>District</th>
<th>Number of farms per district owned by one person</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Outjo</td>
<td>69</td>
</tr>
<tr>
<td>Otiwarongo</td>
<td>60</td>
</tr>
<tr>
<td>Grootfontein</td>
<td>43</td>
</tr>
<tr>
<td>Tsumeb/Otavi</td>
<td>45</td>
</tr>
<tr>
<td><strong>North Total</strong></td>
<td>217</td>
</tr>
<tr>
<td>Windhoek</td>
<td>131</td>
</tr>
<tr>
<td>Gobabis</td>
<td>72</td>
</tr>
<tr>
<td>Okahandja</td>
<td>43</td>
</tr>
<tr>
<td>Omaruru/Karibib</td>
<td>21</td>
</tr>
<tr>
<td><strong>Central Total</strong></td>
<td>287</td>
</tr>
<tr>
<td>Keetmanshoop</td>
<td>45</td>
</tr>
<tr>
<td>Mariental</td>
<td>71</td>
</tr>
<tr>
<td>Karasberg</td>
<td>30</td>
</tr>
<tr>
<td>Maltahoe</td>
<td>30</td>
</tr>
<tr>
<td>Betanie</td>
<td>19</td>
</tr>
<tr>
<td>Swakopmund</td>
<td>04</td>
</tr>
<tr>
<td>Luderitz</td>
<td>10</td>
</tr>
<tr>
<td><strong>South Total</strong></td>
<td>209</td>
</tr>
</tbody>
</table>


Very little research has been done on the efficiency aspect of commercial farms size. Traditional research carried out at research stations in the country, concentrated on breeding, stocking rate and some on pasture management and not much has been done on efficiency and effectiveness of the large size farms. However an indication of the under-utilisation of land within the commercial farms has been documented in the report of the government Technical Committee on Commercial Farmland 1992. See table 2.3.

<table>
<thead>
<tr>
<th>District</th>
<th>0 livestock</th>
<th>1-10</th>
<th>11-20</th>
<th>21-30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otavi/Tsumeb</td>
<td>12</td>
<td>4</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Grootfontein</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Otiwarongo</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total North</strong></td>
<td>16</td>
<td>5</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Okahandja</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Omaruru/Karibib</td>
<td>7</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Windhoek</td>
<td>19</td>
<td>8</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Rehoboth</td>
<td>25</td>
<td>12</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total Central</strong></td>
<td>55</td>
<td>26</td>
<td>16</td>
<td>27</td>
</tr>
<tr>
<td>Mariental</td>
<td>8</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Maltahoe</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Keetmanshoop</td>
<td>4</td>
<td>7</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Karasberg</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Betanie/Luderitz</td>
<td>8</td>
<td>6</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total South</strong></td>
<td>23</td>
<td>24</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>Grand Total</td>
<td>94</td>
<td>55</td>
<td>25</td>
<td>46</td>
</tr>
</tbody>
</table>

Table 2.3 presents the under-utilisation of commercial farms studied in 1991/1992 by the government Technical Committee on Commercial Farmland. The table highlights the incidence of under-utilisation of land by commercial farmers. However, the study did not indicate whether the under-utilisation measured included game for the study only looked at rearing of livestock, while there are many farmers in Namibia that utilise game on their farms and may keep fewer livestock, the under-utilisation presented in this table is therefore incomplete.

Communal Land Management
There is a big contrast between the commercial farming sector and the communal sector. The commercial farms are managed on the principle of grazing potential as mentioned above, the same management criteria were not formulated for the communal areas. The livestock moves from place to place in search of grazing and water and not according to pre-defined grazing potential. Due to lack of prescribed management procedures in the communal areas, there are land management problems in those areas, which are discussed below.

a) **Change in management of grazing in the communal lands**
Before colonial times, the inhabitants of Namibia were largely nomadic in nature, hunter-gatherers and stock herders. The nomadic lifestyle allowed people to be highly mobile in response to the unpredictable rainfall of the country. With the establishment of commercial farms the nomadic life style was restricted (Brown, 1993).

Similarly, in pre-colonial times, pastoral groups practised seasonal migration. In the wet season cattle were kept near the homestead and in the dry season cattle were taken to resource refuge called cattle posts. This system used to work when the communal population was low and there was adequate grazing land. In recent years population has increased and grazing land has become limited. The customary land management systems of seasonal migration are thus gradually disintegrating (Hangula, 1994).

b) **Underground Water provision**
According to Shivute (1993) water provision by the colonial regime in the form of boreholes in the communal areas had artificially maintained large number of livestock beyond the recommended carrying capacity of the area around the water point. Shivute argues that, under normal circumstances those animals would have either died, or been taken to the other areas with better grazing. But because of the availability of water, animals survive and cause overgrazing around the water source.

c) **Lack of control over access to communal lands**
In most communal lands in Namibia control and allocation of land is the prerogative of the traditional leaders. Except in Capriv, where land is the property of the clan or the family and is allocated by an elder of the clan or the family, there appears to be no clearly defined procedure in most communal areas by which a person gains access to land in the communal areas. An individual wishing to use a piece of land for grazing for example can just fence of a tract of land for private use and get settled. This situation of self-allocation, is described by Shivute (1993) as one where individuals have uncontrolled access to the piece of land and are therefore motivated to take what they desire to get from the land before anyone else does or they will lose out.

d) **Social Tension**
The lack of clear authority task with land administration in the communal areas has been linked to social tension between those that are fencing of the communal lands and those that are excluded from the use of that land. Tapscott and Hangula (1994) in their study on Fencing of Communal Range land, observed two groups; small farmers and the larger cattle owners (using enclosed grazing) being in conflict over land use, access to water and right of way.

The University of Namibia's Social Science Division (SSD) report by Fuller et al (1996) on the Ovijoko region noted the enclosure of communal grazing to be increasing by the day and reaching a crisis situation. Richer communal farmers are, in essence, converting common grazing to private ranches and less land is left for those who cannot afford fencing.
This crisis situation is said to stem from the lack of community-based land management and lack of overall land use planning in the country.

e) Lack of legitimacy of local institutions doing land allocation
Totemeyer noted that, with the achievement of independence, the Namibian constitution has transferred all communal lands to the Government. Thus ownership of the communal lands was vested in the state and not in the tribal groups. This situation, he says had led to many traditional chiefs and headmen, claiming chieftancy without any areas of jurisdiction. Totemeyer further stated that the traditional authorities are without legal status or protection and not being recognised as state institutions by article 102 of the constitution. This has contributed to the traditional leaders being unable to enforce property rules of exclusion.

f) Lack of land use planning in the communal areas
The communal areas have different types of land management namely:
- Demarcated, fenced and individually managed (legal and illegal)
- Demarcated fenced and communally managed;
- Demarcated not fenced open grazing and non-demarcated open grazing

Demarcated and individually managed
Suzman (1995) noted that the demarcated lands are in many cases farmed privately by richer communal farmers, and that the strategy behind fencing is to establish exclusive 'emergency' grazing. Farmers with fenced plots initially graze their cattle in communal areas along with the smaller farmers, and only when the communal grazing is depleted do they revert to their private lands. The dual grazing create tension between those fenced out and those feeling they have to protect their private grazing.

Demarcated fenced and communally managed
These form those parts of the communal lands, which were demarcated into blocks of fenced farms during the colonial period. The developed farms were allocated to individual households who paid grazing fees to the government (N$0.80) and stocking rates were controlled through regular livestock census. These demarcated farms in the communal areas have in a way set precedence for illegal fencing of communal land by the well to do farmers aspiring to farm commercially.

Demarcated open grazing and non-demarcated open grazing
The extent of land and general plan of the fenced demarcated communal lands is filed with the Surveyor's office and can be described. The non-demarcated extent is not known and cannot be defined. Currently, access to these lands is by mere presence or by erecting fencing to establish private use to the land.

g) Lack of clear government policy on communal lands
The government of Namibia has been criticised by the Namibia Non-Governmental Organisations' Forum (Nangof) for not tackling the issue of land reform early enough- soon after independence. Thus allowing the leadership vacuum to continue for too long (Nangof position paper on land, December 1996). Nangof later alleged that the lack of government policy on communal lands is the cause of the current land disputes countrywide (The Namibian July, 1997).

In a similar fashion, the Namibian Agricultural Union (NAU) criticised the government for destroying the fragile 'ecology and economy of the commercial areas' by turning commercial farming in to communal areas through its resettlement program. 'We must rather go the other way to commercialise the communal areas' the organisation commented (The Namibian, October, 1997).

The government has also been criticised by some scholars for not showing commitment to major land reform, which critics say, will increase the level of access to land resource for the majority of the population in the overcrowded communal lands. The government is said to
shy away from major agrarian reform by stating immobility within political, economic and environmental constraints (Tapscott, 1993).

The list of land management problems and socio-economic issues narrated above forms a whole complex land management situation in the country especially in the communal areas. The Namibian government intends to tackle these problems with its current National Land Policy and other related land laws.

State Land management
The land under state management consists of 21 national parks and mining areas. This land makes up 15% of Namibia’s land area; the parks alone make up 13.8%. Two of the national parks Etosha and Namib-Naukluft are among Africa’s biggest. The management of National Parks is according to section 14 of the Nature Conservation Ordinance.

Please refer to Land Tenure map (Figure 2.12) overleaf.
2.4.3 Current land use patterns in Namibia

Different societies have different needs and wants. Different environments are composed of different elements in different combinations. The confrontation of different societies with different environments results in different patterns of land use.

Basic types of land use are agriculture, settlement, grazing, hunting and gathering, wildlife conservation and firewood production, just to mention a few. Each of these basic types again may occur in many variations. Agriculture, for example, may range from the simplest form of shifting cultivation to highly mechanised modern farming. The present pattern of land use in an area reflects man's present appreciation of his natural environment with respect to his present level of technology.

The patterns of land use observed in Namibia today are as a result of the natural conditions, (climate, topography, soils, water resources,) the availability of resources, the social structures and the socio-political history of the country. The single most important factor influencing land utilisation giving shape to present day patterns is the distribution of water resources, both surface and underground. Levels of land use intensity are largely determined by the distribution of water resources. It is clearly observed in communal areas that areas adjacent to water points are the most heavily grazed, often to the extent of being degraded. At the same time, it needs to be noted that the land use patterns observed are a result of individual decisions taken by many land users at the farm level. The decisions taken are influenced by the objectives of the land users which are influenced by their needs.

The most prevalent land use activities in Namibia as dictated mainly by natural circumstances, and to a lesser extend by tradition, are as follows:

a. dryland cropping and livestock production in the northern and north central parts of the country in both communal and commercial areas

b. large stock (mainly cattle) production in the central and eastern parts of the country.

c. Small stock (sheep and goats) production in most of the southern and western (outside the Namib Desert) areas of the country

d. Irrigated cropping at Hardap and along the Okavango and the Orange rivers producing crops which cannot be produced under dryland conditions or have a high risk of failure under dryland conditions in Namibia

e. Wildlife as a land use has taken a significant measure of importance in the country. Wildlife is raised on stateland (parks), private farms (in pursuit of diversification) and even in sparsely populated communal areas of the north-east and the west. These areas are largely multiple land use areas because the people raise both crops and animals.

f. In this category are wastelands (from an agricultural point of view) which are used for tourism. This covers the west coast, the Namib Desert and a couple of other isolated places in the country.

g. Most of the south-western part of the country is zoned as "diamond mining area" and no other uses except mining are permitted by law even though potential for tourism exists.

h. Hunting and gathering is mainly practised in the north central part of the country although it is a land use under threat from external pressures, such as the invasion of the area by livestock farmers and the protection of game by the state

i. Wood extraction (for commercial purposes) is a relatively small land use activity in Ohangwena, Okavango and Caprivi Regions. The wood is extracted from indigenous forests

Recent studies conducted in four areas Western Kunene, Caprivi, North Western Erongo and Eastern Ojozondjupa show that non-agricultural land uses (consumptive and non-consumptive tourism) have the potential to contribute significantly to economic growth without being detrimental to
the environment. An aggregate net income of N$8.5 million from such uses was estimated (Barnes, 1995). This may lead to a major swing from traditional land uses even in those areas where agricultural activities have some potential. Land evaluation and cost-benefit analyses will need to be conducted to select the best use of the land.

Traditional land uses in communal area among the ethnic groups of Namibia have evolved under the influence of the natural circumstances. It is possible to attach ethnic groups to most of the land uses described above. Most traditional land use practices are adapted to climatic and water resource variability within the country. But this does not mean that they are necessarily resilient to adverse changes.

Land users have conventionally been classified as subsistence and commercial. It is doubted if these definitions describe the actual situation on the ground. With increasing monetarisation of the national economy and increased demand for improved quality of life, even the so-called subsistence land users are no longer that much subsistence orientated. They always aim at producing something for the market, no matter how small. The volume of marketed produce from the subsistence farmers is limited by factors other than the lack of desire to produce for the market (Shumba 1997).

Several studies in the country have indicated that 20-50% of incomes in communal areas are derived from agricultural activities. It has been observed that the drive behind fencing off communal land is for the individual to be able to produce for the market with the use of commercial breeds such as Brahman and Afrikaner in the case of stock farmers. It needs to be determined whether there is a difference in mentality/perspective with respect to the market between communal (who are believed to be largely subsistence) and commercial farmers. This may assist the shaping up of policies and programs in the country.

2.4.4 Factors influencing land use trends

Land is utilised for the purpose of meeting diverse human needs not only for present generations but for future generation as well. The extent to which land utilisation in the country puts pressure on the natural resources will be assessed on the basis of available and published information. According to (Shumba 1997) Land use at any place and time is a result of the following factors: the people, the land, the economy, technology and the government. These factors are not mutually exclusive but interact to a very large extent.

a. The people - The people factor refers to the population (size and density), the social structures, traditions and culture, and skills

b. The land - this in its broad context covers all natural resources and their condition. Water is the most limiting resource in Namibia. It invariably has an overriding influence on land utilisation

c. The economy - this refers to the kinds and amounts of production, marketing opportunities, money available for investment, credit facilities etc.

d. Technology - the methods/techniques, tools and information used in order to live in an area

e. The government - this refers to laws and policies, organisation, services and infrastructure
2.4.5 Land under-utilisation and over-utilisation

Under-utilisation
Shumba (1997) says it is important to observe that there are no data on land utilisation for most parts of the country. Namibia does not have an official National Land Use Map like the one Botswana has developed. Where such data exist, they are not in a format that can be used to develop the above-mentioned map. The country needs a Land Use Map as it is useful for development planning and policy formulation.

In the same way there have not been Land Evaluation activities to determine the suitability of the land uses practice in the country. The information coming from the various thematic surveys can be brought together in an activity called land evaluation. In land evaluation activity, the different land utilisation types with their specific requirements are confronted with the land characteristics of the different land units. Out of this confrontation the suitability of the land for alternative uses can be assessed. In this assessment also the way in which various uses influence each other has to be taken into account. Some uses may support each other, other uses will exclude each other.

The result of this land evaluation can be expressed as alternative combinations of land uses for particular areas. Due to the lack of Land Evaluation activities in the country, there is therefore not a land suitability map to guide land uses, the planners and decision-makers.

There is thus need to pose some fundamental questions that need to be addressed through research efforts. Have the safe production levels been determined for all land uses? In other words, has land evaluation been undertaken to determine if indeed the described land uses are the most suitable for the areas where they are being practised? Are the land uses meeting the socio-economic needs, such as incomes and food security? How much is known about the total amount of resources and their quality in Namibia. How much of the forestland has been converted to grazing land and grazing land to arable land and what effect such conversion has on the environment.

Anthropologists will argue and rightly so, that people settled in the various areas of the country have already done land evaluation. If this is taken as fact, what needs to be identified and documented are the evaluation criteria (indigenous knowledge) used by the people and how far their findings would correlate with those from conventional science, such as agro-ecological zoning study.

Most smallholder farmers survive the harsh conditions experienced in Namibia through the careful use of micro-environment or patches or key resources. "A micro-environment is a distinct small scale environment which differs from its surroundings, presenting sharp gradients or contrasts in physical conditions internally and/or externally" (Chambers, 1990). Examples of such patches in Namibia are the fertile alluvial soils along the Okavango River and the oshanas of the northern communal areas. These are a series of depressions/ponds which are seasonally filled with flood waters from Angola. They are a key resource in this area but little is known about how the system functions. (Marsh and Seely, 1992). Another use of key resources, are the crop residual after harvesting that farmers in the communal areas of oshana Oshikoto, Omusati and Ongwediva use during the dry season. These crop-fields are utilised as common property for the neighbouring households. How many other microenvironments are known and how are they utilised it is worth finding out. Little work has been done to identify, classify and understand the dynamics of microenvironments and yet they are so important for the survival of the large number of the people. These key resources are possibly being over-utilised due to lack of resource management practices.

Given the population and size of the country, it is clear that there are vast areas of land that is under-utilised in some communal areas. Most of the land is under-utilised due the lack of infrastructure (specifically water) and the presence of plants that are poisonous to livestock. But how much land is under-utilised and what could it be optimally used for? Land is believed to be under-utilised when it is left idle for reasons other than conservation. Not everybody will agree with this notion of under-utilised land.

Table 2.4 shows the location and amount of land which was estimated to be under-utilised soon after national independence. The picture could have changed to some extent due to increased "privatisation" (fencing out for individual use) of such areas.
Less than 20% for the 18.2 million ha can be developed for agricultural purposes (NEPRU), 1991. Research needs to be undertaken to identify the exact location of the land that can be developed as well as to identify the most suitable land uses for those areas. Some of the options that could be looked at are, resettlement of people from overcrowded areas such as western Ohangwena, the development of wildlife and/or forestry conservancies and the demarcation of these areas into economically viable commercial farms for allocation to young emerging farmers.

Table 2.4 Estimates of under-utilised land in Communal Areas of Namibia (in millions of hectares)

<table>
<thead>
<tr>
<th></th>
<th>Total Area (ha)</th>
<th>Main limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovamboland</td>
<td>5.6</td>
<td>water</td>
</tr>
<tr>
<td>Kavango</td>
<td>4.8</td>
<td>water</td>
</tr>
<tr>
<td>Hereroland</td>
<td>6</td>
<td>water and poisonous plants</td>
</tr>
<tr>
<td>Bushmanland</td>
<td>1.8</td>
<td>water and poisonous plants</td>
</tr>
</tbody>
</table>

Source: Shumba (1997)

It is argued that Namibia cannot let resources lie idle while at the same time spending considerable sums of money (N$20 million annually) on purchasing commercial farms for re-distribution to the landless. These under-utilised areas have to be brought into systematic/planned land use through a national program otherwise they will all soon be taken up by the unsystematic privatisation that is going on. Research needs to be undertaken to guide policy development on under-utilised land communal areas.

The government is buying farms for resettling the landless but it does not have any land utilisation models that could be adapted to the farms. The risk that the programme faces is that due to lack of careful planning, it is difficult to monitor and land may be either under-utilised or over-utilised.

Over-utilisation of land in Namibia and degradation

The change in land capability in productivity is viewed as a major environmental issue world-wide and in parts of Namibia it is perceived to be significant. In recent years there have been a re-evaluation, and questioning of the extent of change in land capability and often the extent of change is based on limited data and poor understanding of the causes thereof. The causes of change in land capability are complex and often indirect. Change in land capability can be measure by changes in productivity, however the cause of productivity may be natural such as drought and thus reversible. Productivity reduction may therefore not be due to human activities. In the case of Namibia it may thus be difficult to assess land capability change by productivity alone and an historical aspect may be useful whereby productivity is viewed over time yet is hindered by unavailability of data.

2.4.6 Land suitability for agriculture intensification

Various factors affect the degree to which land use can be intensified in Namibia. The most critical factors are water and soils as already mentioned. Water has an overriding influence.

Shumba (1997) argued that opportunities for intensifying land use might exist, but not for all land uses. He reckoned that it is difficult to intensify veld grazing without environmental damage. UNDP/FAO (1989) estimated that there are 7 000ha in former Ovamboland, 10 000ha in Okavango and 2 000ha in Caprivi that are potentially irrigable, these areas are cultivated under rainfed conditions and are close to perennial water supplies. Opportunities for irrigation also exist along the Orange River, but mostly on commercial farms.

While the need for irrigation development is necessary, there are factors that militate against such development on a large scale. It is not clear whether the perennial rivers could yield sufficient water to irrigate all the areas, especially considering the fact that all the rivers form international boundaries and therefore the water has to be shared with other countries. Added to this is the fact that irrigation is competing with domestic water and aesthetic needs. This is true for the Okavango River. Due to the very high rates of evaporation experienced over most of Namibia, the crop water requirements...
are high, placing a higher demand for water. The costs of irrigation development and running and maintenance (per hectare) are high. This should encourage the production of high value corps. Most of the areas that are suitable for irrigation are remote and lack relevant infrastructure for the production and marketing of high value crops.

Under circumstances of severe water shortages coupled with high rates of evaporation, the challenge would appear to be the development of "low cost water efficient irrigation systems" that could even be adopted by smallholder farmers for their gardens. The experience from Zimbabwe could be instructive. Sub-surface clay pipes as opposed to the traditional flood irrigation have been developed for use by women to irrigate their gardens. On experimental stations water use effectiveness of 40% was achieved (Bachelor and Wallace 1995). In Israel, another arid country, a deliberate policy to develop irrigated agriculture has been pursued vigorously. Water use efficiency increased dramatically over a 30 year period (FAO, 1995). It is argued that similar work in Namibia could open up new opportunities, particularly for the smallholder farmer. Once crop irrigation (especially of cereals and legumes) is established, possibilities for more intensive livestock production arise. This would definitely alter present land use patterns.
2.5 Production Activities

2.5.1 Livestock production

2.5.1.1 Beef production

Due to the arid and semi-arid nature of Namibia’s climate, meat production is and will stay for the foreseeable future the mainstay of agricultural production. Meat production is still the highest earner of foreign capital within the agricultural sector.

Cattle numbers

Cattle numbers have varied considerably over the last decade in both the communal and commercial farming areas. Total cattle numbers increased gradually from 1988 to around 1991/92 and then declined again gradually to 1996. Since 1997 a slight increase in cattle numbers over the country occurred. Of significance is that cattle numbers in the commercial farming areas followed very much the same tendency as the total cattle numbers. Whereas a drastic decrease in the cattle numbers in the commercial farming areas took place from 1993 onwards, just the opposite happened with livestock numbers in the communal farming areas over the same period. In 1988 the livestock numbers in the communal farming areas were 43% of the total cattle numbers in the whole of the country, compared to 62% a decade later. In 1988 the average stocking rate for the commercial farming areas was 33.5 ha/animal (cattle only) compared to 40.6 ha/animal for the communal farming areas. The situation changed drastically in 1998 where the average stocking rate for the commercial farming areas decreased to 44.4 ha/animal and at the same time the average stocking rate for the communal farming areas increased dramatically to 24.3 ha/animal. Figure 2.13 indicates the cattle numbers in commercial and communal farming areas of Namibia from 1988 to 1998.

![Cattle numbers in Commercial and Communal Farming Areas of Namibia from December 1988 to December 1998. (DVS, 1999).](image)

Cattle marketing

During 1997 cattle marketing reached an all-time low as a result of farmers rebuilding their stocks following forced marketing during the drought of 1996. A total of 497 963 head of cattle were marketed during 1996 compared to only 226 775 during 1997. This represents a decrease of 271 188 units (54.4%). It should also be mentioned that during 1997, 86.0% of all cattle marketed were exported. A large decrease in the number of cattle slaughtered at the export markets occurred during 1997. The numbers decrease from 170 707 during 1996 to only 88 879 in 1997. The main markets...
for beef remain the European Union (EU) and South Africa (RSA). Exports to the EU alone represent about 17% of production.

North of the Veterinary Cordon Fence (VCF), the lowest numbers of cattle (13,522) slaughtered were during 1997. The highest number of cattle slaughtered north of the VCF was in 1995 (29,690), due to good rainfall in 1996/97, better prices offered by informal butchers and better prices received for other commodities. The present quarantine system in terms of mass and grade losses, poses a severe threat to the viability of the meat processing plants in these areas. Given the amount of money spent to upgrade the abattoirs to RSA standards, new markets requiring lower animal health requirements and the possibility of using quarantine feedlots should be exploited (Meatboard, 1997).

Fig. 2.14: Cattle marketing through various outlets in Namibia from 1987 to 1997 (Meatboard, 1999)

The average producer price for cattle carcasses decreased by 3% from N$ 8.49/kg at the beginning of January 1997 to N$ 8.23/kg at the end of December 1997. See Figure 2.15.

Fig. 2.15: Average producer price of beef carcasses at export abattoirs (excluding NCA abattoirs) for 1996 and 1997 (N$/kg)
The average auction price during 1997 for weaners and steers was N§ 3.85/kg and N§ 3.06/kg respectively. For 1996 the average auction price for weaners and stores was N§ 3.66/kg and N§ 3.63/kg respectively. This represents a 5.2% increase in weaner price and a 15.75% decrease in the auction price for stores. Competition for weaners is expected to continue between South African feedlots and farmers in Namibia due to stock re-building.

Dairy production
The dairy industry in Namibia is, in terms of numbers of farmers, relatively small. Some 30 commercial farmers are responsible for the direct or indirect employment of 690 people (including dependants). The processing sector employs a further 310 individuals.

However, the dairy industry has a significant standing in the agricultural sector where in 1998 it followed meat as the largest contributor to the agricultural GDP. The industry operates in a totally free market situation with strong competition mainly from South Africa. The main competition to fresh milk in the market is the Ultra Heat Treated (UHT) milk, which is a direct substitute for fresh milk.

![Fig. 2.16: Total annual milk production in Namibia from 1990 to 1999 (NAU, 1999)](image)

The total milk production in Namibia increased from 8 361 469 litres in 1990 to 18 196 205 litres in 1999. This represents an increase of 218% over this period. Although the producer price for fresh milk increased constantly over the period, there was a constant decrease in the real producer price over the same period (see Fig. 2.17 overleaf).
2.5.1.2 Small Stock Production

Small stock farming, both sheep and goats, plays a very important role in both the commercial and communal farming sectors of Namibia. Figure 2.18 indicates sheep numbers in communal and commercial farming areas since 1988.

Sheep Numbers
From 1992 onwards a significant decrease in total sheep numbers occurred. The majority of sheep occur in Namibia's commercial farming areas. Sheep do not appear to be very popular among communal farmers.
**Goat Numbers**

The small stock numbers in the country increased by 4.8% (192,080 units) from 4,015,372 head of small stock (sheep and goats) at the end of 1996 to 4,250,178 at the end of 1997.

**Small Stock Marketing**

A total of 953,685 head of small stock was marketed during 1997 compared to 1,059,434 during 1996. This represents a decrease of 10.0% (105,769 units) as a result of stock rebuilding after the drought of 1996.

Small stock exports to South Africa decreased considerably by 6.8% (62,763 units) from 928,714 head of small stock exported during 1996 to 865,951 exported during 1997. Few small stock were slaughtered at municipal abattoirs during 1997. The decrease in comparison to 1996 was 31.7% (40,808 units). During 1997 only 87,714 head of small stock were slaughtered locally compared to 128,522 during 1996. A total of 949,617 kg of mutton and goat meat were imported into Namibia during 1997. This is 168,184 kg (21.8%) more than during 1996 when 772,433 kg mutton and goat meat were imported.

The average carcass price in South Africa for small stock increased by 1.2% from N$ 10.68/kg in January 1997 to N$ 10.81/kg by the end of December 1997. The average auction price for lamb and goat during 1997 was N$ 7.17/kg and N$ 6.86/kg respectively. For 1996 the average auction price for lamb and goat was N$ 6.55/kg and N$ 4.50/kg respectively. This contributes to a 9% increase in the auction price for lamb and 25% increase in the auction price for goat. Cheaper imported mutton will be readily available on the market, resulting in an over supply and downward pressure of producer prices. **Figure 2.20** overleaf indicates the average auction prices for lamb carcasses at all RSA markets for 1996 and 1997.
Karakul production

The Karakul industry is experiencing a revival due to the increased pelt prices since 1996 and during the June 1998 Swakara auction. Pelt production was at its lowest ever in 1997 when the national Karakul herd decreased to below 200 000. The demand for Swakara however, has increased to such an extent that it exceeds the current pelt production. The higher price level caused the production price index for Karakul pelts to increase to the highest level ever, even higher than the index for mutton production. Figure 2.21 indicates pelt production relative to the national Karakul herd from 1962 onwards.

In 1974 more than 100 % pelts were produced from the national Karakul herd. The extremely high pelt production in 1984 was due to a drastic reduction in ewes after the lambs were slaughtered.
Karakul numbers reached an all-time low in 1996 and pelt production is on the increase again since 1997.

The real change in pelt prices from 1989 to 1998 is presented in Figure 2.22. A steady increase occurred from 1996 onwards with the highest price in 1998.

Fig. 2.22: Real change in pelt prices since 1989 (Karakul Breeders Society, 1998)

**Pork production**

Butchers slaughtered 26 534 pigs for the period January to December 1997, which is 16 % (5 041 units) less than the number of pigs slaughtered in 1996 (31 575 units). Approximately 20 162 pigs were imported during 1997 which is 15,5 % (2 701 units) more than the number of pigs imported during 1996. In order to satisfy local demand, approximately 2,7 tons of pork were imported. Producer prices for pigs were on average N$ 7.44/kg. This is 15 % lower than the N$ 8.75/kg which producers received during 1996. It is forecasted that pork auction prices will be static but could be dragged down somewhat by other meat types. It is expected that an increase in feed costs in the future could put some pressure on producer prices.

Fig. 2.23: Marketing of pigs at butchers in Namibia (live imports from RSA included) from 1987 to 1997 (Meatboard, 1997).
2.5.2 Crop and Horticultural Production

With a mean annual rainfall of approximately 250 mm, Namibia has the driest climate in sub-Saharan Africa. There is a large regional variation in the amount of annual rainfall, ranging from an average of 20 mm in the dry south-west to 600 mm in the Caprivi region in the north-east. The entire country is subject to very high evapo-transpiration rates. The rainfall patterns vary within and between years and the country is susceptible to recurrent droughts. The erratic nature of rainfall, compounded with the general poor quality of soil renders the land largely unsuitable for cultivation. Some 97 per cent of the country's soils have a clay content of less than 5 per cent. Considering soils and rainfall, only about 1 per cent of the land surface, or 820,000 hectares, is considered to have medium to high potential for rainfed and irrigated crop production (RoN. 1995).

Crop production is also constrained by unfavourable market conditions. Namibia's low and widely dispersed population makes the achievement of economies of scale in production, processing and marketing difficult. On the other hand, colonial policies aimed at integrating Namibia into South African markets, combined with good road infra-structure mean it is easier and cheaper to import crop products from South Africa, Zimbabwe and Zambia, where, with their favourable agro-environments, production costs are lower.

Despite the above conditions, low-input and extensive crop cultivation is widely practised mainly in the communal areas, particularly in the north, with a total area under both rain-fed and irrigated crop production in the 1998/99 season estimated at 330,300 hectares of which 295,600 hectares and 34,700 hectares are subsistence (mixed with semi-commercial) and commercial, respectively (Namibian Agronomic Board. 1999). Crop production occupied about 355,000 hectares of land in the 1996/97 season, which was the largest area harvested since records started (RoN. 1999). The country has some 7,500 hectares under irrigation (T. Basson. pers. com), and about 25,000 hectares are used for high input rainfed crop production by large scale commercial farmers in the Grootfontein area.

Pearl millet is the major staple produced and consumed locally in the Omusati, Oshana, Oshikoto and Kavango Regions, while maize and pearl millet are the main staples produced and consumed in the Kunene and Caprivi Regions. In these northern Regions low input-low output, subsistence dryland cropping mainly of pearl millet, maize, sorghum, cowpeas, bambaranas and groundnuts is combined with extensive cattle and goat production, characterised by communal tenure of grazing and low off-take rates. Local varieties of cultivated green leafy vegetables and cucurbits, as well as a number of wild fruits and vegetables form an important component of the diet. Livestock are a vital part of all crop farming systems providing both traction and manure, though more and more households have lost their livestock, and are multi-purpose trees and shrubs.

The different grain producer types, which have recently been identified on the basis of available data, are shown the following table (RoN. 1997).
Table 2.5: Namibian grain producer types

<table>
<thead>
<tr>
<th>Description</th>
<th>Omusati, Oshana, Ohangwena, Oshikoto</th>
<th>Kavango</th>
<th>Caprivi</th>
<th>Private-tenure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 ha</td>
<td>70,345</td>
<td>8,946</td>
<td>10,567</td>
<td></td>
</tr>
<tr>
<td>5-10 ha</td>
<td>9,526</td>
<td>971</td>
<td>993</td>
<td></td>
</tr>
<tr>
<td>10+ ha</td>
<td>588</td>
<td>208</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>NDC (farmer support prog.)</td>
<td>-</td>
<td>139</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>NDC schemes</td>
<td>1 (Etunda)</td>
<td>3 (Shitemo, Shadikongoro, Musesee)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Private dryland</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>86</td>
</tr>
<tr>
<td>Private irrigated</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>35</td>
</tr>
</tbody>
</table>

A review of changing farming practices indicates some of the changing pressures on arable land.

In most of northern Namibia labour shortages and lack of access to oxen power, not lack of arable land, is the main constraint to production. Labour shortages are in turn the result of the low value of crop production per unit of labour input (due to the high risk of grain crop failure and the lack of cash cropping opportunities) which results in out-migration from cropping areas. This means that farming methods involve low labour inputs. Even in areas with relatively high population densities (e.g. the Cuvelai Basin and the south bank of the Okavango River) returns from cropping are insufficient to be an incentive for greater use of inputs (see tables below).

Table 2.6  Rural household welfare indicators in Kavango Region

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of households</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No cattle</td>
<td>44 %</td>
<td>26 %</td>
<td>30 %</td>
</tr>
<tr>
<td>1-10 heads</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 10 heads</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average area cultivated per household (ha)</td>
<td>4.2 ha</td>
<td>7.0 ha</td>
<td>10.6 ha</td>
</tr>
<tr>
<td>Net value of crop production per household labour day (N$/day)</td>
<td>7.4</td>
<td>9.4</td>
<td>11.1</td>
</tr>
</tbody>
</table>

* Non-farm cash + livestock & crops production ** over the agricultural season (Nov. to June)

Table 2.7  Rural household welfare indicators in Caprivi Region

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of households</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No cattle</td>
<td>16 %</td>
<td>30 %</td>
<td>53 %</td>
</tr>
<tr>
<td>1-15 heads</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 15 heads</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average area cultivated per household (ha)</td>
<td>4.2 ha</td>
<td>8.0 ha</td>
<td>10.6 ha</td>
</tr>
<tr>
<td>Net value of crop production per household labour day (N$/day)</td>
<td>29</td>
<td>33</td>
<td>36</td>
</tr>
</tbody>
</table>

* Non-farm cash + livestock & crops production ** over the agricultural season (Sep. to June)

(Source: RoN. 1997; RoN. 1999)

Farmers are interested in measures that will increase the efficiency with which the major resources of labour and oxen power are used. These could be labour-saving devices, such as cultivators for
weeding, or ploughs for cultivation, or improved inputs such as seeds and fertilisers to increase yields per unit of labour/power.

In practice, fertiliser use is insignificant, despite the fact that fertiliser has been sold in the northern communal areas by the MAWRD in the last few years at about one fifth of commercial retail prices. This because of uneconomic rates of return given frequent crop failures and high labour requirements. The table below looks at the value cost ratio (VCR) of pearl millet and fertiliser. The value cost ratio is a ratio of the value of increased yield to the cost of fertiliser per unit. A VCR of 2.0 is usually considered the absolute minimum for fertiliser use to be efficient, while VCRs in excess of 3 are needed if farmers are to have a strong incentive to risk such investment (König et al. 1997).

**Table 2.8 Value cost ratio of Pearl Millet and Fertiliser**

<table>
<thead>
<tr>
<th></th>
<th>No Fert.</th>
<th>Subsidised Fert.</th>
<th>Commercial Fert.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of pearl millet (threshed) - 300 kg/ha (no fertiliser) and 750 kg/ha (fertiliser) @ N$ 1.60/kg</td>
<td>480</td>
<td>1200</td>
<td>1200</td>
</tr>
<tr>
<td>Seed (Okashana-subsidised)</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Fertiliser -</td>
<td></td>
<td>64.5</td>
<td>308</td>
</tr>
<tr>
<td>3 x 50 kg bags basal 2:3:2 (30%)</td>
<td></td>
<td>32</td>
<td>189</td>
</tr>
<tr>
<td>2 x 50 kg bags urea topdressing</td>
<td></td>
<td>15</td>
<td>66</td>
</tr>
<tr>
<td>AgrifBank Interest @ 13%&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>280</td>
<td>280</td>
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<tr>
<td>Incremental labour - 28 days @ N$ 10&lt;sup&gt;3&lt;/sup&gt;</td>
<td>386.5</td>
<td>856</td>
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<tr>
<td>Total costs</td>
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<tr>
<td>Net value&lt;sup&gt;4&lt;/sup&gt;</td>
<td>485</td>
<td>813.5</td>
<td>344</td>
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</tbody>
</table>

Value Cost Ratio (VCR) - N$ 720 worth of additional pearl millet costing an additional N$ 386.5 to produce using subsidised fertiliser, and N$ 856 using commercial fertiliser = 1.86 in the case of subsidised fertiliser, and 0.84 in the case of commercial fertiliser.

<sup>1</sup> Figures used in this box derive from production figures and prices in the north central Regions of the NCAs, assuming good rains, and that draught animal powered tilling and weeding is used, as presented in a draft paper prepared by the RDSP (RDSP. 1997), and from retail fertiliser prices from Agra Groofotein.

<sup>2</sup> The National Agricultural Credit Program’s interest rates are due to rise annually until parity with commercial interest rates is achieved.

<sup>3</sup> Assuming a combination of family and hired labour.

<sup>4</sup> This only includes the incremental costs of labour due to the use of fertiliser.

(Source: Vigne & Whiteside. 1997)

Likewise, the application of manure is minimal. Animal manure is commonly used only in the relatively densely populated Cuvalei Basin area, where fallowing is minimal, but amounts of available manure are sufficient only for a small proportion of the overall cultivated area. The main constraints to manure use are insufficient supply, lack of low labour input manure storage, treatment, transport and application methods, and in some areas competing demand for manure as fuel. On the other hand, movement of dwellings and kraals within field areas acts to recycle nutrients. Another important means of restoring nutrients is the intercropping of legumes, principally cowpeas, bambaranuts and groundnuts.
Rather than intensify the existing farming systems, households have turned to various sources of off-farm incomes and livelihood diversification, such that crop production is estimated to provide relatively little contribution to total household incomes. The limited value of crop production and the lack of cash crops mean there is little incentive for farmers to adopt practices to maintain soil fertility.

2.5.2.1 Rainfed Crop Production

The major rainfed crops produced in Namibia are discussed below.

**Pearl millet**

Pearl millet (or mahangu) is the main cereal crop suited to the prevailing conditions in the Omusati, Oshana, Ohangwena, and Oshikoto Regions. It is grown by farmers throughout the northern communal areas where it is the staple grain of most people (other than in Kunene and Capriví Regions where some communities prefer maize). During the 1992/93 MAWRD/ICRISAT surveys it was found that the average area cultivated by female headed households was 2.3 hectares compared to 3.8 hectares cultivated by male headed households. Only 9 per cent of farmers in the northern communal areas were found to be cultivating over 8.5 hectares (RoN. No date).

Mahangu self-sufficiency at the household level is only achieved by a minority of households. 58 per cent of all households in the Omusati, Oshana, Ohangwena, and Oshikoto Regions may be expected to buy in grains in any one year to make up for shortfalls in production. In Kavango, where rainfall is more reliable and land more available, only 19 per cent usually buy it (Keyler, 1994). Millet is the preferred staple of most Namibians which is reflected in market prices for various grains and their products both in rural and urban markets.

Short season varieties including the famous “Okashana Number 1”, and more recently other new varieties, provide greater drought avoidance. Yields are normally in the range of 100 - 400 kg/ha. These may be doubled with limited applications of nitrogen and phosphorus, but because of the risk of crop failure due to drought, and the extra labour they require, mineral fertilisers are not used (see Part 3 of this report).

**Maize**

Maize is used to produce green maize, which is eaten shortly after picking, and dry grain, from which maize meal is made. Because of its soils and climate yields of maize are much lower in Namibia than in neighbouring countries. Even with some supplementary irrigation yields of only 6.5 tonnes/ha can be achieved. Without supplementary irrigation plant populations must be drastically reduced and yields of only 3 - 4 tonnes/ha are normal even years of good rains.

**Sorghum**

Sorghum is grown mainly for brewing purposes throughout northern Namibia, particularly in areas where it has access to increased soil moisture - such as beside osmana. It is estimated to constitute only some 7 per cent of grain production in the Omsati, Oshana, Ohangwena, and Oshikoto Regions (Keyler, 1994), and the mean area set aside for sorghum per grower is surveyed to be 0.16 hectares (RoN. No date). It is usually grown in close association with pearl millet and therefore area and yield statistics collected by the NEWFIU combine the two.

**Legumes**

Cowpeas, and to a lesser extent bambarawants and groundnuts, are important intercrops with mahangu, sorghum and maize throughout the north, though to differing degrees according to local preference. Cowpeas are particularly valuable because of their tolerance of heat, low rainfall and poor quality soils. Legumes provide an important source of dietary protein for both man and livestock (in the form of dried residues).

**Cotton**

In the 1970’c some 4 to 5,000 hectares of cotton were grown annually. Production declined because of high transport costs, low prices and labour problems. In the 1998/99 season some 3,670 hectares were grown, of which about 850 hectares were planted under irrigation below Hardap and Naute dams, as well as in other irrigation schemes (Namibian Agronomic Board. 1999). The remainder was planted on dry land, mainly in the commercial sub-sector.
Cotton is sown in October-November, with picking starting in April in the south and May-June in the north. Yields average around 3.3 tonnes/hectares with irrigation and 0.9 tonnes/hectares rain-fed. Cotton is one of the few crops for which Namibia has environmental comparative advantage over other countries in the region. Long hours of sunshine and well-drained soils produce high quality long staple length which is in high demand. It is a crop which is well suited to both small-holders and commercial farmers.

The government has established a Cotton Task Force to promote the crop. Efforts to promote the growing of the crop under rain-fed conditions in the north-east are now gathering momentum. One of the major constraints facing cotton production is the high cost of transport to ginneries in South Africa. A cotton ginnery is proposed for either Tsumeb or Grootfontein. This follows the successful trials in the north-central and north-east. It is necessary that there should be a certain minimum area of commercial irrigated cotton to ensure a critical minimum supply to make operating a ginnery in Namibia worthwhile. The other major problem is shortage of skilled labour.

Oriental Tobacco
Oriental tobacco is suited to Namibia’s climate and soil, and trials indicate it can be grown profitably given a minimum amount of irrigation. Recent local research and development efforts has led to two tobacco production initiatives: one communal and one private-tenure, and both likely to expand and be replicated elsewhere in Namibia. Current production totals approximately 25 hectares. The advantages of oriental tobacco production are that the crop only needs around one fifth of the water required by maize and is around five times more valuable.

There are some 10 hectares under oriental tobacco at Sesfontein. Virginia tobacco is grown on at least one commercial farm in Caprivi. Several commercial tobacco companies in the region are interested in developing tobacco.

Sunflower
Dwarf short season sunflower varieties can do well on sandy soils with rainfall as low as 250 mm. if well distributed. Constraints are poorly distributed rainfall and poor soils. Small areas of sunflower have been grown in the Grootfontein area and in the Caprivi. Manual oil pressing has been promoted in the Caprivi.

Production statistics

Information on areas under production and yields of different coarse grain cereals (both communal and commercial) from 1991/92 to 1998/99 is indicated in Table 2.9 (NEWFIU, 1999).

Little or no data was collected on coarse grain production in the communal sub-sector prior to 1991/92. It should also be noted that, due to inter-cropping, which is widely practised in the communal sub-sector, it has not been possible in terms of areas statistics to treat sorghum and millet separately, instead these grains are lumped together. Again, maize in most of the communal areas is often consumed green as a vegetable, while data on maize in both sub-sectors reflects only grain production (NEWFIU, 1999).

It is also worth noting that some production, particularly maize, though based in the communal areas, is actually commercial or semi-commercial. This is produced on Namibia Development Corporation irrigation projects beside the Kavango river and Etunda in the Omusati region, or by commercially organised communal farmers in Kavango and Caprivi regions.
### TABLE 2.9a: Total (Irrigated and Rain-fed) Coarse Grain Production in Thousand Tonnes

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<tr>
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<td></td>
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<tr>
<td>Millet/sorghum</td>
<td>176.6</td>
<td>171.2</td>
<td>310.7</td>
<td>298.4</td>
<td>297.0</td>
<td>321.7</td>
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<td>17.2</td>
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<td>117.1</td>
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<td>Maize (rain-fed)</td>
<td>15.5</td>
<td>14.8</td>
<td>14.0</td>
<td>9.0</td>
<td>12.8</td>
<td>16.7</td>
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<td>0.4</td>
<td>8.7</td>
<td>3.2</td>
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<td>0.5</td>
<td>0.6</td>
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<td>3.2</td>
<td>2.9</td>
<td>2.0</td>
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<td>2.6</td>
<td>3.2</td>
<td>3.7</td>
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<tr>
<td><strong>Sub-total</strong></td>
<td>205.6</td>
<td>186.5</td>
<td>325.3</td>
<td>307.8</td>
<td>310.3</td>
<td>339.0</td>
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<td>282.3</td>
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</tr>
<tr>
<td>Millet/sorghum</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.7</td>
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<tr>
<td>Maize (rain-fed)</td>
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<td>17.3</td>
<td>7.5</td>
<td>13.0</td>
<td>13.2</td>
<td>12.9</td>
<td>14.3</td>
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<tr>
<td></td>
<td>5.2</td>
<td>13.5</td>
<td>34.4</td>
<td>2.9</td>
<td>8.3</td>
<td>30.1</td>
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<td>Maize (irrigated)</td>
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<td>0.6</td>
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<td>1.6</td>
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</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td>23.4</td>
<td>14.2</td>
<td>17.9</td>
<td>8.6</td>
<td>13.3</td>
<td>13.4</td>
<td>13.7</td>
<td>16.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>216.1</td>
<td>200.6</td>
<td>343.2</td>
<td>316.4</td>
<td>323.6</td>
<td>352.4</td>
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</tbody>
</table>

*The output is in Italic and appears below the hectares
Some figures are rounded and may not fully correspond with information in other sources.

*Source: Namibia Early Warning and Food Information Unit (Information collected through annual crop assessment missions)*

Agriculture & Land Resources SoER Consortium
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<td>Cotton (tonnes)</td>
<td>142</td>
<td>240</td>
<td>296</td>
<td>400</td>
<td>600</td>
<td>1200</td>
<td>1990</td>
<td>2000</td>
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<td>1300</td>
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<td>2350</td>
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<td>1835</td>
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<td>2100</td>
<td>2200</td>
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<td>Lucerne (tonnes)</td>
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<td>230</td>
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<td>410</td>
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<td>Grapes (tonnes)</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>2298</td>
<td>2748</td>
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<td>2800</td>
<td>5700</td>
<td>5271</td>
<td>2896</td>
</tr>
<tr>
<td>Wheat (tonnes)</td>
<td>557</td>
<td>591</td>
<td>674</td>
<td>778</td>
<td>828</td>
<td>828</td>
<td>890</td>
<td>1053</td>
<td>1110</td>
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<tr>
<td>Price (N$/tonne)</td>
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<td>39600</td>
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<tr>
<td>White maize (tonnes)</td>
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<td>464</td>
<td>493</td>
<td>637</td>
<td>701</td>
<td>850</td>
<td>920</td>
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<td>1915</td>
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<td>1234</td>
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<td>Yellow maize (tonnes)</td>
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<td>438</td>
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<td>701</td>
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<td>41100</td>
<td>64500</td>
<td>117100</td>
<td>37090</td>
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</table>

Source: RoN. 1999.
2.5.2.2 Irrigated Crop Production

There are several irrigation schemes scattered throughout the country, concentrated mainly along the perennial rivers on the borders and below the dams in the interior. These schemes are privately, government and/or Namibia Development Corporation managed projects. Some of the government projects are research oriented while others are used to train and or resettle farmers.

Most schemes use centre-pivots and sprinkler irrigation systems. There is also a limited use of micro- and drip systems. Flooding, which is said to be the most inefficient, is mainly practised at the Hardap scheme.

The 1998/99 total cereal output is estimated at 75,500 tons, comprising 48,200 tons of millet/sorghum, 22,300 tons white maize and 5,000 tons of wheat. Of these cereals, only white maize is both irrigated and rain-fed, while millet/sorghum and wheat are entirely rain-fed and irrigated, respectively. Only about 13,000 tons (5,000 tons of wheat and 8,000 tons of white maize), representing 17% of locally produced cereals came from irrigated land. This contributes a mere 5.4% to the total domestic utilisation (food use, non-food uses and closing stocks), calculated at 239,000 tons of cereals (millet, sorghum, maize and wheat) (NEWFRIU. 1999).

The major crops produced under irrigation in Namibia are discussed below.

Grapes, dates and melons
Grape production has proved successful in the Aussenkehr area and elsewhere on both the Namibian and South African sides of the lower Orange River. Production is earlier than other southern African production areas. The major boost to the grape industry came from preferential access to the European market. In 1996 the Aussenkehr farm alone harvested 450,000 cartons, or over two thousand tons of grapes, from 150 hectares in production, and employed over 1,000 people during the peak harvest season in December and January. In the 1998/99 season, about 1,000 hectares were planted to grapes. The latest production methods are used to ensure they do not loose the niche they have established. Therefore the highest standard possible are observed at all levels of production.

A Date Production Support Programme was initiated by the Government in 1993. Dates are being grown profitably under the management of the Namibia Development Corporation in a number of places including the Naute Dam scheme. In 1998/99 some 260 hectares of dates were under cultivation.

Sweat melons grown in the Stampriet and Aussenkehr areas have been successfully exported to Europe for the past few years. Gallia and yellow honeydew melons are now under production and exports should commence in the near future. Water melons can be grown for the small Namibian market and the Cape winter market. The recently introduced muskmelons for export are grown in furrows using overhead and drip irrigation systems.

Wheat
South African and Zimbabwean winter wheat varieties are sown in May and June and harvested in November. Average yields are about 5.6 tons/hectares. This requires 700 - 900-kg fertiliser and 8 - 9 m3/hectares of water are needed. Wheat is better suited to the southern parts of Namibia with their cooler winters, which decreases the likelihood of fungal disease, and early rains delaying harvests. In Hardap under flood irrigation wheat is only marginally profitable despite low water prices. Domestic purchases by the millers are usually around 5,000 tons per annum. Alternative winter crop options include winter legumes and vegetables.

Cotton (see under rainfed above)

Vegetables
Horticulture in Namibia is constrained by climatic conditions, soils, lack of management skills, poor market development, and significant competition from South Africa. Horticultural statistics is very scanty. However, it is estimated that in 1997, about 200 tonnes were produced. It is assumed that the output level has since improved and could have been at some 230 tons in 1999 (Namibian Agronomic Board. 1999). There are about 250 hectares of vegetables grown annually, all under
irrigation; if the green maize (which is also a vegetable) is included, the figure can go as high as 430 hectares.

On small-holder irrigation schemes in the north vegetables are a sideline usually to supply local demand. The main crops grown include green maize, onions, pumpkins and cabbages, usually with low inputs and little pest control. Yields and consequently surpluses, for sale as well as quality are generally low and variable.

Due to the nature of horticultural information, both with regard to supply and demand, it is not yet clear what percentage of domestic requirement in vegetables is met through domestic production. The vegetable imports, mainly from South Africa, are estimated at 20,000 tonnes annually (Von Bach, 1998) This figure includes cabbage, beans, carrots, onions, potatoes, tomatoes and "other"; its reliability is uncertain. The market demand dictates that retailers, even in the case of Katima Mulilo, purchases from South Africa several thousand kilometres away rather than from local growers around the town. This is partly because local producers cannot provide continuity of supply year round sand are limited, for climate reasons, to only certain types and varieties. The current situation may be compared to the era before road and rail links with South Africa when Namibia was self-sufficient in horticultural products.

Other fruits
As with vegetables, marketing and transport constraints have limited fruit production to small areas. Also most of Namibia is too cold and frost prone in winter. This is not conducive for most tropical fruits. Another factor is Namibia's extended diurnal-temperature range which prohibits many tropical crops, but is suited to melons for example. As a result, there are only some 70 hectares of land mainly under citrus and mangoes.

Lucerne and other fodder crops
Lucerne is well suited to the deep sandy loam soils found in Namibia's irrigated areas, and yields averages of about 22 t/hectares/annum of air-dried hay. Production is fully mechanised and there is a good market both in Namibia and South Africa. Most Lucerne is grown in Hardap under flood irrigation. Water use at 25 to 34 Ml per hectares is high and a small fall in producer price or increase in water prices could make it unprofitable.

Rice
Rice was proved a viable crop in Caprivi region before independence. Trials on a 40 hectare required and achieve yields of 8.5 tonnes/ha to break even. Apart from some recent trial plots in the oshana areas, there is no significant rice production in Namibia. However, about 4,000 hectares in the Lake Llambesi area are said to be very suitable for rice production.

Sugar cane
Sugar cane is only planted on forty hectares at Isize in the Caprivi region for seed production. Government plans to put between 10,000 and 15,000 hectares under sugar cane in the former Lake Llambesi in the Caprivi region. This will involve huge investment in piped water from the Zambezi River, as well as the construction of flood control measures, and means of dealing with fertilised waste water in ways that do not pollute the Chobe River. Trials have demonstrated that sugar cane yields of 100 tonnes/hectare are possible (Schaffer & Associates, 1998).

Irrigation development
It is stated in Namibia's Water and Sanitation Policy of 1993 that the irrigation sector should be geared towards:
- improving sustainable national food self-sufficiency and security;
- promoting improved nutrition and surplus production at household level;
- supporting sustainable settlements, and stimulating development of viable arable agriculture.

Given the unreliability of rain and the generally poor quality soil, the government policy of food self-sufficiency and substitution of food imports will only be realised if more land is put under irrigation. However, the crop production sector will have to cooperate with other sectors for the country's limited water resources. This state of affairs has necessitated prioritisation not only on the basis of economic
outputs of each sector per cubic metre of water used, but considering also the basic needs of humans and livestock as well as various other socio-economic aspects. Irrigation, together with other industries such as mining and processing, is ranked as a second priority (Boois. 1999).

Currently (1998/99 season) only some 7,500 hectares are developed throughout the country, against the estimated potential of about 40,000 hectares (L. Hugo. Pers. Comm.) This shows that apart from the scarcity of water and the high investment required, there is also limited area suited for irrigation. The sizes of the existing irrigation schemes vary between two hectares and over 2,000 hectares. They are concentrated mainly along the perennial rivers and below the Naute and Hardap dams in the southern interior of Namibia. Underground water sources are also used in for small to medium-scale irrigation schemes at Stampriet, Sesfontein area and in and around the Maize Triangle (Grootfontein-Otavi-Tsumeb). Whether adequate water supply can be guaranteed for new large-scale irrigation schemes will largely depend on the details of particular agreements with neighbouring countries with which Namibia shares its border rivers: the Orange, Okavango and Kwando-Chobe and Zambezi rivers.

Water Demand for Irrigation
According to the latest annual report produced by the Ministry of Agriculture, Water and Rural Development (MAWRD. No date) covering the period April 1996 to March 1997, the Directorate of Water Supply (now NamWater) supplied 94,213,632 m$^3$ of water for various purposes throughout the country. Of this, 53,352,370 (57%) was for primary consumers (including domestic, livestock, and industrial purposes), 5,052,306 (5%) was for mining, and 35,808,956 (38%) was for irrigation. In 1998, agriculture consumed approximately 64 percent of total water use, estimated at 280.9 Mm$^3$. The use for irrigation alone takes up 75 percent of water used in agricultural production, higher than the global average of 69 percent. However, compared to other sectors such as mining and fishing, the use of water in the agriculture sector is less productive due to high usage of water in irrigation, and the generally low economic returns to agriculture as a whole. The value added per m$^3$ of water used is only N$37.20 (Boois. 1999). In a country with a growing demand for water from primary consumers, and a limited supply, which is vulnerable to drought, the allocation of water for irrigation is being increasingly carefully considered.

Water use, particularly in large-scale irrigation schemes is heavily subsidised and this has resulted in the use of inefficient irrigation methods, while the effects on overall agricultural growth remained negligible. While, in 1963, irrigation used three times as much water as livestock, the production value was only two percent of that of livestock. Agriculture (livestock and both rain-fed and irrigated crops) contributes only about nine percent (9%) to the GDP. This clearly shows that, of all the economic activities that use water, irrigation features the lowest value added to each m$^3$. There is growing appreciation at the policy-making level of the need to switch from the low-value staple food crops to cash crops (Boois. 1999).

Until the Namibia Water Company (NamWater) was formally established in April 1998, irrigation farmers were charged for water according to the number of hectares of crops grown and not for the actual units of water consumed. This is still the case in schemes where metering facilities are not yet installed, including the Hardap Scheme. Recently, NamWater increased the bulk water charges from 12c/m$^3$ to 14.2c/m$^3$. However, this new rate caused concern among irrigation farmers, and is currently being disputed by various stakeholders on the basis that it does not reflect real costs. If the new rate is finally implemented as proposed, irrigation farmers, particularly those that are still farming with low-value crops such as white maize will be severely affected. Reportedly, under irrigation and at the current rates, only producers that manage a minimum of 5.5 tons per hectare will break even. At the moment, the average yield per hectare for irrigated cereals (maize and wheat) is estimated at 5 tons per hectare, with some farmers only managing about 3 tons per hectare (P. Klein. Pers. Comm.)

It is now generally realised that the best option for the irrigation sub-sector would be to focus on the production of high value crops and leave the ever-present cereal deficit to be met through cheap imports from low-cost production countries which benefit from comparative environmental advantages.
The government and private sector have planned significant new irrigation investments along the perennial rivers. Once developed, these schemes will definitely increase the demand for irrigation water. However, the ultimate demand will most likely be primarily determined by the combination of water pricing policy, the value of crops that will be cultivated under irrigation and the provisions of interstate water-use agreements. The availability of land (estimated at 40,000 hectares potential) will not be a major problem issue in the medium term.

The Ministry of Agriculture, Water and Rural Development has recently instituted a Water Management Review Team, which is tasked with investigating water resources, and demand thereof, and pricing since the establishment of NamWater. Since the findings and recommendations of the Water Resources Management Review (which is currently underway) are not yet known, it is still not possible to indicate what further developments may be expected concerning the irrigation sector in Namibia.

Irrigation activities 1998/99
Information gathered by the NEWFIM indicates that, out of the total area of 330,200 hectares of land planted during the 1998/99 cropping season, only two percent (2%) is under irrigation.

The information presented in the table below on hectares planted under different crops at different projects was gathered by the SOER project from the main irrigation schemes. Windhoek Consulting Engineers, working under the auspices of the Water Management Review, is, at the time of reporting, in the process of preparing a comprehensive and detailed account of all irrigation schemes nationally. Although not yet finalised, this study includes some 200 different schemes, and reveals that a total of some 7,500 hectares was irrigated last year. The study also estimates total irrigation potential to be around 70,000 hectares nationally.
## Table 2.10 Hectares planted to different crops during 1998/99

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Total hectares developed</th>
<th>Hectares not yet developed</th>
<th>Cereals</th>
<th>Grapes</th>
<th>Dates</th>
<th>Ground-nuts</th>
<th>Melons</th>
<th>Vegetables</th>
<th>Other fruits</th>
<th>Lucerne</th>
<th>Cotton</th>
<th>Tobacco</th>
<th>Others or fallow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groot Gariep Boerdery</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIVEX</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAGRAPEX</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Namibia Grape Company (Orange river)</td>
<td>360</td>
<td>360</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GRN Aussenkehr Scheme (Orange river)</td>
<td>130</td>
<td>110</td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardap Co-operative (Hardap dam on Fish river)</td>
<td>2,300</td>
<td>176</td>
<td>120</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>750</td>
<td>645</td>
<td></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Naute (Naute dam on Fish river)</td>
<td>270</td>
<td>330</td>
<td>56</td>
<td>20</td>
<td>82</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>56</td>
</tr>
<tr>
<td>Stampsriet (Underground Aquifers)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sesfontein (Underground Aquifers)</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

Agriculture & Land Resources SoER Consortium
<table>
<thead>
<tr>
<th>Area</th>
<th>Land Area (ha)</th>
<th>Water Use (m³)</th>
<th>Water Use (m³)</th>
<th>Water Use (m³)</th>
<th>Water Use (m³)</th>
<th>Total Water Use (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Etunda (Calueque canal)</td>
<td>640</td>
<td>560</td>
<td>270</td>
<td>30</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Aussenkehr Farms Pty. Ltd. (Orange river)</td>
<td>340</td>
<td>1,200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shitemo (Kavango river)</td>
<td>380</td>
<td>640</td>
<td>256</td>
<td>56</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Museshe (Kavango river)</td>
<td>135</td>
<td>865</td>
<td>1,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vungu Vungu (Kavango river)</td>
<td>67</td>
<td>533</td>
<td></td>
<td></td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>Shadikongoro (Kavango river)</td>
<td>270</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>145</td>
</tr>
<tr>
<td>Others (Kavango river)</td>
<td>100</td>
<td>15</td>
<td></td>
<td>25</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>Katima Farm (Zambezi river)</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I Site Project (Zambezi river)</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Maize Triangle (Underground Water)</td>
<td>800</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4,000</td>
</tr>
<tr>
<td>Eersbegin</td>
<td>35</td>
<td>66</td>
<td></td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others (Water from Underground Aquifers and dams?)</td>
<td>18</td>
<td></td>
<td></td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total: 6,094 hectares (excluding StAMPriet, Sesfontein and other smaller irrigation schemes which are estimated to bring the total to 7,500 hectares currently in operation).

Please note: total potential is shown in *italics*; while hectares occupied by settler farmers are both *italics and underlined*.

Source: Namibian Agronomic Board and NDC

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Food security and food self-sufficiency

It is clear that Namibia cannot produce its domestic grain requirements even in a good year. Therefore, depending on the annual rains, between 50 percent and 80 percent of the market demand for cereals has to be imported. The official cereal imports constitute mainly white maize (maize imports fluctuate negatively in relation to domestic maize and millet-sorghum output) for human consumption (yellow maize is mainly for livestock consumption), wheat (90% of domestic requirement), fruits and vegetables (70% of domestic requirement) and all of rice.

However, it is considered that Namibia does not experience food security problems in relation to overall availability of food at national level. For example, food exports were N$1,571 million against food imports of N$1,043 million in 1993. The government is aiming at enhancing this situation by promoting the production of crops suited to the country's semi-arid situation (Directorate of Planning - DoP, MAWRD, 1997).

Namibia has ready access to the world grain market and borders one of the world's major producers of white maize - South Africa (whose costs of production are significantly lower than Namibia's). There is, therefore, virtually no reason why the country will be unable to import food (DoP, 1997). Cereal imports from South Africa where rainfall shortages is not as problematic as in Namibia cost N$800 per tonne in 1999, while local white maize production costs more than N$1,000 per tonne.

Given the level of staple food production and the scarcity and/or location of potential irrigation water sources in Namibia, any moves towards self-sufficiency would require massive investment in irrigation. The cereal production shortfall has averaged approximately 115,000 tons over the then past six years (DoP, 1996). With an average of 5.5 tons per hectare it is estimated that, in addition to the 6,000 hectares then currently under irrigation, an additional 21,000 was required to be for Namibia to seek to become self-sufficient in food grains. The size of investment would be in excess of N$1,300 million, which could not be justified economically, because experience to date has shown that irrigation schemes that produce cereal crops (which are of a low value) in Namibia have so far been unable to meet even their operating costs. However, the government is keen that the country's irrigation potential be exploited to the fullest to maximise development (DoP, 1997).

2.5.3 Forest Utilisation and Production

While the MET's National Forest Inventory project and the National Botanical Research Institute's Vegetation Mapping project are still in process, Gies's (Gies, 1971) vegetation classification is still taken as the standard reference. The characteristics of the three main vegetation classes are summarised below.
Table 2.11: Characteristics of the three main vegetation classes

<table>
<thead>
<tr>
<th>Vegetation class</th>
<th>Percentage of Namibia’s land area/ approx. total hectares</th>
<th>Description</th>
<th>Utilisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deserts</td>
<td>18% and 13 million ha</td>
<td>Varies from the desert and succulent steppe in coastal areas to shrubs and grasses around the Etosha Pan and in river beds of the northern Namib desert</td>
<td>Biodiversity, wildlife habitat and livestock grazing</td>
</tr>
<tr>
<td>Savannahs</td>
<td>64% and 53 million ha</td>
<td>Varies from desert shrubs in eastern and southern Namibia to Mopane woods in the north and north-east.</td>
<td>Livestock grazing, biodiversity, wildlife habitat, multiple wood products.</td>
</tr>
<tr>
<td>Woodlands</td>
<td>20% and 16 million ha</td>
<td>Varies from savannah trees and woodlands in north-west, the Caprivi Strip, the Waterberg Plateau, and riverine woodlands, to areas in the Erongo Mountains</td>
<td>Dry season grazing, watershed protection, biodiversity, multiple wood products including timber.</td>
</tr>
</tbody>
</table>

(Sources: Gles. 1971, and RoN. 1999)

Other, smaller, but important woodland resources are those found along the permanent river systems of northern Namibia, as well as the ephemeral rivers throughout the country, which provide vital support to human and livestock populations and biodiversity. Also, Namibia boasts about 250 hectares of plantations, including smaller planted woodlots, which contain mainly *Eucalyptus*, as well as amongst others the indigenous *Sclerocarya birrea*.

**Forest resources utilisation**

This section of the report adopts a broad view of the term forest, including not only conventional forests, but also the benefits of trees generally to other land use systems and rural livelihoods.

A study of consumption of wood products in Namibia in 1990 (Ollikainen. 1991) produced the following findings:

Table 2.12: Estimated consumption of wood products in Namibia 1990

<table>
<thead>
<tr>
<th>Category</th>
<th>Production (000*)</th>
<th>Imports (000*)</th>
<th>Exports (000*)</th>
<th>Consumption (000*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuelwood - rural areas (m³)</td>
<td>1540</td>
<td>-</td>
<td>-</td>
<td>1540</td>
</tr>
<tr>
<td>Fuelwood - urban areas (m³)</td>
<td>120</td>
<td>-</td>
<td>-</td>
<td>120</td>
</tr>
<tr>
<td>Sawmwood (m³)</td>
<td>3.1</td>
<td>22</td>
<td>1.2</td>
<td>23.9</td>
</tr>
<tr>
<td>Wood-based panels (m³)</td>
<td>-</td>
<td>2.1</td>
<td>-</td>
<td>2.1</td>
</tr>
<tr>
<td>Charcoal (tons)</td>
<td>14</td>
<td>-</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Electricity poles (m³)</td>
<td>-</td>
<td>4.4</td>
<td>-</td>
<td>4.4</td>
</tr>
<tr>
<td>Telephone poles (m³)</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Fencing poles (m³)</td>
<td>-</td>
<td>12</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>Mining (m³)</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td>15</td>
</tr>
</tbody>
</table>

(Adapted from Ollikainen. 1991)
In 1996, the government estimated that the annual value of forest resources utilised amounted to N$ 1,058, as per the table below.

Table: 2.13: Estimated annual economic value of forest resources exploitation (1996)

<table>
<thead>
<tr>
<th>Product</th>
<th>Main species</th>
<th>Annual value (N$ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction poles</td>
<td>Mopane</td>
<td>383</td>
</tr>
<tr>
<td>Tourism</td>
<td>Ecosystem</td>
<td>218</td>
</tr>
<tr>
<td>Fences for crop protection</td>
<td>Mopane</td>
<td>175</td>
</tr>
<tr>
<td>Firewood</td>
<td>Mopane <em>Acacia spp</em></td>
<td>131</td>
</tr>
<tr>
<td>Medicine</td>
<td>Various</td>
<td>31.5</td>
</tr>
<tr>
<td>Kraals</td>
<td>Mopane</td>
<td>31</td>
</tr>
<tr>
<td>Charcoal</td>
<td>Various bush invaders</td>
<td>22.4</td>
</tr>
<tr>
<td>Crafts and Implements</td>
<td>Various</td>
<td>21</td>
</tr>
<tr>
<td>Mahangu baskets</td>
<td>Mopane</td>
<td>12.4</td>
</tr>
<tr>
<td>Goat forage</td>
<td>Various</td>
<td>8.5</td>
</tr>
<tr>
<td>Fencing poles</td>
<td>Mopane</td>
<td>6.6</td>
</tr>
<tr>
<td>Food</td>
<td>Marula oil</td>
<td>4.6</td>
</tr>
<tr>
<td>Basketry</td>
<td><em>Hyphaene spp</em></td>
<td>4</td>
</tr>
<tr>
<td>Commercial logging</td>
<td><em>Pterocarpus, Baikea</em></td>
<td>2.4</td>
</tr>
<tr>
<td>Mortar and pestle</td>
<td>Various hardwoods</td>
<td>1.5</td>
</tr>
<tr>
<td>Beverages</td>
<td>Various</td>
<td>1.5</td>
</tr>
<tr>
<td>Ornamental roots</td>
<td>Mopane</td>
<td>1.1</td>
</tr>
<tr>
<td>Carving</td>
<td>Various</td>
<td>1</td>
</tr>
<tr>
<td>Mopane worms</td>
<td>Mopane</td>
<td>0.5</td>
</tr>
<tr>
<td>Food</td>
<td>Mangetti kernels</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Total Economic Value 1058.2

(Source: Marsh. 1996; RoN. 1996)

The methodologies used in deriving the figures presented in both these tables are questionable. Certainly much of the basic data needed to make these estimates was lacking. Table 2.9 also raises questions of definition; for instance on the definition of 'crafts and implements' and 'carving'. Realistically, they can only be considered as educated guesses. More work needs to be done on the production and consumption and value of forest products, particularly at the local level where for many communities forests play a central role in livelihood systems. This should contribute to advocacy for sustainable forest management practices.

Another more holistic approach to assessing the value of forests is to consider their place in people's overall livelihood systems. Here one is continually struck throughout northern Namibia, in particular, by the central role played by forests and trees in traditional livelihood systems. The predominant farming system, particularly in more densely settled areas, has rightly been termed an 'agro-silvopastoral system' (Kreike. 1995). It includes a crop component, cattle and goats, and a mix of multi-purpose trees and shrubs. The system is integrated and highly dynamic and flexible, enabling survival in a marginal and risk-prone natural environment.

Key timber products are discussed below.

Construction poles
In the north central regions the construction of traditional palisade dwellings and cattle kraals uses large amounts of wood, particularly termite-resistant hardwoods such as mopane, *Combretum hereroense*, *C. imberbe*, and *Terminalia*. Hardwoods can be used for fifty years or more and are moved from site to site as dwellings and kraals are moved periodically.
**State of the Environment Report on Agriculture and Land Resources**

*T. sericea* is possibly the most important species used in Kavango Region (Flower & Van Rooyen. No date) as it is widely distributed, is relatively fast growing, coppices and pollards well, and produces poles of the right size that are easy to harvest. A study in Kavango (Robinson. 1996) found that it comprised 42 per cent of poles used in hut walls and 90 per cent of those used for roofing. This study also found that an average sized hut consumed 160 poles with an average diameter of 5-7cm and 1.5-3m length.

In the last decade as wood has become scarcer the use of alternative building materials has grown. Bundles of mahangu stalks or thin branches may be used to construct palisade walls, while cement bricks and corrugated iron are increasingly used for house construction.

**Fencing posts**

Fencing posts used on commercial farms are almost exclusively imported. Fencing in communal areas consumes large amounts of wood. Because posts are often untreated they need to be replaced frequently. Preferred species are the same as for construction. New land legislation may lead to more efficient commercial approaches to fencing which may again be expected to rely on imports.

Crop fields are still commonly fenced with thorny *Acacia* species. Live fencing is practiced in some areas, using species such as *Euphorbia tirucalli* and *Commiphora angolensis*.

**Firewood**

Firewood is the used for cooking by more households than any other fuel source nationally. It is the main source of energy for 90% of rural households, and is also increasingly important in peri-urban and urban areas as economic hardship increases. Nationally, recent surveys indicate that 49.2 per cent of all households rely on firewood as their principle source of energy for cooking (29.6 per cent on electricity, 16.8 per cent on gas, 2.4 per cent on agricultural wastes and 2 per cent on kerosene (Wamukonya & Hamutwe. 1998). One study estimated average firewood consumption at 0.57 kg/person/day or 0.2 tons/person/year. Marsh suggest a higher figure of 1 ton/person/year may be more accurate (Marsh & Seely. 1992). Ollikainen (Ollikainen. 1991) also assumed a figure of 1 ton/person/year from studies in other African countries.

Hard wood species that are used for construction are also those favoured for firewood. Dead wood is preferred to green because it is lighter and can be burned immediately. Trees are thus often killed in advance of when they will be required. While firewood is still abundant and supply is not considered a problem in most of Kavango and Capriv, the same cannot be said of former Ovamboland where in many areas it is very scarce. Firewood is sold in all of Namibia’s urban areas.

**Charcoal**

Charcoal production is largely restricted to commercial farming areas where it fulfills the dual purpose of generating income and clearing bush encroached range land. The best quality charcoal is produced from the most aggressive encroachers, namely *Acacia mellifera* (Black Thorn), *Dickrostachys cinerea* (Sickle Bush), and *Terminalia pruniodes* (Deurmekaar) (Bester and Reed, 1997).

Domestic consumption accounts for only a small share of national charcoal consumption. Exports are mainly to Europe (433 tonnes in 1997/98) and South Africa (13,537 tonnes in 1997/98). The local market consumes up to 10,000 tonnes annually. Recovery rates range from about 20 per cent when for high quality braai charcoal, and much higher when 'fines' are used for making briquettes. The export market is expected to be influenced by emerging international requirements for forest product certification.

**Carving, crafts and implements**

Traditionally, most domestic and farming implements were made from wood. For instance, cups were made from *Commiphora angolensis*, ploughs from *Combretum imberbe*, and axes, tool handles, yokes, sledges, ladders are made from a number of species.

Nowadays, three types of woodcarving products made in northern Namibia can be distinguished (Terry et al. 1994).

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1. Traditional functional artifacts, including bows and arrows, walking sticks, cooking sticks and spoons, pestles and mortars and musical instruments, which if well made can be sold to tourists.
2. Contemporary crafts such as masks, drums, animal figures, toys, bowls, and other items sold as curios.
3. Furniture including tables and chairs often made with modern tools.

One exported specialist wood product is sand blasted roots of *Colophospermum mopane* (in 1997/98 436 tonnes to South Africa, 152 tonnes to Europe, 29 tonnes to the USA). These could be further processed in Namibia.

There is a lack of reliable information on the number of carvers at work nor on the value of their production. The figures given in Table 2.13 would appear reasonable, and reflects the fact that the industry has a long way to go before it reaches its potential.

**Commercial logging**

In the 1940s there was major demand for pit props in the Tsumeb area which led to the depletion of Tamboul (Sporostachys africana) and Mopane (Colophospermum mopane), amongst other species. In modern times commercial logging has been restricted to the woodlands of north-east Namibia. Large scale extraction however was limited by lack of infrastructure. Between 1955 and 1959 two concessionaires cut 11,405 ft³ and 71,061 ft³ of dry and wet Klaat respectively (Lau & Reiner, 1993). There was no idea of how much of the resource was available and little way of controlling extraction.

There are sawmills in Rundu and Katima Mulilo (both government owned), and a mobile sawmill belonging to a private company. The concessions are given to cut timber and to run the government mill has been held by a number of companies. While some records were kept it is likely that control was lax. In 1980, a local enterprise, MKU, were contracted by the Directorate of Forestry with stricter conditions. This contract was ended in 1993. Flower reports that during this period MKU cut a total of 13,965 m³ of timber, 90 per cent of which was P. Angolensis (and the rest *B. plurijuga* and *G. coleosperma*). Since then only the DBC has operated a small saw mill obtaining wood for planks from DoF permits for individual mainly P. Angolensis trees. A Gobabis furniture business also operates on the permit system taking mainly *G. coleosperma*. All monies earned from timber concessions since independence goes to the Treasury.

Domestic consumption of sawn wood and wood-based panels and boards are currently almost all supplied by imports.

At present there is only one concession in operation in the Kavango Region, which is reportedly awarded on the basis of pre-harvest inventories (RoN, 1999).

**Key non-timber products** are discussed below.

**Livestock forage and fodder**

Tree and shrub browse provide an important source of livestock nutrition particularly during drought periods and in the dry season. They are either browsed directly from the trees or branches or are cut and given to livestock. Important fodder species include: *Baphia massaiaensis*, *Lonchocarpus nelii*, *Balkia plurijuga*, *Bauhinia macrantha*, *Boscia albitrunca*, and *Colophospermum mopane*. Some species (eg. *F. Albida*) are valued because they remain green through the dry season while others produce new leaves in the spring well before the rain starts and grass growth starts.

**Food** (including fruits, nuts, leaves, tubers, bulbs, edible gums, marula oil, mopane worms, Mangetti fruits, kernels and oil)

Before the advent of agriculture to Namibia, probably some two thousand years ago, forest foods were central to food security. Up until a few hundred years ago, communities we now think of as
comprising settled farmers grew crops only to supplement the foods they gathered from the wild and that they got from their livestock. Today, forest foods and income from forest products still play a vital role for many communities especially in times of food shortages.

Mangetti (*Schinziopython rautanenii*) is commonly ranked as the most important species by people living in areas where it grows. While its fruit are used to ferment and distill alcoholic drinks and spirits, its kernel is highly nutritious and produces a valuable oil. The importance of alcohol in the local economy is of great importance, providing a major source of income. Mangetti can be stored for up to two years, so that its processing can take place when labour is available.

The Directorate of Forestry is planning the promotion and improvement of indigenous fruit trees. Three species will be selected from the following shortlist: *Sclerocarya birrea*, *Berchemia discolor*, *Strychnos cocculoides* and *S. pungens*, *Grewia sp.*, *Garcinia livingstonii*, and *Syzygium cordatum*.

**Medicine and cosmetics**

About half of the 110 species with scientific names and 190 species whose scientific names are not known listed in Flower are said to have medicinal uses (Flower & Van Rooyen. No date). Stroebach (Stroebach, 1998) lists 251 out of 336 species of economic value as being used for medicinal purposes. Many people today collect their own medicines while medicinal plant materials are also widely used by traditional healers and are available in urban markets. Devil's claw, *Harpagophyllum procumbens*, is a particularly well-known example of a medicinal plant with significant export value (particularly if communal harvesting can be organised in a sustainable manner).

Other non-timber forest products include:

- Fruits which may be eaten or traded or processed, or made into various beverages.
- Chemicals for dying, tanning leather and poisoning fish.
- Grass used for thatching.
- Bark for making rope.
- Palm leaves for making baskets.
- Reeds for making mats.
- Pollen and nectar for honey bees
Forests are important components of rural livelihoods systems, which often include a number of agroforestry practices; they provide recreational and tourist attractions, and fulfil important environmental functions.

Forests and rural livelihoods
Forests are of vital significance to the livelihoods of many communities, particularly in northern Namibia. As already noted, their products are consumed as food, they provide fuel and building materials, they provide grazing and browse for livestock, and forest products are the basis of much rural small and medium enterprise. Forest resources are vast compared to other sources of primary production, and constitute the largest and potentially most productive opportunity for livelihoods diversification. Harvesting of forest products, requiring as it does, little more than labour (and transport in places), can be carried out by the poorest of the poor.

For instance, Keyler (Keyler. 1994) found that 20 per cent of households in the northern communal areas gain some income from the sale of veld fruit, and 19% from the sale of alcoholic beverages made from forest fruit. This contrasts with community surveys in the Kavango Region (Kakukura et al. 1997) in which forest products were ranked as the most important form of enterprise (equal to millet and livestock production, and above legume and sorghum production and fishing), and where 100 per cent of households were involved in non-agricultural, home-based enterprise involving forest products.

Two studies of villages in the Kavango Region (Brouwer. 1995, Robinson. 1996) found that 89 per cent and 100 per cent of households in their respective cases study villages collected wild fruits. Fruits were found to be increasingly sold and bartered as trees decrease. Some fruit can be stored for long periods which is particularly useful insurance against the shock of drought. The most important period for fruit collection is November to January when stocks of grain are lowest and before early plants crops have produced.

Ethnobotanical, anthropological and forestry and agroforestry related surveys indicate that many species of trees, shrubs, herbs and grasses found in forests are widely used. A literature review (Flower & Van Rooyen. No date) lists 110 tree species and their uses. More recent research (Strohbach. 1998) identified 336 indigenous plant species in the Kavango Region with economic potential of which 160 were for medicinal use only, 85 were edible only and 91 were both edible and had medicinal uses.

As would be expected forest products are most important:
- in less densely populated areas where many trees still remain;
- to the more food insecure (especially female-headed households);
- in times of drought.

Agroforestry
The term agroforestry is used to refers to a wide variety of practices in which trees are closely associated with and benefit crops, livestock and range production. In this broad sense, it does not only refer to growing trees on farm land but to all of the many ways trees and forests benefit farming.

Important benefits of trees in agroforestry, in addition to those already mentioned, include shade for people, crops and livestock; fences to stop livestock invading crop fields; windbreaks to stop erosion and crop damage; and soil improvement through nitrogen fixation and bringing nutrients from underground to the surface and by breaking up compacted soils.

The soil improvement benefits of trees have traditionally been achieved by leaving land fallow and shifting to new land which is cleared. With increasing population densities shifting and fallowing becomes more difficult. It is only in the more remote areas away from settlements (e.g. in parts of the Mangetti area of Oshikoto Region and the Kavango Region's 'inland' area) that it is still practised to any extent.

Interventions to promote the benefits of agroforestry are discussed in part 4.

Recreation and tourism
21 proclaimed parks and reserves account for 13.8 per cent of Namibia's land area. At the same time community tourism, private nature reserves and game farms also account for an increased area
of protected forest. These areas and the wildlife they contain represent probably the major attraction for foreign tourist, who by the year 2000 are projected to contribute gross foreign exchange earnings of N$1 billion and to provide employment to 20,000 people (Holm-Petersen, 1996). The topic of national parks and tourism is to be discussed by another State of the Environment Report and will not therefore be discussed further in this report. Here it is simply noted that forests are a vital component in this important sector of the economy.

Environmental functions
Namibia's Forest Strategic Plan (RoN. 1996) states that:

"the most important functions of natural forest resources in the Namibian national economy, in priority order, are:

- Forest environmental protection
- Provision of specialised local forest products
- Support to wildlife activity and ecotourism."

And:

"Although the economic value of the regulatory functions provided by the forest resources is currently difficult to quantify, it is plausible to assume that it outweighs that of forest productive use in the national economy."

The Strategic Plan document goes on to state that:

"Conservation of soil and water resources constitute (sic) the most important service to be derived from sustainable management of the national forest resources, which will benefit mainly agricultural production."

Agriculture, particularly arable agriculture, is directly responsible for much more of Namibia's deforestation. Hence, what is being advocated is not the conservation of natural forests per se but the use of trees in farming systems. As discussed under (sections on arable and range lands) trees protect watershed from physical erosion, protect land from wind erosion, and contribute to maintenance of soil fertility through biomass production and nitrogen fixation.

The argument continues that:

"Another important environmental function of the savannas and woodlands is their biological diversity, genetic material and the potential impact of their ecosystems on the climate through the ability of the forests to sequester carbon."

However, the contribution of Namibia's forests to preventing global warming is surely negligible when considering the enormous mass of forests being lost and already lost in tropical and temperate regions. On the other hand, it is likely that through their influence on albedo effects and water cycles forests do influence micro-climates. It is also clear that Namibian forests play a role in preventing soil erosion and controlling water flow and quality in important river catchments. For example, the upper catchments of Namibia's west-flowing ephemeral rivers are protected by the forested areas of the central plateau, and while its northern perennial rivers, and their ecology, are likewise protected by forested catchment areas (Kojwang, 1995).

A balance between maximum resource productivity and sustainability of natural resource use must be the objective of Namibia's forest management policies. In places this means that agriculture may have comparative advantage over forest production. One key issue is that of land use planning to ensure that change takes place in an environmentally-safe and efficient manner.
2.5.4 Wildlife Production and Utilisation

The issue of wildlife on farms in Namibia is surprisingly poorly covered in the literature. Barnes & De Jager (1995) assessed the industry on the basis of questionnaire returns from 1972 and 1992 and also assessed the economics of the enterprise. Although the Ministry of Environment and Tourism issues permits for game utilisation on farms, there has been no thorough evaluation of the data held by the MET permit office. Recent assessments of the current status of the game farming industry are based on localised empirical evidence rather than a thorough examination of data.

Wildlife (or game) production is largely restricted to the privately owned commercial farmlands. The basic form of land use on these farms is extensive livestock production, with large stock practices dominating the northern parts of the country and small stock being most important in the south. Empirical evidence indicates that a significant amount of land in these areas has been converted from livestock production to wildlife (at least in part) in recent years. The industry is estimated to be worth about N$ 60 million a year. A major shift in attitudes towards wildlife on private farmlands resulted from the promulgation of legislation in 1975 which granted ownership rights to those individuals on whose farms the game occurred. As farmers were then afforded the right to use wildlife for financial gain, game became a valuable commodity.

The development of conservancies in the communal areas of Namibia has followed the promulgation of an amendment to the Nature Conservation Ordinance in 1995. This affords the rights to ownership and utilisation of wildlife products (game, vegetation, etc.) to be held by residents of an area. The conservancies on communal lands are in the early stages of development and are generally being developed for ecotourism, with concessionary trophy hunting being another source of income. Game numbers are low and as most fall north of the Veterinary Gordon Fence the potential for live game sales is minimal.

Wildlife production (and utilisation) on private farm land has generally developed as a supplementary activity to livestock production, but more and more farmers are investing in this sector with a number having converted to operations devoted purely to game production. The scale and type of operation varies considerably from farm to farm. The majority of farmers maintain a mixed farming system with the emphasis on livestock production but with game being actively encouraged on farms. Direct investments in the game production side are generally low. A smaller number of farms have wildlife as their main source of income either as specialised trophy hunting farms or non-consumptive wildlife viewing tourism. These farms tend to be well stocked with a wide range of species (some not indigenous to Namibia). The capital development costs of these pure wildlife enterprises is high in terms of game stock and fencing. Barnes & De Jager (1995) determined that the mixed farming enterprises were economically efficient but with financial profitability being generally low. They also found that there are financial incentives for landholders to group together to form conservancies. These larger land units benefit from economies of scale and so are more financially viable and robust. Conservancies have been formed around the country, with most being found in the central regions, North of Windhoek (Table 2.14).
Table 2.14: Estimated annual economic value of forest resources exploitation (1996)

<table>
<thead>
<tr>
<th>Name</th>
<th>District</th>
<th>No. of Farms</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Nossob</td>
<td>Hochveld</td>
<td>50</td>
<td>176 283</td>
</tr>
<tr>
<td>Dordabis</td>
<td>Dordabis</td>
<td>52</td>
<td>206 851</td>
</tr>
<tr>
<td>Khomas Hochland</td>
<td>Windhoek</td>
<td>36</td>
<td>171 502</td>
</tr>
<tr>
<td>Namatanga</td>
<td>Windhoek</td>
<td>26</td>
<td>88 570</td>
</tr>
<tr>
<td>Ngarangombe</td>
<td>Grootfontein</td>
<td>19</td>
<td>81 209</td>
</tr>
<tr>
<td>Ombotozu</td>
<td>Okahandja</td>
<td>68</td>
<td>326 244</td>
</tr>
<tr>
<td>Omirunga</td>
<td>Grootfontein</td>
<td>47</td>
<td>162 451</td>
</tr>
<tr>
<td>Otavi Mountain</td>
<td>Otavi</td>
<td>12</td>
<td>59 385</td>
</tr>
<tr>
<td>Owipuka</td>
<td>Otjiwarongo</td>
<td>24</td>
<td>107 502</td>
</tr>
<tr>
<td>Seeis</td>
<td>Seeis</td>
<td>65</td>
<td>271 508</td>
</tr>
<tr>
<td>Swakopdal</td>
<td>Okahandja</td>
<td>30</td>
<td>145 907</td>
</tr>
<tr>
<td>Tiras</td>
<td>Aus</td>
<td>12</td>
<td>133 456</td>
</tr>
<tr>
<td>Waterberg</td>
<td>Otjiwarongo</td>
<td>29</td>
<td>105 399</td>
</tr>
</tbody>
</table>

With the exception of the conservancies being established on communal lands little is known about the wildlife production industry in Namibia. It is an enterprise that has seemingly "fallen through the cracks" with little involvement by the MAWRD and with the declining involvement of the MET in the commercial farming areas as more resources are directed towards conservation in the communal lands. The trends of growth in the wildlife production industry have gone largely untracked, but it is unlikely that there have been any negative impacts on the environment overall. Diversification of land use practices is seen as being a major step towards sustainable land use and as such wildlife production should be strongly encouraged in Namibia.

2.5.5 Freshwater Fisheries

This report aims to address the state of freshwater fisheries in relation to issues of resource production and utilisation. It does not attempt a comprehensive review of freshwater fisheries biodiversity issues which, it is expected, will be addressed elsewhere in the State of the Environment Reporting initiative.

Freshwater fisheries make an important contribution to household food security and nutrition in northern Namibia, particularly along the Okavango, Zambezi, Chobe, Kwando-Linyanti river systems and in the oshana areas and lakes (eg. Lake Oponono and the Olushandja Dam in the north central region). These areas support the highest densities of rural people in Namibia, for many of whom fish is an important source of protein rich food and income, particularly in times of drought.

According to the 1995 White Paper on the Responsible Management of Inland Fisheries of Namibia (RoN, 1995) approximately 2,800 tonnes of freshwater fish are caught in Namibia annually. The White Paper makes the point that freshwater fisheries benefits more Namibians directly, albeit to a lesser extent, than does marine fisheries.

Fisheries are perhaps most abundant in the eastern Caprivi flood plain where fish are an important aspect of Caprivian life. It is estimated that 20% of Caprivian households or some 3,600 households are involved with fisheries, and that average annual consumption is 400 grammes of fish per person.
Katima Mulilo boasts Namibia's only freshwater fish market. Fish are dried and transported to other northern regions for sale. Based on a total estimated production of 1,500 tonnes and an average value of N$ 9/kg, at current prices, the value of the Caprivian fishery is about N$ 12 million per annum. The most commonly caught species are the threespot tilapia (Oreochromis andersonii), catfish (Clarias gariepinus and C. ngamensis), greenhead tilapia (Oreochromis macrochir) and redbreast tilapia (Tilapia rendalli). A total of 81 different species have been recorded in the Zambezi River and associated flood plains.

The Okavango River is relatively small, with significant seasonal floods, and its banks are densely populated. During the rainy season its flood plain area increases from some 110 km² to some 434 km² at its peak. The river is used for irrigation, drinking, washing and watering livestock, and riverine vegetation is cut for various purposes. Fishing takes place mainly as the flood plain dries and fish are concentrated in pools. Fish traps, corrals, and fences, as well as rod and line, scoop baskets, and mosquito nets and shade cloth are used. This practice means that fingerlings are caught before they are able to grow to anything approaching maturity when their yield would be higher. "Passive" gear, such as traps, is preferred in periods of peak labour demand, for obvious reasons. Natural poisons are also used. 83 fish species have been recorded in the river. The most commonly caught species are from the families Cichlidae, Cyprinidae, Claridae, Characidae and Mochokidae. The productivity of the river has not been well researched and productivity estimates range from 840 and 3,000 tonnes annually, with the most recent study estimating a yield of 1,045 tonnes being caught on the Namibian side of the river (Tveteren et al. 1994). At an average value of N$ 9/kg, the value of the Namibian Okavango fishery is about N$ 9 million per annum.

Oshanas, being seasonal, are only a temporary source of fresh fish. 49 species have been identified, many of which have invaded from the Kunene River via the canal and pipeline. The fishery also varies in its extent in line with the extent of the annual flood, and no estimates of total productivity have been made. When the Cuvelial system, which derives from near the Sierra Encocoo Mountains between the upper reaches of the Kunene and Okavango Rivers in Angola, floods, fish move southwards in large numbers up to 200 kilometres. Large-scale flooding (known as etundja) is much less common nowadays than in the past. When fish reach the oshana system they may be considered available for total exploitation. Large numbers of people catch fish during the short season as the oshanas dry up. This should have no impact on the parent populations. Hence, sustainable management of the oshana fisheries essentially involves conservation of parent stocks in Angola (Marsh and Seely, 1992). On the other hand, intensive fishing of the upper parts of the oshana system early in the season may prevent fish from moving in numbers further downstream. Traditional management systems, controlled by headmen, were recorded as recently as 1976 (van der Waal, 1991) but now seem to have died out. Van der Waal also recorded new forms of exploitation at man-made drainage structures, and estimated that about 4,200 kg of fish were collected at seven culverts between Oshakati and Oshana in a single day during the flood period. Marsh and Seely (Marsh and Seely, 1992) suggest that the most important species caught in the oshana are Clarius spp. (catfish), Barbus paludinosus (the straight-fin barb), and Oreochromis andersonii (the three-spot tilapia). In the oshana area most of the fish caught is dried, enabling it to be stored for long periods, or sold fresh. There is a considerable market of freshwater fish in the north central regions, where it fetches double the price of marine species such as hake and horse mackerel.

It may be noted that the Kunene River's fisheries resource, including 68 species (Holtzhausen, 1991) as well as the freshwater prawn, Macrobrachium vollenhovenii, is barely exploited. This is partly because of the eating habits of the local Ovahimba and Ovaherero populations. The exploitation of the Orange River's 17 reported species of fish is solely for recreational purposes.

Finally, it may be noted that although freshwater fish farming or aquaculture has clear potential in much of Namibia, in terms of stocking both wild waters and constructed ponds and dams, as demonstrated by a number of initiatives (including the Hardap Inland Fisheries Research Station, the Rural Development Centre, Ongwediva, and Mahanene Research Station), it has never been adequately supported by the government, and remains an untapped development opportunity, particularly in communal areas. Likewise, it is reported that fisheries production from state dams is under-developed. The most productive dams are Hardap (124 tonnes p.a.) Naute (99.5 tonnes p.a.), Omatako (71.4 tonnes p.a.), von Bach (19.1 tonnes p.a.) (Van Zyl & Hay, 1994).
PART 3: THE STATUS OF NATURAL RESOURCES IN NAMIBIA

What we understand by the terms natural resources change and degradation respectively is influenced by our appreciation of the concept of sustainability. On the one hand, the traditional conservationist view has for a long time defined sustainability exclusively in terms of natural resource management. The focus has been on management practices which immediately influence changes in natural resource status. The conservationist aims is to preserve or replenish natural resources.

Another view sees sustainability in terms of the overall stocks of physical capital (infrastructure, equipment and the means of production) as well as natural capital in whatever combination. This can allow for losses in biodiversity with the introduction of modern agriculture. It also takes a more holistic view, recognising that in our risk-prone natural environment, diversified and flexible livelihood strategies are essential, such that if one is stressed survival can be assured from the others.

The view which has been adopted by Namibia's SOER project goes further still. It sees sustainability dependent not only on natural resources or stocks of physical capital, but also on the institutions which support them. Hence, one of the SOER to be undertaken will focus on the state of Namibia's traditional, governmental and commercial institutions, as an essential element in the overall state of Namibia's environment.

This report considers degradation to have occurred when people's livelihood and natural resource systems, despite their apparently higher short-term productivity, are subject to greater risk of instability and upset. This upset can occur for a variety of reasons be it ecological, socio-economic or institutional. The results of upset in these areas are for example that irrigated soils can suffer from salinity, rainfed arable soils may be prone to erosion, while rangelands can become totally denuded of vegetation and also suffer from erosion. But, as should become evident in this chapter, the key words here are "can" and "may be". With the adoption of sound farming practices, supported by necessary socio-economic infrastructure and access to resources, and underpinned by sound institutions, these things need not and should not occur.

It is hoped that the description of resource status change, and the analysis of causal relationships with proximate and ultimate factors seen as responsible for these changes, that follows will enable us to see more clearly how we can better manage our resources. It should help us to identify what actions we can take to deal with the problems that can upset the fine balance between productivity and sustainability that we should strive for in the management of our agricultural and land resources.
3.1. Rangelands (including woodlands and savannah)

3.1.1. Biophysical indicators of resource status

Namibia is mainly a pastoral country where the major features are scarce productive land and fragile soils, coupled with limited water resources and an erratic rainfall regime. Namibia is the driest country in Africa south of the Sahel and can be divided into four main ecological zones. (Fig. 3.1)

Fig. 3.1: The four major ecological zones of Namibia (DRFN, 1996)

- the desert region, comprising 12% of the land area with a mean annual rainfall of less than 100 mm.
- the arid region, comprising 16% of the land area with a mean annual rainfall of between 100 and 300 mm.
- the semi-arid region, comprising 69% of the land area with a mean annual rainfall between 301 and 500 mm; and
- the semi-humid and sub-tropical region, comprising 3% of the land area with an annual rainfall between 501 and 700 mm.

About 34% of the land area receive more than 400 mm rainfall per year and can be seen as having some kind of potential for rainfed crop production. About 95% of these soils however have a clay content of less than 5% and only one percent of the land area has soils with a medium to high potential for rainfed or irrigated arable production. Although an estimated 274 000 ha in the northern communal areas are used by approximately 137 000 farm households for rainfed crop production, it can be clearly stated that Namibia has a very limited potential for rainfed crop production and that extensive livestock production is thus the major agricultural sector, taking into account that 85% to 90% of the nation's total agricultural income is derived from red meat production and livestock products. The country is largely unsuitable for crop production and possesses a varied potential for cattle and small stock farming.
Climate variability is characteristic of all drylands, but in Africa it is particularly potent. It results usually in a high degree of uncertainty in the behaviour of such ecosystems. This makes it difficult or impossible to predict the levels of production that the system might yield from one year to another, or how ecosystem structure may change over time. Systems which demonstrate this kind of behaviour, be they physical or biological, are sometimes categorised as non-equilibrium systems and the behaviour typical of these systems is called complex or non-linear dynamics (Pirguire, 1981). The theory of non-equilibrium dynamics is relatively new (Holling, 1973) and Walker et al. (1981) recognised the relevance of these ideas to arid savannahs and applied these approaches to the highly dynamic ecosystems of southern Africa.

Rainfall variability rather than the mean, is a more significant indicator in non-equilibrium environments. Coughley et al. (1987:5) judged that the threshold, where a system becomes dominated by variability more than by average conditions, occurs when rainfall CV (Coefficient of Variation) nears or exceeds 30 percent. They also suggest that where CV’s are below 20 percent, animal populations will remain relatively stable and strong feedback will develop between herbivores and plants.

Dry ecosystems are more unstable than wet ones because rainfall variability is inversely correlated with total rainfall. The lower the annual rainfall, the greater the coefficient of rainfall variation (Conrad, 1941). However dry equatorial systems are among the most variable on earth because rainfall variation is also negatively correlated with latitude. Variation also increases in regions influenced by sea surface temperature anomalies associated with El Nino-Southern Oscillation (ENSO) patterns. Nicholls and Wong (1990) developed a relationship which integrates the effects of total rainfall, latitude and ENSO on inter-annual rainfall CVs. Their analysis suggests that at latitudes near the equator, CV’s of 33 percent or greater will occur at rainfall levels of about 600 mm or less, in other words we can expect non-equilibrium dynamics in equatorial regions with less that about 600 mm rainfall. However, where ENSO effects prevail, then CV’s of 33 percent might be found even where rainfall levels are as high as 1400 mm.

At 30 degrees latitude CV’s of 33 percent or greater are likely at about 350 mm rainfall or below, if there are no ENSO effects. With ENSO effects, 33 percent CV’s could occur up to 600 mm rainfall (Nicholls and Wong, 1990). Based on this information, it is reasonable to hypothesise that rainfall CV’s might exceed 33 percent anywhere in Africa with 600 mm or less rainfall per year and in areas of southern and eastern Africa, where ENSO effects are prevalent, CV’s may surpass 33 percent, even where rainfall exceeds 1000 mm per year. Namibia is clearly a country with a non-equilibrium (brittle) environment.

Except for the far north and north east, Namibia experiences a semi-arid to arid climate. Three basic seasons occur: a hot wet season (January-April), a cool dry season (May-August) and a hot dry season (September-December). The mean annual rainfall decreases from about 600 mm in the far north-east to virtually zero towards the west and south (Fig. 3.2).
Fig 3.2: The rainfall isohyetal map of Namibia (Dept of Water Affairs, 1994)

3.1.1.1 The four fundamental ecosystem processes.

Many scientists today speak about different ecosystems, e.g. riparian-, grassland-, rangeland-, savannah ecosystems, etc. The boundaries that define these ecosystems are mostly artificial and managers seem to isolate these ecosystems from each other when trying to manage them. The word environment does not seem to promote the idea of boundaries to the same extend as the word ecosystem does. In this environment in general, and in the rangeland ecosystems of Namibia in particular, there are four fundamental processes that form the foundation that supports all human endeavour, all economies, all civilisations and all life (Savory, 1999).

The four fundamental processes are:

- The water cycle
- The mineral cycle
- The energy cycle
- Community dynamics

These four processes are fundamental to the condition and productivity of our rangelands in Namibia and their “health” will to a large extend describe the trend in desertification or land degradation. By focusing on these four processes and trying to improve them, the restoration of the condition and productivity of our rangelands will automatically follow.

The water cycle

For Namibia, the water cycle is perhaps the most important process in the ecosystem. The water cycle describes in general the process where water penetrates the soil, is available for as long as possible for plant...
growth and where the excess water will infiltrate to replenish underground water sources. Figure 3.3 illustrates effective and non-effective water cycles:

During the rainy season, rainfall will wet the soil layers down to level C where the water cycle is effective. The excess water will infiltrate through rock fragments to join underground supplies. In the non-effective (right) water cycle, most of the moisture will evaporate or run off after each rainfall and will not always wet soil layers deeper than level A and underground water sources will receive no recharge.

**Fig. 3.3. Effective and non-effective water cycles (Savory, 1999)**

Causes of a non-effective water cycle in Namibia's rangelands.

There are mainly two major direct causes for the non-effective water cycles in Namibia's rangelands. These causes are:

**High runoff of rainfall**

The biggest contributor to high runoff rates is the extent of bare ground in the rangelands of Namibia. The greater the amount of bare ground, the higher the rate of water runoff, especially after a heavy rainstorm and when the land surface is on a slope. Research done in South Africa indicates that with a slope of 5%, the run-off on veld with a good cover is only 5% but on veld with a similar slope but totally bare, the run-off can be as high as 30%. Actual soil losses recorded were 0.5 ton/ha and 28 ton/ha respectively (de Klerk, 1988). In the brittle environments of the United States of America, runoff rates are even higher. With a rainfall of 750 mm on one acre (0.405 ha) a total of 3,038 cubic meters of water will assemble. Over a million acres (405,000 ha) 3 billion cubic meters of water will assemble. If only half of that water were to run off, it will result in amazing floods (Savory, 1999).
The occurrence of bare ground in the rangelands of this country is alarmingly evident. Most of the soils in the communal farming areas are exposed (>80% bare soil), mainly due to overgrazing and a lack of sufficient recovery time after heavy utilisation. In most of the communal grazing areas the rangeland is constantly being grazed, resulting mainly in a loss of grass cover and an increase in forbs and other annuals. Most of the rangeland in the commercial farming areas look seemingly in a better condition in terms of ground cover. A distinction should however be made between the availability of fodder (production, which is mainly a function of rainfall) and the amount of bare ground between individual plants. Although individual grass tufts might be bigger in the commercial farming areas, the distance between them is still great, resulting in large areas of bare ground and subsequent higher risks for runoff.

Work done by Strohbach (1999) indicated large areas of Namibian rangelands where soil erosion and capping of the soil surface takes place. These are only preliminary data and follow-up work is in the process of being done. Table 3.1 indicates the types of soil erosion that were recorded in 1051 plots all over Namibia (See Fig. 3.4). These plots can all be traced with GPS for future references.

Table 3.1: Types and degree of soil erosion in different places of Namibia (Strohbach, 1999)

<table>
<thead>
<tr>
<th>Type and degree of Erosion</th>
<th>No of Plots</th>
<th>% of Plots</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>300</td>
<td>31.5</td>
</tr>
<tr>
<td>Slight wind erosion</td>
<td>38</td>
<td>3.8</td>
</tr>
<tr>
<td>Moderate wind erosion</td>
<td>14</td>
<td>1.5</td>
</tr>
<tr>
<td>Severe wind erosion</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Extreme wind erosion</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Slight sheet erosion</td>
<td>302</td>
<td>31.7</td>
</tr>
<tr>
<td>Moderate sheet erosion</td>
<td>213</td>
<td>22.4</td>
</tr>
<tr>
<td>Severe sheet erosion</td>
<td>69</td>
<td>7.3</td>
</tr>
<tr>
<td>Extreme sheet erosion</td>
<td>8</td>
<td>0.8</td>
</tr>
<tr>
<td>Slight rill erosion</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Moderate rill erosion</td>
<td>6</td>
<td>0.6</td>
</tr>
<tr>
<td>Severe rill erosion</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Extreme rill erosion</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total plots eroded</td>
<td>652</td>
<td>68.5</td>
</tr>
</tbody>
</table>

Three major types of erosion are reflected in this study (wind, sheet and rill) and in 68.5 % of all plots some form of erosion took place. The 31.5 % of the plots might not have shown real erosion, but it will be interesting to know what the condition of the soil surface is and to what extent bare soils are present.

In the same plots the degree of capping of the soil surface was also estimated. These data are presented in Table 3.2.
Table 3.2: Degree of capping of the topsoil in different places in Namibia (Strohbach, 1999)

<table>
<thead>
<tr>
<th>Degree of Capping</th>
<th>No of Plots</th>
<th>% of Plots</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>105</td>
<td>23.4</td>
</tr>
<tr>
<td>Slightly hard, thin</td>
<td>73</td>
<td>16.3</td>
</tr>
<tr>
<td>Slightly hard, medium thickness</td>
<td>58</td>
<td>13.0</td>
</tr>
<tr>
<td>Slightly hard, thick</td>
<td>24</td>
<td>5.4</td>
</tr>
<tr>
<td>Hard, thin</td>
<td>3</td>
<td>0.7</td>
</tr>
<tr>
<td>Hard, medium thickness</td>
<td>45</td>
<td>10.0</td>
</tr>
<tr>
<td>Hard, thick</td>
<td>61</td>
<td>13.6</td>
</tr>
<tr>
<td>Very hard, thin</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Very hard, medium thickness</td>
<td>25</td>
<td>5.6</td>
</tr>
<tr>
<td>Very hard, thick</td>
<td>53</td>
<td>11.8</td>
</tr>
<tr>
<td><strong>Total plots capped</strong></td>
<td><strong>343</strong></td>
<td><strong>76.6</strong></td>
</tr>
</tbody>
</table>

What is extremely alarming is that in 76.6% of the plots some form of capping of the topsoil occurred. In more than 30% of the plots these capped layers were thick which is absolutely detrimental to water infiltration and maintenance of an effective water cycle.

Fig. 3.4: The location of vegetation plots where data on erosion status and capping of topsoil were recorded (Strohbach, 1999 Map produced by Agro-ecological Zones project)

These plots indicated in Figure 3.4 are permanently marked and research on erosion, capping and vegetation is currently ongoing. The National Botanical Research Institute (NBRI) is taking the lead in this regard as a by-product of its vegetation mapping work.
High evapo-transpiration rates
If the amount of water lost through runoff is alarming, the amount lost through evapo-transpiration in the more brittle environments is equally more so. Evapo-transpiration reflects the total loss of water through evaporation off the bare ground and transpiration of plants, mainly bush encroached areas. When soils are bare with hard surfaces, like the situation in big parts of Namibia, water does not penetrate deep enough into the soil profile to be utilised by plants. The temperature in the bare soils are considerably higher than in soils covered with litter, which results into higher evaporation rates. The loss of soil moisture through transpiration due to bush encroachment is perhaps on of the most serious problems in Namibian rangelands, mainly in the commercial areas.

In the communal areas bush thickening is less serious than in the commercial farming areas. This is due to climate differences and frequent occurrence of fire. Savory (1999) is of the opinion that the presence of bush encroachment in the commercial areas can mainly be attributed to over-resting of the grass component. The fact that bush encroachment is less serious in the communal areas, is mainly because the cause for rangeland degradation is mainly due to overgrazing or partial rest. Most of the areas suffering from severe bush encroachment lies to the north of the 23 degree latitude. Between 10 -12 million hectares of rangeland in Namibia (approx. 12 - 14 % of the total land area) are estimated to be infested by undesirable bush species. Of this, 5.3 million hectares or 65% of the northern commercial farming areas, are seriously infested. In the central sub-region about 1.8 million hectares have been transformed into bush thicket, while in the southern areas *Rhigozum trichotomum* infests about 1.8 million hectares of rangeland (Bester, 1996). The thickening of *Acacia mellifera* is occurring mostly in the Otjiwarongo, Okahandja, Omaruru and Karibib districts as well as in parts of the Gobabis, Outjo and Grootfontein districts. *Dichrostachys cinerea* is a problem in the Tsumeb and Grootfontein districts while *Terminalia sericea* is posing a problem in the northern areas of the Gobabis district. Other species of concern are *Acacia erubescens*, *A. reficiens*, *Colospermum mopane* and *Combretum apiculatum* (Bester, 1996). Work done by Bester et al, 1999 for the Agro-ecological Zones programme indicates that large areas in the central commercial areas are opening up due to natural die-back of mainly *Acacia* species (See Fig. 3.5).

![Bush Densities in Namibia - 1999](image)

**Fig: 3.5** : The extent of bush encroachment in Namibia (Bester, Van Eck and Koelling, 1999)
Bush encroachment can, depending on the level of encroachment, decrease the carrying capacity of an area between 20% and 80%. After the chemical control of bushes, grass production can increase with up to 200% within two years after control. Even in 1987 it was estimated that this production increase could be as high as N$ 100 million per year. Recent studies of the cost of bush encroachment in the Oujjarong and Grootfontein areas (Ashley, 1994), indicate an estimated loss of around 34 000 tonnes of beef production worth N$ 102 million per year. This means around N$ 50 000 per farm. For the economy as a whole, this represents a serious loss of production, exports and national income.

Although the costs of bush encroachment are high in terms of lost production, the costs of combating it are also high. Most techniques are simply not worth it financially. Even in 1987 it was estimated that the cost of aerial applied chemical control methods would be between N$ 80 and N$ 150 per hectare, about three times more than the production value of the farms.

In a country like Namibia with very low and variable rainfall, it is of utmost importance that the soil moisture (rainfall) is used as effectively as possible to produce fodder with high palatability and nutrient value for animals. Moisture losses due to bush encroachment can be alarming when looking at research done in the Molopo area of South Africa. (Table 3.3).

### Table 3.3: Transpiration losses (kg/day) from an area of 500 bushes/ha for four different species in the Molopo area of South Africa (de Klerk, 1988)

<table>
<thead>
<tr>
<th>Bush species</th>
<th>Transpiration (kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grevia flava</td>
<td>3 842</td>
</tr>
<tr>
<td>Boscia albitrunca</td>
<td>6 920</td>
</tr>
<tr>
<td>Terminalia sericea</td>
<td>8 320</td>
</tr>
<tr>
<td>Acacia mellifera</td>
<td>32 400</td>
</tr>
</tbody>
</table>

The undesirable *A. mellifera* transpires up to 8 times faster than some of the other more palatable bush species. It is also important to mention that 100 000 *Schmidtia pappophorooides* grass tufts (palatable desirable grass) only transpire 11 600 kg per day and produce much better fodder for animals than *A. mellifera*.

**How to recognise a non-effective water cycle**

It is of the utmost importance to be able to recognise a non-effective water cycle in the rangelands as early as possible in order to try and rectify it. One of the first indicators is the presence of bare soils that are not covered with live or fallen plant material (litter). Other signs are litter banks where litter has been washed and caught against vegetation. More extreme forms of a non-effective water cycle are signs of water flow, exposed grass roots sticking up into the air in the space between plants, silt deposits, coarse pebble layers left on the bare surface and water levels in boreholes and springs lowering and ever drying up. People find it very difficult to recognise a non-effective water cycle. Managers are used to very demonstrative indicators like dongas and rivers drying up. It is important to be able to recognise the "smaller" indicators as mentioned.

**The mineral cycle**

Like water, minerals and other nutrients follow a cyclical pattern as they are used and reused by living organisations. A good mineral cycle implies a biologically active soil with adequate aeration and energy underground to sustain an abundance of organisms that are in continuous contact with nitrogen, oxygen and carbon from the atmosphere. Figure 3.6 illustrates good and poor mineral cycles in the rangeland ecosystem (Savory, 1999).
To benefit humans, wildlife and livestock, mineral nutrients have to be brought to above ground via living plants. To obtain maximum nutrient supplies in the active soil layers, minerals must continually be pumped up to the surface from deeper layers. After being used above ground by animals, they must be returned underground. Although plant roots are the main agents in mineral uplift, many small animals and microorganisms play an important role too.

There are clearly two major phases in mineral cycling. The first phase, from \textit{above ground to surface}, is where plant material moves from the plants to the soil surface and the second phase, from \textit{the soil surface to underground}, is where the plant material needs to move underground in order for the minerals to be reused. In less brittle environments, the topsoil has many micro-organisms that actively contribute towards breaking down the plant materials and releasing minerals. In the more brittle environments, like in Namibia, most of the plant material dies off during the dry season, as well as most of the micro-organisms. Therefore, large herbivores are needed to either trample the material down to the soil surface or to reduce its bulk by grazing and digesting it. All rangelands have evolved with animals over millions of years.
The key to the health of the mineral cycle lies in the condition of the soil surface. An exposed soil surface capped by the effects of rainfall, is a harsh micro-environment in which biological breakdown occurs slowly. Such a capped surface also limits air exchange between the soil and the atmosphere leading to reduced oxygen and excessive carbon dioxide, which generally inhibits root growth. As aeration decreases, so does life. As life decreases, so does organic material. As organic material decreases, so does soil structure. As soil structure decreases, so does aeration. As this cycle continues through the whole ecosystem, fewer plants produce less soil cover and more bare, capped soil results. This phenomenon occurs more explicitly in more brittle environments like Namibia.

**Energy Flow in the Ecosystem**
All organisms require energy to live. All of them depend on the ability of green plants to capture the energy from the sun and convert it to a form they can use. Traditionally the flow of sunlight to food is represented conceptually as an energy pyramid, as shown in Figure 3.7.

![Energy Pyramid Diagram](image)

**Fig. 3.7: The basic energy pyramid (Savory, 1999)**

Sunlight energy must first be converted by the plants at the base of the pyramid (level 1) before it can be utilised by other life forms. In order to increase the energy flow through the ecosystem, the base of the pyramid needs to be extended. The energy pyramid, however, also extends below ground where the energy flow greatly affects the health of the other three ecosystem processes — water cycle, mineral cycle and community dynamics. All three require a biologically active soil community that in turn requires solar energy to be conveyed underground mainly by plant roots or surface-feeding worms, termites, dung beetles and others (See Figure 3.8).
The old two-dimensional pyramid also does not reveal the possibility of much sophistication in the management of energy flow. The broader the base of the triangle, which the face of the energy pyramid represents, the larger the whole structure, and the more energy available for use at every level. This two-dimensional view, however, suggests very few ways of broadening the base. It is therefore suggested that the energy pyramid is not one or two dimensional, but rather multidimensional, above and below the ground, like two tetrahedrons joined at their bases. It is then possible to increase the energy flow at the vital first level – the soil surface. The three-dimensional energy tetrahedron has three sides, namely time, density and area. By extending only one or all three of them, the base of the energy tetrahedron can be dramatically enlarged, thus making it possible for plants to convert more sunlight into energy.

By improving the water cycle, mineral cycle and community dynamics within the rangelands as well as improving the management of the plants, the growth rate of plants can be increased dramatically and more energy can be captured by the plants for use at higher levels of life. Simultaneously, the density (number of plants per area) will also increase to make provision for more plant to capture and convert energy. A very dense stand of narrow-leafed plants captures less energy than a moderately dense stand of broader leafed plants. To expand the area side of the base of the tetrahedron, the number of broad-leafed plants will increase and more effective conversion of energy will take place.

High densities (high basal and crown cover of perennial grasses) of broad-leafed (climax grasses) plants that are growing fast during the growing season (high vigour) are all indicators of effective energy flow through our rangeland ecosystems in Namibia.
Community dynamics
From the moment living organisms establish residence on bare or recently disturbed soil, a rock, or in a newly formed pool of water, things are never the same again. Change begets change as the organisms interact with each other and with their micro-environment. Eventually a complex community made up of a great many life forms develops and functions as a whole in an apparently stable manner.

Once any community has reached the highest level of development achievable in any environment, be that environment grassland, river, lake, coral reef or forest, it can appear that it will remain in that stable state indefinitely. However, closer inspection reveals a kaleidoscope of changing patterns even within the mature community. Species composition, numbers and age structure, as well as numerous other factors are in a constant state of flux. Individual plants and animals are continually dying and being replaced, and varying weather conditions promote the well-being of some species and diminish that of others. Because communities remain dynamic at every stage, we refer to the process of their never-ending development as community dynamics. Of the four ecosystem processes, community dynamics is the most vital.

3.1.1.2 Research Programmes

Plant communities form the basic units in all ecological processes, and are thus also to be regarded as basic units of natural resource management (like rangeland management). Unfortunately, no concise description of vegetation is available. Currently the only existing vegetation map of Namibia, by Giess (1971) is very sketchy, while the Relative Homogenous Farming Areas map of 1979 is outdated and does not cover the whole country.

A project has been initiated in the National Botanical Research Institute (NBRI) in the Ministry of Agriculture, Water and Rural Development to update the vegetation map of Namibia to the scale of 1:1000 000, as part of the agro-ecological zoning project in the same Ministry (Strohbach & Sheuyange, 1999). Surveying started in the Karas and Hardap regions during 1997, with opportunistic sampling in other regions. Sixteen land type units were covered with a total of 958 relevés. Additional data sources (mostly historic) have been identified. One such data source, done by Prof. Volk in 1956, has been followed up and some indicative results are available.

The objectives of the NBRI study are:
- to update and refine the Giess vegetation map of Namibia to a scale of 1:1 000 000
- to classify and describe the veld types in Namibia
- to establish a database of vegetation and habitat data
- to establish an inventory of species occurring in each veld type, both influencing grazing capacity and other species of economic importance
- to obtain baseline information on the densities of species in the veld, with regards to possible uses (grazing, browsing, harvesting of medicinal plants, etc.) and conservation of rare/endangered species
- to create a baseline on which veld condition models can be developed

The beneficiaries of this effort will be any researcher, technical staff, students working with the natural environment, decision makers at all levels, extension workers and farmers (Strohbach & Sheuyange, 1999).

The AEZ map (De Pauw, et. al., 1999) was used as a basic stratification and Strohbach & Sheuyange (1999) are in the process of updating the vegetation map on this basis. Some 958 relevés have been collected in 16 different AEZ's to date and it is as follows:
### Agro-ecological Zones

- **CPL1** Central Plateau, Southern Omatako Plain
- **CPL2** Central Plateau, fringe plains
- **CPL3-4** Central Plateau, strongly dissected inselberg plains, average growing period 61-90 days, very short dependable growing period
- **CPL3-6** Central Plateau, strongly dissected inselberg plains, average growing period 41-60 days
- **CPL3-7** Central Plateau, strongly dissected inselberg plains, average growing period 21-40 days
- **CPL3-9** Central Plateau, strongly dissected inselberg plains, average growing period 11-20 days
- **CPL4** Central Plateau, strongly dissected plains on Karoo rocks, average growing period 21-30 days
- **CPL4-6** Central Plateau, strongly dissected plains on Karoo rocks, average growing period 11-20 days
- **CPL5** Central Plateau, flat plains on metamorphic rocks
- **CPL6** Central Plateau, flat plains on Karoo sedimentary rocks
- **CPL7** Central Plateau, flat plains with dolerite outcrops and pans
- **CPL8** Central Plateau, rolling hills of the Kalahari
- **CPL9** Central Plateau, flat plains of the Kalahari with sand drift
- **CPL10** Central Plateau, flat plains on Karoo rocks with pans and dunes
- **CPL11** Central Plateau, hill-footslope associations on Karoo rocks
- **CPL12** Central Plateau, hills of the Orange River Valley
- **CPL13** Central Plateau, strongly dissected tablelands on Karoo rocks
- **CPL14-3** Central Plateau, table mountains on Karoo rocks, average growing period 61-90 days
- **CPL14-9** Central Plateau, table mountains on Karoo rocks, average growing period 31-60 days
- **CPL15** Central Plateau, plains on metamorphic rocks with dune fields
- **CPL16-2** Central Plateau, red Kalahari, average growing period 91-120 days
- **CPL16-3** Central Plateau, red Kalahari, average growing period 81-90 days
- **CPL16-5** Central Plateau, red Kalahari, average growing period 71-80 days
- **DA1** Damara and Caliban table mountains
- **DA2** Damara and Kalahari hill-footslope associations
- **DA3** Damara and Kalahari loess plains
- **ETO** Etosha Plains and Etosha Pan
- **ESC1** Escarpment, high table mountains on Karoo rocks
- **ESC2** Escarpment, high mountains on Basement Complex rocks
- **ESC3** Escarpment, high plateaux on Karoo rocks
- **ESC4** Escarpment, high plateaux on Basement Complex rocks
- **ESC5** Escarpment, strongly dissected uplands bordering the highlands
- **ESC6** Escarpment, inselberg and pediment plains with stony sandy cover
- **KAL1** Kalahari Sands Plateau, stabilized W-E dunes with few pans
- **KAL2-7** Kalahari Sands Plateau, stabilized NW-SE dunes with common pans, average growing period 31-60 days
- **KAL2-9** Kalahari Sands Plateau, stabilized NW-SE dunes with common pans, average growing period 21-30 days
- **KAL2-9** Kalahari Sands Plateau, stabilized NW-SE dunes with common pans, average growing period 11-20 days
- **KAL3** Kalahari Sands Plateau, stabilized sand drift with few pans, average and dependable growing period exceeds 120 days
- **KAL3-2** Kalahari Sands Plateau, stabilized sand drift with few pans, average growing period 91-120 days
- **KAL3-3** Kalahari Sands Plateau, stabilized sand drift with few pans, average growing period 61-90 days, dependable growing period 90% of average
- **KAL3-4** Kalahari Sands Plateau, stabilized sand drift with few pans, average growing period 81-90 days, very short dependable growing period
- **KAL3-8** Kalahari Sands Plateau, stabilized sand drift with few pans, average growing period 41-60 days, no dependable growing period
- **KAL4** Kalahari Sands Plateau, stabilized sand drift with common pans
- **KAL5** Kalahari Sands Plateau, slightly incised river valleys
- **KAL6** Kalahari Sands Plateau, terrace of the Okavango and Kwanza river systems
- **KAL7** Kalahari Sands Plateau, floodplain of the Zambezi and Kwanza - Linyanti - Chobe river systems
- **KAL8** Kalahari Sands Plateau, 'umurumba'-dune association
- **KAL9-3** Kalahari Sands Plateau, 'Oshana' flood system, dependable growing period 91-120 days, dependable growing period 60% of average
- **KAL9-4** Kalahari Sands Plateau, 'Oshana' flood system, with growing period 61-90 days, very short dependable growing period
- **KAL10** Kalahari Sands Plateau, Tsumkwe Panveld
- **KAL11** Kalahari Sands Plateau, Aha hills and Kalahari
- **KALK-2** Kalahari, average growing period 91-120 days, dependable growing period 80% of average
- **KALK-3** Kalahari, average growing period 61-90 days, dependable growing period 60% of average
- **KALK-4** Kalahari, median growing period 61-90 days, very short dependable growing period
- **KAO1** Kaokoland, high plateaux
- **KAO2** Kaokoland, pediment plains
- **KAO3** Kaokoland, intermontane low plains
- **KAO4** Kaokoland, mountains and hills
- **KAO5** Kaokoland, strongly dissected foothills
- **KAO6** Kaokoland, intermontane narrow valleys
- **NAM1** Namib Sand Sea, high longitudinal dunes
- **NAM2** Namib Sand Sea, low transversal dunes
- **NAM3** Namib coastal salt plains
- **NAM4** Namib Desert Plains, sand dunes and gravel pavement
- **NAM5** Namib Desert Plains, sand sheets and low dune cover
- **NAM6** Namib Desert Plains, gravel and rock pavement
- **NAM7** Namib Desert, dissected plains with complex cover
- **GOR** River canyons
- **R** Undifferentiated rocky hills and inselberg mountains

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<table>
<thead>
<tr>
<th>AEZ</th>
<th>Description</th>
<th>No of releves</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPL12</td>
<td>Hills of the Orange river valley, including the river embankment.</td>
<td>22</td>
<td>Undersampled for the variation expected and experienced</td>
</tr>
<tr>
<td>CPL15</td>
<td>Plains with dunefields on metamorphic rock</td>
<td>17</td>
<td>Sampling can be improved, especially water courses</td>
</tr>
<tr>
<td>CPL11</td>
<td>Hill-footslope association on sedimentary rocks</td>
<td>16</td>
<td>Harsh environment. Sampling intensity can be improved</td>
</tr>
<tr>
<td>CPL14</td>
<td>Table mountains of the Great and Small Karas mountains</td>
<td>44</td>
<td>The Great and Small Karas mountains differ greatly regarding their vegetation. The small Karas mountains are not yet sampled due to drought</td>
</tr>
<tr>
<td>CPL13</td>
<td>Strongly dissected table lands on sedimentary rocks (eastern great Karas mountains)</td>
<td>21</td>
<td>Sampling can be improved. The extent to be re-determined, as these units seem to overlap with the CPL4-9 tot he north and south</td>
</tr>
<tr>
<td>CPL4-9</td>
<td>Strongly dissected plains on sedimentary rock</td>
<td>80</td>
<td>Highly variable, ranging from stony dissected plains to old floodplains to sand drift plains. Needs to be revised. The northern parts (old Namaland) is undersampled</td>
</tr>
<tr>
<td>R</td>
<td>Mountains and inselbergs. Granite and gneiss of the basement complex in southern Namibia</td>
<td>15</td>
<td>Sampling can be improved</td>
</tr>
<tr>
<td>CPL10</td>
<td>Flat plains with pans and dunes. Mixture of stony plains similar to CPL4-9, and sand drift to dune fields - southern extent of Kalahari desert</td>
<td>21</td>
<td>Sampling can be improved</td>
</tr>
<tr>
<td>CPL7</td>
<td>Flat plains with dolomite outcrops</td>
<td>56</td>
<td>Two distinct forms; -the dolomite outcrops and associated footslopes around Keetmanshoop -the panveld SW of Koes Sampling can be improved</td>
</tr>
<tr>
<td>KAL2-8</td>
<td>Kalahari sand plateau, stabilised NW-SE dunes with common pans. Includes major rivers like Auob, Nossob, Ollifants</td>
<td>201</td>
<td>Sampling in the rivers can be improved. No samples north of Aranos-Kalahari R/S axis</td>
</tr>
<tr>
<td>KAL2-9</td>
<td>Kalahari sands plateau, stabilised NW-SE dunes with common pans.</td>
<td>92</td>
<td>Detailed sampling on the Kalahari Research Station for a vegetation map of the Station</td>
</tr>
<tr>
<td>CPL9</td>
<td>Flat plains of the Kalkrand</td>
<td>41</td>
<td>Sampling is adequate, could be improved towards the north</td>
</tr>
<tr>
<td>CPL2</td>
<td>Central plateau, fringe plains around the Omatako plains</td>
<td>180</td>
<td>Detail sampling on the farm Erichsfeide to follow up on Volk's work</td>
</tr>
<tr>
<td>KALK2</td>
<td>Kalkveld around Grootfontein</td>
<td>60</td>
<td>Northern Grootfontein district. Should be improved</td>
</tr>
<tr>
<td>KALK2 &amp;3, CPL16-2, R</td>
<td>Kalkveld around Grootfontein, Otavi Mountain range</td>
<td>82</td>
<td>Detailed sampling on Ulkomsat Research Station</td>
</tr>
</tbody>
</table>

Only 501 of these releves have been data based to date. Data basing is ongoing, although seriously held up by delayed specimen identification. Only limited data processing could therefore be attempted. Due to the slow progress with surveying, an attempt is made to identify and utilise data from other sources, provided they meet certain criteria. The following data sources have been identified:
<table>
<thead>
<tr>
<th>Author/Surveyor</th>
<th>No of releves</th>
<th>Region</th>
<th>Area/Locality</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acocks 1953</td>
<td>12?</td>
<td>Karas</td>
<td>Southern Namibia</td>
<td>As quoted in Westfall &amp; Greeff 1998. Data source to be verified</td>
</tr>
<tr>
<td>Volk 1956</td>
<td>70</td>
<td>Otjozondjupa</td>
<td>Erichsfelde</td>
<td>Data has been databased and cleaned, with exception of unresolved nicknames of species</td>
</tr>
<tr>
<td>Robinson 1976</td>
<td>472</td>
<td>Erongo</td>
<td>Central Namib</td>
<td>Collected during an extreme rainy season. Data available as table</td>
</tr>
<tr>
<td>Le Roux 1980</td>
<td>204</td>
<td>Kunene</td>
<td>Etosha National Park</td>
<td>Plant data digitised by Pretoria University, habitat data still to be added. Original survey sheet available</td>
</tr>
<tr>
<td>Jankowitz 1983</td>
<td>175</td>
<td>Otjozondjupa</td>
<td>Waterberg Plato Park</td>
<td>Plant data digitised by Pretoria University, habitat data still to be added. Original survey sheets to be obtained</td>
</tr>
<tr>
<td>Kellner 1988</td>
<td>147</td>
<td>Khomas</td>
<td>Daan Viljoen Game Reserve, Claratal, Bergvlug</td>
<td>Data available as a table. No original survey sheets available</td>
</tr>
<tr>
<td>Fanroth 1991</td>
<td>236</td>
<td>Karas</td>
<td>Luderitz and surroundings</td>
<td>Data available as a table. No original survey sheets available</td>
</tr>
<tr>
<td>Strohbach 1990-1993</td>
<td>343</td>
<td>Otjozondjupa</td>
<td>Eastern Groffontein district</td>
<td>Data cleaned and entered into database, ready for processing (Part of &quot;bush&quot; project)</td>
</tr>
<tr>
<td>Hines 1992</td>
<td>224</td>
<td>Otjozondjupa</td>
<td>Old Bushmanland</td>
<td>Data still to be obtained and digitised</td>
</tr>
<tr>
<td>Burke (Gunster) 1993</td>
<td>?</td>
<td>Hardap</td>
<td>Naukluft</td>
<td>Data still to be obtained</td>
</tr>
<tr>
<td>Hachfeld 1996</td>
<td>183</td>
<td>Erongo</td>
<td>Central Namib (Ugab to Kuiseb)</td>
<td>The study is continuing. No final data set yet available</td>
</tr>
<tr>
<td>Gimborn 1996</td>
<td>45</td>
<td>Hardap</td>
<td>Hanaus &amp; Noo</td>
<td>Data available as a table. No original survey sheets available</td>
</tr>
<tr>
<td>Schedel 1997</td>
<td>39</td>
<td>Hardap/Karas</td>
<td>Transect from Helmeringhausen via Gibeon to Gochas</td>
<td>Data available as table. No original survey sheets available</td>
</tr>
<tr>
<td>Strohbach 1997</td>
<td>32</td>
<td>Hardap</td>
<td>Acacia Park, Rehoboth</td>
<td>Data to be digitised</td>
</tr>
<tr>
<td>Strohbach, Sheuyange &amp; Callitz 1997</td>
<td>17</td>
<td>Otjozondjupa</td>
<td>Old Bushmanland</td>
<td>Data to be digitised</td>
</tr>
<tr>
<td>ACACIA 1996-1999 (T Becker)</td>
<td>300+</td>
<td>Kunene</td>
<td>Opuwo district</td>
<td>ACACIA project still ongoing. No final data set yet</td>
</tr>
<tr>
<td>ACACIA 1996-1999 (A Schulte)</td>
<td>168</td>
<td>Kunene</td>
<td>Opuwo district</td>
<td>ACACIA project still ongoing. Preliminary data set, to be translated, encoded. Repetition of 56 plots over 3 years</td>
</tr>
</tbody>
</table>
### Agro-ecological zoning of Namibia

A Technical Co-operation Project (TCP/NAM/6611) between the Food and Agricultural Organisation (FAO) and the Namibian Ministry of Agriculture, Water and Rural Development (MAWR) with the mandate to produce an Agro-Ecological Zone Map for Namibia. In this project, agro-ecological zones are considered to be land entities that are sufficiently uniform in terms of climatic, landform and soil features for broad planning objectives and are unique by the specific combinations of these land attributes (De Pauw, et al., 1999).

The value of this work is that the zones are fully described in terms of their component attributes and can easily be linked to land use or farming system patterns, thereby forming a useful framework to assist agricultural development planning, land use harmonisation and environmental management (De Pauw, et al., 1999). The Agro-Ecological Zoning Map is presented overleaf.

There are ten major zones namely Central Plateau; Kalahari; Escarpment; Namib; Damaraland; Kaokoland; Etosha; Kalk; Gorges/Canyons and Rock/Mountain. These are further divided into 69 smaller zones, according to different underlying geology, landforms and growing period zones. In some cases, two or more zones may be similar in geology and landform, but differ in the growing period zones (indicated by hyphenated digits) into which they fall. For example: KAL 2-7, KAL 2-8 and KAL 2-9 are all described as “Kalahari Sand Plateau, stabilised NW-SE dunes with common pan”. In all three classes the landform type is "plain", the general altitude ranges between 1 000 and 1 400 meters, the geological substratum is "Kalahari Sands" etc. The first one, however, resents under growing period 7 (an average growing period of 35 days and no dependable growing period), the second one under growing period 8 (average growing period of 25 days and no dependable growing period and the third under growing period 9 (an average growing period of 15 days and no dependable growing period). Whereas KAL 2-7 can provide grazing suitable for mixed large and small stock, KAL 2-8 and KAL 2-9 are only suitable for small stock.

The data available for the first zoning exercise, were insufficient for zone-specific interpretations of agricultural potential and constraints. A grouping of zones with more or less similar biomass productivity potential from the viewpoint of the regional water balance, as determined by rainfall and the evaporative demand of the atmosphere, was made. This allows for an initial ranking of zone-groups in terms of their suitability for cropping and grazing for either large or small stock. Similar groupings are also done to in terms of their suitability for crop production, rainfed or irrigation. See Table 3.4.
Table 3.4: Summary evaluation of potential per agro-ecological zone (De Pauw & Coetzee, 1999)

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Suitability</th>
<th>AEZ’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Short maturing crops; large stock grazing</td>
<td>KAL3-1, KAL6, KAL7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CPL16-2, KAL3-2, KAL8, KALK-2</td>
</tr>
<tr>
<td>2</td>
<td>Large stock grazing</td>
<td>CPL16-3, KAL3-3, KAL4, KAL9-3, KAL10, KAL11, KALK-3, KAL5</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>CPL2, CPL1, CPL3-4, ETO, KAL1, KAL3-4, KAL9-4, KALK-4</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>CPL3-6, CPL5, CPL16-6, ESC4, KAO4, KAL3-6</td>
</tr>
<tr>
<td>5</td>
<td>Mixed large stock and sheep grazing</td>
<td>ESC2</td>
</tr>
<tr>
<td>6</td>
<td>Sheep grazing only</td>
<td>CPL3-7, ESC5, KAL2-7, KAO2</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>CPL4-8, CPL6, CPL10, KAL2-9, KAO1</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>CPL3-9, CPL4-9, CPL7, CPL8, CPL9, CPL13, CPL14, CPL15, ESC3, KAL2-9</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>CPL11, CPL12, DAM1, DAM2, ESC1, ESC6, KAO3, KAO6</td>
</tr>
<tr>
<td>10</td>
<td>Unsuitable for grazing</td>
<td>DAM3, KAO5, NAM1, NAM2, NAM3, NAM4, NAM5, NAM6, NAM7</td>
</tr>
<tr>
<td>N.A.</td>
<td></td>
<td>R, GOR</td>
</tr>
</tbody>
</table>

In grouping these AEZ’s, reference was made to work done by the previous Government in 1979 in relation to the Relative Homogeneous Farming Areas for the commercial areas in the then South West Africa. This study was limited both in time and scope. The currently defined agro-ecological zones are provisional units, pending further resource surveys and research. One of the findings of the study was the inadequacy of basic and integrated resource data to assess with great confidence agricultural potential and constraints in a given area. Consequently, the AEZ team of the Ministry of Agriculture, Water and Rural Development will continue with collection of natural resource data through soil, landform and vegetation surveys, to improve the level of detail. The objective is to eventually have information on agricultural resources and agricultural potential available on at least 1:250 000 scale for the whole country, and 1:50 000 scale for selected areas of high potential or specific interest (De Pauw & Coetzee, 1999).

Different formats of AEZ data are available, as the data are stored in a computer database. A user-friendly interface, written in Visual FoxPro, had been developed. The AEZ database is a “stand-alone” application, so users do not need to have Visual FoxPro on their computers. The computer must, however, operate in Windows 95 or later versions of Windows. MS-Word for Windows 95 (Version 7) or a later version, are needed to access the on-line Help function.

The AEZ Map and Database are available at:
- AEZ Programme
- MAWRD
- Private Bag 13184
- Windhoek
- Tel (061) 208 7039
- Fax (061) 208 7068

During 1999, Strohbach and Sheuyange discovered some relevant data on the farm Erichsfelde that was surveyed by Volk in 1956. They managed to find the survey plots, cleaned up the data and did similar surveys in 1999. The data in three of the so-called “Volk” plots are presented:
Volk Plot 720

Fig. 3.9: Summarised vegetation composition of Volk Plot 720 (Strohbach & Sheuyange, 1999)

Volk’s plot 720 was initially surveyed on 12 March 1956, and resurveyed on 14 April 1999. This plot represents the typical sandy plains of the CPL2 in the Okahandja district. No drastic change in shrub composition can be detected from the given abundance ratings, although Volk states “the view is unobstructed” (i.e. small shrubs). This cannot be said today. The drastic change is in the grass cover. Volk did not observe any annual grass species, whereas he estimated the perennial grass cover to be near 100%. At present the perennial grass cover is less than 20%, with an annual cover of about 15%.

Volk Plot 739

Volk Plot 739 has initially been surveyed on 15 March 1956, and resurveyed on 15 April 1999. The plot is situated on alluvial soil (highly erodible) next to the banks of a river. This plot changed dramatically. The tree cover nearly doubled, whereas the dwarfshrub and grass cover diminished from over 80% to less than 10% respectively. The grass cover, what was dominated by Monelyrum luederitzianum, has been totally replaced by Enneapogon desvauxii, which affords virtually no protection to the ground. Even browse species like Grewia flava, which have been recorded during 1956, are absent at present.
Volk Plot 757 was initially surveyed on 23 March 1956, and resurveyed on 20 April 1999. This plot represents the shallow Omuramba's on the farm – a shallow, fairly wide, fairly slow-flowing water course typical of the CPL2. He describes the vegetation as “nearly without trees” – as a matter of fact, he did not list any tree or shrub species in this releve. The opposite is true today. The vegetation cover of just over 50% is made up by Acacia mellifera subsp. detinens and some Acacia tortilis as well as Acacia reficiens. The grass cover of over 80% (half of which were perennial grasses) has been reduced to about 5% - all of them annual species. The shallow omuramba has been eroded to form a river.

![Graph showing vegetation composition](image)

**Fig. 3.11**: Summarised vegetation composition of Volk Plot 757 (Stroehbach & Shenyange, 1999)

Looking at the general trend, three tree/shrub species and one dwarfshrub species can be highlighted as encroaching on the farm, namely Acacia mellifera subsp. detinens, Acacia tortilis subsp. heteracantha, Dichrostachys cinera and (as dwarfshrub) Monochma genistifolia subsp. genistifolia (Figure 3.12, 3.13 and 3.14). Of concern is the general reduction of browse species like Grewia flava and Tarchonanthus camphoratus. Not only theses species reflected a change – all grass species show a reduction in abundance. Two species, Antephora pubescens and Brachiaria nigropedata, could not be found on the entire farm of 13 000 ha at all during 1999 (see Figures 3.15 and 3.16).

![Graph showing crown cover change](image)

**Fig. 3.12**: Change in the crown cover of some selected tree species (average of all relevés) on Erichsfelde (Stroehbach & Shenyange, 1999)
Fig. 3.13: Change in the crown cover of some selected shrub species (average of all relevés) on Erichsfelde (Strohbach & Sheuyange, 1999).

Fig. 3.14: Change in crown cover of some selected dwarfshrub species (average of all relevés) on Erichsfelde (Strohbach & Sheuyange, 1999).
Fig. 3.15: Change in the crown cover of some selected perennial grass species (average of all relevés) on Erichsfeld (Strohbach & Sheuyange, 1999).

Fig. 3.16: Change in the crown cover of some selected annual grass species (average of all relevés) on Erichsfeld (Strohbach & Sheuyange, 1999)
3.1.2 Socio-economic indicators of desertification and rangeland degradation

Desertification has many manifestations in Namibia. The most prominent and important ones are:

3.1.2.1 Loss of productivity of the rangelands

Farming units are no longer able to sustain enough livestock numbers to ensure a decent livelihood. This is a statement very often made by especially commercial farmers. A farming unit big enough to sustain at least 400 LSU's or 2 000 SSU's is considered an economic unit. According to this criterion, about 38% of all commercial farms in Namibia are no longer economically viable. The reason can be fully attributed to unsustainable rangeland management practises and other indirect causes, as described in the previous section.

3.1.2.2 Bush encroachment.

Bush encroachment is largely the result of unsustainable rangeland management practises in the past. Aspects like overgrazing, reducing the competition ability of grasses for available soil moisture, the absence of fire as management tool, the reduction in the use of browsers (goats and game), etc., might have contributed to the thickening of bushes.

Although the problem is more acute in the commercial farming areas of central and northern Namibia, it can be detrimental not to recognise it also in the communal areas of the country. The southern areas are in the process of being encroached with *Rhigozum trichotomum* ("driedoring") which can cause huge problems to livestock production. Bush encroachment contributed largely to the loss in productivity of the rangelands and thus to farming units becoming less economically viable.

3.1.3 Proximate and Ultimate Causes of Rangeland Degradation

The core problem causing rangeland degradation in Namibia is that rangeland in both commercial and communal areas is not managed properly. This can be attributed to several factors:

3.1.3.1 Overgrazing

Overgrazing, although linked to overstocking, confuses many people. Overgrazing is caused where animals are concentrated in one specific area for too long resulting in over utilisation of the vegetation without providing adequate time for the rangeland to recover in terms of seed production and germination, restoring the vigour of individual plants and the accumulation of enough material for future utilisation. This again results into a loss of ground cover, loss of species diversity, loss of vigour and the ability of plants to tolerate heavy grazing and droughts and subsequently it leads to bare grounds and soil erosion.

One major cause of overgrazing is the poor water distribution in some of the communal rangelands in Namibia. The phenomenon of "where there is water, there is no grazing; where there is grazing, there is no water" so commonly expressed by communal pastoralists is a very good example. The concentration of livestock around the more permanent waterpoints in the north (e.g. the Zambezi and Okavango rivers; boreholes in the omurambas of the eastern communal areas; etc.) illustrates this point.
more clearly. Water quality (saline water in parts of the east and north) can also be a major reason making it very difficult for pastoralists to move animals to other areas.

Although pastoralists may still possess know-how on traditional ways of rangeland management (nomadic movements), it can be accepted that the younger generations lack technical know-how on practices and principles of sustainable rangeland management.

In some areas (especially the North Central regions) the concentration of people, and thus livestock, is just too high. Even with the provision of more and better distributed waterpoints (e.g. the pipelines south of Ondangwa), the possibilities of finding a way how animals can be moved remains a big challenge. Apart from the fact that too many people might have been forced into too small areas and thus restricting their flexibility, the issue of a high population growth rate especially in the communal areas should be addressed.

3.1.3.2 Overstocking.

Overstocking is the phenomenon where more animals are kept on a certain piece of land than there is fodder available to feed those animals at any point in time. Although perceived by many people as the major problem causing rangeland degradation in Namibia, empirical evidence is just not available to prove it in terms of larger areas of land. Except for the North Central regions, overstocking is not a problem in all the other communal farming areas of Namibia, but it is rather a problem of too high concentrations of animals at certain small areas, as discussed in the previous section.

Rainfall variation, and thus the availability of fodder, is very high in both time and space. This means that grazing capacities vary greatly from year to year and from place to place. Hence stocking rates might be too high for certain places in certain years, and too low for those places in other years. The challenge is therefore not to destock the Namibian rangeland to recommended average carrying capacities, but to find ways and means how farmers can adapt fast and efficiently to changing fodder regimes.

The lack of land or too many people having livestock in a certain area, can be a cause of overstocking. As indicated in the previous section, this is directly related to the number of people living off livestock in the communal areas which is again, directly related to the alarming high population growth rates.

Due to the important social and cultural role livestock play in all the communal areas of Namibia, the issue of overstocking will be very difficult to address. Livestock is the only source of livelihood for many rural Namibians and sustain people in many ways. The perception of "wealth" and "status" connected to owning livestock and the social and cultural use of livestock should never be neglected. The strategy of maximising livestock numbers to minimise risks, is a common strategy amongst African pastoralists and is also present in Namibia.

The commercial orientation of maximising output and income by faming with fewer animals of higher quality and production abilities, is uncommon to many Namibian subsistence farmers in the communal areas. Reasons for keeping livestock differ very much between commercial farmers and the majority of communal livestock owners.

The lack of alternatives for capital accumulation and capital investment in the rural areas of Namibia is seen as a major cause of having too many animals. Cash obtained from selling animals can not easily be invested into other enterprises, due to a lack of investment alternatives. Saving possibilities are also very limited in most of the areas. Commercial banks don't have adequate banking facilities available to farmers on a regular basis, which leave farmers with little options than to re-invest their money in livestock, putting an extra burden on the rangelands.

The lack of diversification within and outside livestock production is also seen as a major reason for reduced incomes from livestock and thus the tendency to keep more livestock. Diversification in terms of adding value to livestock products (tannery, shoes, cheese, etc.) as well as using a wider range of adapted animals (small stock, camels, game, karakul, ostriches, etc.) will have to be investigated.
The lack of alternative income generating activities outside the livestock sector in the communal areas will further contribute towards putting a higher emphasis on livestock alone to provide for a decent livelihood. This serves as a further impetus for keeping higher livestock numbers.

3.1.3.3 Non-flexible use of rangelands

The rainfall, and therefore the availability of fodder, in Namibia is highly variable in terms of time and space. In the past, this dictated a highly flexible strategy of using the rangelands. Pastoralists were much more flexible in moving animals to areas where sufficient rain had fallen and where enough fodder was available.

Sedentarisation is a reality in most of the communal areas of the country, and there is no way for the farmers to return to the more nomadic lifestyles of the past. Fences (international, commercial farms, game parks, illegal fencing, etc.) prevent farmers from moving with their animals freely in search of fodder.

Perceptions that the rangeland as a natural resource is infinite and that everything will be back to normal once the good rains have fallen, are still common amongst farmers in both communal and commercial areas. The perception about so-called recommended carrying capacity norms for certain areas based on average rainfall and other characteristics, further contributes towards an over-optimism about the potential of the rangelands. The fact that equilibrium oriented (fixed stocking rates, succession theories, etc.) solutions are recommended for non-equilibrium environments needs to be addressed urgently in order to improve the flexibility of range management practices.

3.1.3.4 Weak institutional basis at “grass-roots” level

Sustainable natural resource management can only be implemented by the users of such resources. In the case of sustainable rangeland management, the livestock farmers are the implementers and should therefore be enabled to do so. In the past community structures were strong and very well established and access to and management of rangeland was done properly. Most of these structures were replaced during almost a century of colonisation by centralised decision making, dislocation of many farmers to new areas which resulted in poor organisational and self-help capabilities of rural communities. People were made very dependent on outside support, mainly from government, for services and goods. Even 10 years after independence rural communities in the communal areas struggle to help themselves; to know what they need; to know where they want to go (visions) and to know how to get there.

Traditional leadership was responsible for allocation of land and land management in the past. Currently the role of traditional leaders is not so clear any more regarding this function, and the newly established regional authorities still lack the capacity and means to perform such functions.

3.1.3.5 Lack of technical know-how and services

Older people might still have a lot of know-how and experience on nomadic movements of animals and traditional practises of livestock production. It is however doubtful whether the transfer of this know-how to the younger generations will happen. Even then this “indigenous” knowledge might not be fully adequate any longer to enhance sustainable rangeland management and improved livestock production.

In the past, services like extension, research and training were mostly oriented towards the needs of the commercial farmers, neglecting the communal livestock producers. Extension officers also lack adequate know-how and experience on livestock production and rangeland management, especially as far as communal farming is concerned. Research was mainly commercially and on-station oriented with very limited direct benefit to the communal farmers.

Other services such as veterinary, marketing, credit, etc., were commercial farming orientated. Even today, the access of communal farmers to these services is very much limited.
3.1.3.6 Uncondusive frame conditions

Natural resource management in general and sustainable rangeland utilisation in particular, is not possible without political, social, economic and climatic frame conditions conducive to it.

The most important frame condition still lacking and preventing sustainable rangeland management, especially in the communal areas of Namibia, is the absence of the Agricultural (Communal) Land Reform Bill. This bill is supposed to address the critically important issues such as land tenure, land taxes, the Regional Land Boards, land-use, ownership of land, role of traditional authorities in land allocation and land management, and many more relevant aspects. It is unclear when this Bill will be promulgated and come into effect.

The Agricultural (Commercial) Land Reform Act has been promulgated, providing the state with the necessary legal powers to acquire commercial farm land for the purposes of resettlement of historically disadvantaged people. Uncertainty, mostly amongst commercial farmers regarding the implementation of the Act, might create a climate where commercial farmers try to get as much as possible out of the farms they have, thus contributing towards the process of land degradation.

The National Agricultural Policy (NAP) has been approved by Parliament following a process of participatory consultation and provides valuable guidance towards the development of strategies to implement sustainable rangeland management practices. A "weakness" of this policy is the emphasis on national food self-sufficiency rather than on national food security. Due to a lack of natural resources, especially for the production of crops, it is virtually impossible to pursue national food self-sufficiency as a national objective.

Subsidies to livestock production encourage farmers to keep more livestock than they would keep if they had to pay the full costs of inputs. Therefore, with limited land available, subsidies promote overgrazing and overstocking. In addition to legitimate "enabling environment" activities like extension, research, and marketing, livestock husbandry in communal areas is subsidised through:

- veterinary services (not full-cost recovery)
- quarantine provision (fees are about to be introduced, but not full cost-recovery)
- some effective price support (e.g. meatco price support to communal farmers in the north)
- income tax waived
- no land rental fee
- free water provision (also about to be changed)

The 1995/96 Drought Aid Scheme provided fodder, transport and grazing subsidies to both commercial and communal farmers at a cost of N$ 99 million. The scheme did not require farmers to destock in order to receive assistance (the requirement for commercial farmers to destock to 60% of approved carrying capacity presented problems for very few farmers, because they use old and outdated carrying capacity norms). Since subsidies were available throughout the drought period for up to 100 LSU's or 500 SSU's (for fodder), there was an incentive to keep up to this number of animals. Farmers were not entitled to receive subsidy if there was still grazing available, and this has the perverse effect of discouraging good range management.
3.2 Arable land

This chapter starts with a review of research, inventory and monitoring programmes directed at providing information on the status of arable lands. Biophysical and socio-economic indicators of changing status derived from the findings of some of these programmes are then discussed. Thereafter, the chapter looks at causes of changes in arable lands' status that have been identified.

3.2.1 Research, inventory and monitoring programmes

3.2.1.1 Soil surveys

Namibia's soils have yet to be surveyed and mapped. There has been little systematic study of Namibia's arable soils. As noted, by way of explanation by one local soil research scientist: "you can't eat soil."

The Agro-Ecological Zoning project, which is discussed in chapter 3.1.1.2 and below, was unable to incorporate systematic soils data in the basic delineation of zones. In describing the soils component of the 69 different zones that were identified, the study had to use "various literature sources, aerial photograph interpretation and limited fieldwork" (De Pauw, et. al. 1999).

The Agricultural Laboratory of the MAWRD has been providing soil analysis services to clients throughout the country for many years. However, results have not been analysed for trends over time, nor have the results been spatially mapped. This is because soil samples are poorly distributed and their locations are often not properly reported. Also, sampling procedures are not systematic and look only at the top 30-40 cm, and soil analysis concentrates mainly on nutrient content and gives little information on physical characteristics.

The MAWRD's Agricultural Laboratory is currently engaged in a project, assisted by the Government of Spain, to produce by August 2000:

- a 1:1,000,000 scale soil map for the country,
- a 1:100,000 scale soil map for a 10 kilometre strip of river terrace land on the southern banks of the Okavango River
- a 1:100,000 scale soil map of a larger area in the Omusati, Oshana, and Ohangwena Regions (this area is mainly the more densely settled areas between Ondangwa and Ruacana, to the Angolan border in the north and bounded by rather undifferentiated dune fields to the south).
- a 1:250,000 scale soil map to the east of the above, including the Otavi and Grootfontein area and extending to the Botswana border.

The maps will follow the FAO World Reference Base soils classification. Methods used include interpretation of 1996 aerial photos for the 1:100,000 maps, LANDSAT satellite images, the geological survey map, the FAO land type map, and ground-truthing involving soil profile analysis at GPS referenced locations. In addition, existing localised soil survey work in specific areas of the Kavango, the Etosha Park and some Agricultural Research Stations, is also being used.

3.2.1.2 Agro-ecological zones

The MAWRD has defined a set of 69 preliminary agro-ecological zones covering all of Namibia (MAWRD, 1999). Agro-ecological zones are defined as "land entities that are sufficiently uniform in terms of climatic, landform and soil features for broad planning objectives and are unique by the specific combinations of these land attributes", defined on the basis of existing information on landforms, soils and climate. (De Pauw, et. al., 1999). They have also produced a First Draft Agro-ecological Zones map (MAWRD, 1997).

These achievement have been based on the re-interpretation of data from the following sources:

(1) a 1:1,000,000 Land Type map produced by the FAO before independence using LANDSAT satellite images but without field reconnaissance (FAO, 1984) and Geological maps of Namibia, on which in part the former are based.
the 44 1:250,000 scale topographical maps produced by the Office of the Director General of Surveys (Director-General of Surveys. 1978).

(iii) Generalised plant growing period zones map based on 11 uniquely defined zones and relatively homogenised farming areas (MAWRD. 1998).

It is intended to improve the preliminary Agro-ecological Zones map by incorporating the soils map, noted above, and a reliable vegetation map being produced by the National Botanical Research Institute. This will enable these factors to be included as basic differentiating components for drawing up larger scale agro-ecological zone maps (see also chapter 3.1.1.2).

3.2.1.3 Water Erosion Hazard map for Namibia

As part of the SADC Erosion Hazard Mapping project the MAWRD's Agro-ecological Zones project and NBRI aim to produce a Water Erosion Hazard map for Namibia. This will be based on a standard erodability index, considering soil type, slope, vegetation type, rainfall type and amount, amongst other factors. As can only be prepared when Namibia's soil and vegetation maps have been produced. (see also chapter 3.1.1.1 and table 3.1)

3.2.1.4 Namibia Early Warning and Food Information System

An important source of evidence on crop production is the Namibia Early Warning and Food Information System (NEWFIS). The NEWFIS is run by the Ministry of Agriculture, Water and Rural Development, though there has been continued emphasis on shifting the responsibility for information procurement and basic analysis to other participating agencies.

Types of information of importance for drought identification which are currently available are as follows.

- Data on the production of cereals within the large-scale farming sector, including early estimates of the forthcoming harvest, derived from several organisations.
- Data on areas planted, yields, and production of cereals in the small-scale, non-commercial farming sector in the six northern Regions derived from extension officer reports and specialised crop assessment missions.
- Data on the grazing situation and condition of livestock derived from field reports by extension, research and veterinary officers, as well as from monthly vegetation images (Normalised Differentiated Vegetation Index (NDVI)) produced from National Oceanographic and Atmospheric Agency (NOAA) satellite data which give an instant picture of the state of the vegetation relative to previous months and years.
- Agro-meteorological information consisting of 10-day, monthly and seasonal rainfall maps that depict the status of rainfall throughout the country in absolute amounts and relative to expected, average levels. An agro-meteorological crop yield forecasting system using ground observations and remotely sensed data was established in 1994. From the 1995/97 season, the Namibia Meteorological Service, in conjunction with the South African Weather Bureau, has been producing long-term forecasts.

This information, along with data on imports and exports and stocks of both maize and wheat, and forecasts of food production by Region are incorporated into a Crop and Food Security Bulletin, which is produced monthly and widely distributed to decision makers.
3.2.1.5 Rainfall records

An important piece of circumstantial evidence to look at for evidence of the changing state of arable soils is rainfall records. While total annual rainfall figures for Oshakati and Rundu are shown overleaf, it should be remembered that distribution of rainfall within a season becomes critical in lower rainfall years. In the absence of irrigation, we need look little further for the reason Namibian cropping systems can be characterised as low-input low-output which are only able to support low population densities.

Table 3.5 Annual rainfall figures for Oshakati for the 91/92 to 92/93 seasons and percentile and % of mean figures

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Annual Rainfall</th>
<th>% of Mean</th>
<th>Season</th>
<th>Rainfall</th>
<th>Percentile</th>
<th>% of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>85,2</td>
<td>21,2</td>
<td>91/92</td>
<td>119,5</td>
<td>&lt;5</td>
<td>29,7</td>
</tr>
<tr>
<td>5</td>
<td>127,4</td>
<td>31,6</td>
<td>92/93</td>
<td>173,6</td>
<td>10 - 20</td>
<td>43,1</td>
</tr>
<tr>
<td>10</td>
<td>164,8</td>
<td>40,9</td>
<td>93/94</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>275,4</td>
<td>68,4</td>
<td>94/95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>341,1</td>
<td>84,7</td>
<td>95/96</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>372,3</td>
<td>92,4</td>
<td>96/97</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>408,4</td>
<td>101,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>426,8</td>
<td>106,0</td>
<td></td>
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<tr>
<td>70</td>
<td>487,7</td>
<td>121,0</td>
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<tr>
<td>80</td>
<td>508,3</td>
<td>126,0</td>
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<tr>
<td>90</td>
<td>646,8</td>
<td>161,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>740,7</td>
<td>184,0</td>
<td></td>
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</tbody>
</table>
Table 3.6  Annual rainfall figures for Rundu for the 91/92 to 96/97 seasons and percentile and % of mean figures

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Annual Rainfall</th>
<th>% of Mean</th>
<th>Season</th>
<th>Rainfall</th>
<th>Percentile</th>
<th>% of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>286,8</td>
<td>51,1</td>
<td>91/92</td>
<td>356,5</td>
<td>10 - 20</td>
<td>63,5</td>
</tr>
<tr>
<td>5</td>
<td>301,1</td>
<td>53,6</td>
<td>92/93</td>
<td>455,6</td>
<td>40 - 50</td>
<td>88,2</td>
</tr>
<tr>
<td>10</td>
<td>314,7</td>
<td>56,0</td>
<td>93/94</td>
<td>571,7</td>
<td>50 - 60</td>
<td>101,8</td>
</tr>
<tr>
<td>20</td>
<td>420,0</td>
<td>74,8</td>
<td>94/95</td>
<td>307,8</td>
<td>5 - 10</td>
<td>54,8</td>
</tr>
<tr>
<td>30</td>
<td>437,6</td>
<td>77,9</td>
<td>95/96</td>
<td>286,9</td>
<td>5</td>
<td>51,1</td>
</tr>
<tr>
<td>40</td>
<td>491,8</td>
<td>87,5</td>
<td>96/97</td>
<td>791,5</td>
<td>90 +</td>
<td>140,9</td>
</tr>
<tr>
<td>50</td>
<td>533,8</td>
<td>95,0</td>
<td></td>
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<tr>
<td>60</td>
<td>572,6</td>
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<tr>
<td>70</td>
<td>669,0</td>
<td>119,0</td>
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<tr>
<td>80</td>
<td>705,2</td>
<td>126,0</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>90</td>
<td>790,2</td>
<td>141,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>1138,0</td>
<td>203,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

( Source: RoN. 1998)

3.2.1.6 Farming systems research

Much of the government’s farming systems research work in the northern communal areas since independence has focussed on improving arable soil fertility. Aspects of soil fertility management that have been investigated include the use of manure and limited fertiliser, as well as the use of legumes and crop residues. Findings, both locally and internationally, make it clear that:

- Small applications of phosphorus (e.g. 10-15 kg/ha) can be recommended because of its residual effect if rains fail (but is not available in suitable forms commercially or from the government). Nitrogenous fertilisers cannot be recommended because of the high risk of rain failure (but is readily available);
- Manure in amounts that can realistically be applied (e.g. up to 2 tonnes per hectares) will have little soil fertility benefit, though it may have long term physical benefits (improved CEC, water holding etc.);
- Legumes contribute minimally through nitrogen fixation, but the incorporation of good quality (e.g. leguminous) residues, which would be more beneficial, conflicts with demands for fodder;
- Incorporation of non-leguminous crop residues (i.e. inedible materials left after livestock have grazed fields) can have negative effects through the immobilisation of nitrogen supplies, and are best mixed with manure before application or burned (which can result in a small flush of phosphorus and potassium).

3.2.2 Biophysical indicators

From the above review of research, inventory and monitoring programmes, it can be seen that there is little biophysical data to indicate the past or current status of Namibia’s arable, nor are any programmes in place which will provide such data in immediate future. Hence, the description of the
status of Namibia's arable soils which follows relies largely on circumstantial or indirect evidence based on data from other countries, as well as anecdotal and historical evidence. It may also be concluded that it will be difficult at this stage to define a biophysical indicator of the status of Namibia's soil resources. In addition, it must be emphasised that generalisations regarding soils are dangerous. Changes in soil fertility status are determined by complex dynamic interactions at the soil-plant interface. Also, in interpreting data both spatial and temporal factors are of vital importance.

An important piece of biophysical evidence which can tell us much about their changing state is the nature of the soils themselves. Namibia's sandy soils mainly derive from acid, crystalline rocks such as granite and gneiss. As such they are inherently infertile even in their virgin state. Nitrogen, phosphorus and trace element deficiency is most pronounced. Potassium is available in reasonable amounts. This combined with low rainfall, low humidity and high temperatures mean that soil organic matter content is low.

The mere fact of low-input continuous cultivation, sometimes for decades, of arable soils with high sand and low clay and silt contents and low and fragile organic matter contents (and hence low Cation Exchange Capacity), as well as high temperatures and infrequent but heavy rainfalls, implies that nutrient and organic matter loss may be expected to be rapid.

It also suggests that nutrient equilibrium may be achieved after a few seasons of continuous cultivation. Thus, while Cation Exchange Capacity, nutrient levels and consequently yields are low, it is likely that having "bottomed-out" they are also, for the most part, stable (Vigne & Whiteside. 1997).

Nutrients that are lost through leaching and crop production are being replaced by natural mineralisation of organic and inorganic matter, from symbiotic and non-symbiotic fixation of atmospheric nitrogen from rainfall. Farmers enhance these processes, and reduce leaching losses, by incorporating manure, weeds, stover or stover ash, household wastes and ash, and even termite soil, and by inter-cropping, agro-forestry and following practices (sometimes inadvertently as a result of crop failure).

The two major threats to this equilibrium are the loss of organic matter or biomass in the system and physical or structural damage to soil or soil erosion.

Organic matter is being lost as trees are cut down and manure and stover used for fuel. This process is particularly evident in the Cuvelai Basin area. The effects on soil organic matter content of the cessation of the efundja floods also in the Cuvelai, can, again because of the lack of data, only be assumed. On the one hand such flooding can act as a destructive force washing away topsoil and leaching nutrients, on the other it can deposit sediment from upstream to enrich soils. The dynamics of the efundja floods on soils are probably complex. In recent years, the extent of the efundja has significantly diminished, and a new dynamic process has replaced it.

Declining organic matter content and nutrient levels may also be compounded by structural damage and soil erosion, including, in some soils, removal of soils, the rapid destruction of the fragile clay-humus complex, the development of hard pans at the plough line, and increased salinisation.

Farmers experience increasing soil erosion caused by deslocation and pulverisation of soils resulting from cultivation, particularly when mould board ploughs and disc harrows are pulled fast by tractors, followed by strong winds. Soil particles lost are of the finer range which also contain most soil nutrients and water holding capacity. Thus, such soil erosion may be accompanied by rapid decline in soil fertility. Dust storms are reportedly more severe than in the past when tree cover was more plentiful. In the Capriv, for example, forest clearance which occurred 20 years ago has resulted in the loss of up to 20 cm of soil in some areas. This is easily recognised when tree roots are left hanging in the air (University of Helsinki. 1996). In the densely populated Cuvelai Basin area dunes are in evidence beside the oshana and in cultivated areas.

It may be argued, however, that without slopes and permanent water courses, soil materials are in fact mainly being moved around by wind and water, rather than being lost to the system altogether. While winds remove top soil and carry nutrients away, they also deposit these same materials as the winds die down. Much of northern Namibia's crop growing land is virtually flat. On the other hand, slopes that do occur, such as in omuramba (fossil river beds), oshana and river banks are often
amongst the most heavily cultivated and produce valuable grazing. The result is complex soil patterns including areas which are being eroded and depositional areas.

Heavy rains falling in large drops can break up soil aggregates on the soil surface leaving them vulnerable to sheet erosion as loose soil particles are simply washed away. Consequent sheet erosion and particularly soil capping are widely experienced in much of Namibia (see table 3.1). However, wind erosion is probably the greatest natural hazard to arable soils (although rainfall surface run-off becomes important in croplands in sloped areas).

The build up of a hard layer below the plough line is a widely recognised problem amongst farmers. Agricultural research and extension services have responded by promoting the use of rippers.

While fallowing of soils and the application of organic and inorganic fertiliser may theoretically be expected to return most soils to reasonably productive levels, of particular concern is that some Sandveld soils, particularly in the Kavango and Oshikoto Regions, having been deforested to allow cropping, and subjected to a few cultivations, could return to the state from which they evolved when they constituted the northern part of the Kalahari Desert. Another situation where degradation may be irreversible is where severe wind erosion leads to the wholesale removal of top soil leaving underlying hard and impermeable soil layers exposed.

In certain solonetz soils in the north salinisation does occur when water tables are close to the surface (EEAN, 1992). A further issue is that of salinisation in irrigation schemes. High salt levels in soils can make growth for most crops impossible, and often results in yield losses. Also, once soils have become saline their rehabilitation is expensive. However, when draining systems are well designed salinisation of irrigated soils is not a problem. Although no records are kept of its extent and degree in Namibia, isolated incidences of salinisation are reported, for example on the Ministry of Agriculture, Water and Rural Development’s research farm in the Hardap Scheme. With the construction of proper drainage systems and the employment of water conserving irrigation methods most such salinisation is likely to be reversible.

3.2.3 Socio-economic indicators

The clearest result of arable soil degradation are the notoriously low crop yields experienced throughout northern Namibia and the impact this has on livelihoods. Pearl millet and sorghum grain yields of 200-400 kg per hectare are common even in average rainfall years. These yields can double given optimal rainfall; however crop failure is more common.

Attempts have been made to assess the cost of declining soil fertility based on theoretical models (see Table 3.7). While the validity of these figures (and the assumptions they are based on) is highly questionable, especially at the aggregate level, they do highlight the theoretical benefits to be had by improving management practices.

Table 3.7 Cost per household of replacing crops lost due to lack of manure

| (adapted from Quan et al. 1994) |
| Cost per household of replacing crops lost due to lack of manure = N$ 165 |
| Assuming: |
| - production has fallen 33% (from 6 to 6 months household supply) in the last 10-15 years |
| - a household of 6-8 people requires 90 kg per month |
| - replacement with maize meal @ N$60 per 50kg |
| - 50% of production losses are due to lack of manure |

| Assuming 124,000 households in the northern communal areas face similar losses then the aggregate subsistence losses amount to N$ 20.5 million at market prices. |

Low but stable crop yields coupled with increasing population mean that fewer and fewer farmers are able to produce enough food for their families every year. Other socio-political factors, such as the
out-migration of labour and the availability of alternative sources of income have also contributed to declines in household grain self-sufficiency over the last few decades.

The National Planning Commission (quoted by Hansohm and Presland, 1997) suggests that as little as 20 per cent of total household income in the north central Regions is derived from agriculture (including crops and livestock). Another study (Keyler, 1995) indicates that 18-27 per cent of household income in the north comes from crops and livestock. A recent study in Kavango (MAWRD 1997) found that 37 to 66 per cent of cash incomes are from agricultural sales, while the 1993/94 National Household Income and Expenditure Survey (CSO, 1996) indicates that for 35 per cent of all households, subsistence farming is the main source of income.

An important indicator is the degree to which the poor (e.g. those households spending more than 60 per cent of their total consumption expenditure on food) are dependent on agriculture. Rapid rural appraisal would suggest that in many areas this group, which contains a significant proportion of female headed households, is highly dependent on agriculture. Also, given the annual income figures of the poorest 25 per cent of households, at US$ 90, and assuming that all households cultivate between two and three hectares of crops, that they harvest average pearl millet yields of 300 kilograms per hectare, that pearl millet prices are 1 N$ per kilogram, and the 1993/94 exchange rate was US$ 1: N$ 3.6, it is clear that crops contribute most if not all of the income of the poorest households. Furthermore, given the limited potential of other income generating enterprises in the rural areas, agriculture will remain the most important vehicle for improving the position of the rural poor.

A process of socio-economic differentiation is proceeding rapidly in some rural areas. Many households are accumulating more agricultural assets, most importantly cattle, while others are being dispossessed. Perhaps the clearest indicator of poverty is lack of ownership of cattle, and thus lack of access to their products including draught power. Hence, poor households, who are the most dependent on crop production, are the least equipped to undertake it. And so, the poor get poorer, and more dependent on wealthier members of their communities. The ultimate result of this process is that, for many, farming is no longer a viable means of securing a livelihood. This is particularly so where cultivable land is in short supply, as in the north central Regions. The inevitable result is rapid urban growth. A projected growth rate of about 5.4 per cent per annum in the urban areas, compared to between 3.1- 3.3 per cent overall, means that in the next ten years, that is by 2006, over 43 per cent of the projected population of the country, will be living in urban areas.

3.2.4 The extent of of arable land degradation

The foregoing analysis of the nature and extent of soil degradation in Namibia, with its somewhat low-key conclusions, stands in contrast to the conventional wisdom as expressed by numerous international initiatives on sub-Saharan Africa and recycled in relation to Namibia. For instance, an FAO study (Stoorvogel & Smaling, 1990) in 1990 estimated net losses from soils in sub-Saharan Africa at 10kg N, 4 kg P₂O₅ and 10 kg K₂O per annum. Extrapolating such figures leads to such conclusions as:

Over the last 30 years an average of about 660 kg N/ha, 75 kg P/ha and 450 kg K/ha have been lost from 200 million ha of cultivated land in 37 countries. Nutrient outputs (harvests and losses) have simply not been balanced by inputs (inorganic and mineral fertilisers) and there is no reason to suppose that things have been different in northern Namibia. (McDonagh, 1998)

Proximate causes for this state of affairs are equally clear.

Activities such as overgrazing, inadequate agricultural techniques and deforestation are the direct causes of land degradation. In dryland areas, overgrazing affects 49% of the region; agriculture, 24%; and deforestation and over-exploitation, 27% (World Bank/FAO, 1996).
As are ultimate causes.

Population growth, land shortage and diminishing yield due to lack of inputs culminate in the impoverishment of land users and hence greater inability and disinclination to make long-term investments in soil conservation. (GTZ. 1995)

The major problem with this conventional analysis is its propensity to over-generalise and its failure to take into account the enormous variety of soils, topography, and land uses found. It is difficult not to conclude that political, budgetary and other pressures mean that particular 'narratives' about soils are 'mutually constructed' by scientists and policy actors, using data selectively and without due qualification, to support arguments about environmental crisis for strategic ends (Soones & Toulin. 1969). One result of such conventional analysis is that the popular mythology of massive soil erosion problems tends to give the false impression that the situation is unmanageable, which in turn feeds into emphasis on solutions such as population control and use of mineral fertilisers (often subsidised by the State). This report argues that there are serious information gaps despite so much alarmist talk. In the end, while we can confidently say that soil erosion is taking place in various places throughout the country, we are not in a position to say where it is happening, to what extent it is happening, or even whether it should be considered a severe problem either economically or environmentally.

3.2.5 Causes of arable land degratation

In the following short summary of causes of change in the status of arable soils we will briefly look at soil management practices, which constitute the proximate cause of change, as well as some key factors which determine the farming systems, and specifically the degree of intensification of soil management practices, which constitute the ultimate causes of change. In the first place we can summarise the following common proximate causes, most of which have been mentioned in the preceding section:

<table>
<thead>
<tr>
<th>Management practices leading to arable soil degradation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- lack of fallowing</td>
</tr>
<tr>
<td>- limited leguminous cropping</td>
</tr>
<tr>
<td>- little/no use of manure</td>
</tr>
<tr>
<td>- little/no use of inorganic fertiliser</td>
</tr>
<tr>
<td>- grazing of leguminous and other crop residues</td>
</tr>
<tr>
<td>- inappropriate tillage practices which pulverise top soils and create hard pans at the plough line</td>
</tr>
<tr>
<td>- cutting of trees which act as wind and rainfall and run-off breaks</td>
</tr>
</tbody>
</table>

Each one of the practices noted above is of course the result of a chain of cause and effect processes. Agricultural extension workers in Namibia are trained to draw up causal linkage diagrams with farmers, in order to get at the root causes of problems for programme planning purposes. For the purpose of this report we will short-cut the process and focus immediately on some common factors which determine farming systems. Again the tables below summarise some of the key factors noted in the preceding discussion.

**Biophysical**

**Climate:** Low and variable annual and seasonal rainfall limits the value of crop production and is responsible for a high risk of crop failure. Risk makes farmers unwilling to invest heavily in land management.

**Soils:** Inherently low fertility status combined with fragile soil structures mean that arable soil degradation is rapid but also that low but stable fertility status is rapidly attained. Failure to recycle nutrients, and physical erosion due to cultivation and wind (exacerbated by loss of tree cover) can disrupt this system.
Crops and livestock: While the crops types grown in Namibia are mainly determined by climate (and lack of irrigation) and soils, the fact that markets for cash crops, be it staple grains, horticultural crops, cotton, tobacco and others, are poorly developed, means that farmers have little incentive to invest in the soils.

Crop-livestock interactions are vital for the maintenance of the condition arable soils. Livestock are the means of capturing nutrients from the rangelands and concentrating them on crop lands. The system is stressed when livestock holdings fall due to drought, disease and lack of grazing. In high population density areas livestock intensification (eg. fodder production, cut and carry and stall feeding) are yet to develop.

Socio-economic

Population density: While on the one hand the rise in rural population density results ultimately in continuous cultivation and only drought enforced fallowing, on the other, once it rises still further, it becomes a factor leading to management intensification. Intensification can only take place when there is sufficient labour available per unit area. This allows for more effective use of limited inputs, for instance, by more careful timing and placement. The extent to which a household invests labour in managing arable lands depends on what that labour can earn off-farm. Rising populations also generate more opportunities for increased economic diversification in rural areas especially when there are external sources of income.

Access to markets: Access to markets determines opportunities for the sale of crops, off-farm incomes, and purchase of inputs. Limited market development in the northern crop growing areas, be it in terms of crop and livestock product markets, have limited margins on crop production and blocked intensification of management practices.

Diversified livelihood strategies: Managing arable lands and soils is one of many issues to be handled by farmers seeking to improve their welfare. Choices about where to invest their labour and capital are broad, and include different farm and off-farm options. In the end returns from each, and risk, are the main determining factors.

Land tenure: There is no clear evidence as to whether lack of secure title to arable land tends to limit investment in arable land improvement in Namibia, or whether customary usufruct rights provide sufficient security. PRA exercises carried out by farmers and agricultural extension workers across northern Namibia have not reported the issue of land tenure as a constraint to land management practices expected to yield short-term benefits. On the other hand, it is reported that farmers' tree planting is constrained by lack of tenure (Flower and Van Rooyen 1999).
3.3 Forests

This chapter starts with a review of research, inventory and monitoring programmes directed at providing information on the status of Namibia’s forests. Biophysical and socio-economic indicators of changing status derived from the findings of some of these programmes are then discussed. Thereafter, the chapter looks at causes of changes in forest status that have been identified.

3.3.1 Research, inventory and monitoring programmes

The Directorate of Forestry is in the early stages of developing a number of elements of a forest management information system. This has the following key components:

- An operations and management reporting system comprising quarterly and annual reports from the different Divisions and sub-Divisions of the Directorate of Forestry.

- A forest resource information system, which in due course should be developed into a user-friendly presentation. This will be based on data from the on-going National Forest Inventory and Forest Cover Mapping projects.

- A forest fire monitoring system.

- A forest products utilisation permit system.

Information on the current and changing status of forest resources should come mainly from the following projects which are contributing to the forest management information system.

(i) the Forest Cover Mapping project, which should indicate areas of forest cover by density and height types;

(ii) the National Forest Inventory project (including its growth monitoring component), which should indicate trees species, tree numbers, height and densities, and growth rates of different forests;

(iii) the Forest Permit System, which should indicate the extraction of woody material from forests; and

(iv) the Forest Fire Monitoring System, which should indicate the extent and degree of forest destruction caused by fire.

Other projects which should contribute information on forest resource status change include the Namibia Tree Atlas Project, the National Botanical Research Institute’s Vegetation Mapping Project, and the Ministry of Agriculture’s work on bush encroachment. The Forest Cover Mapping project and the National Forest Inventory project may be expected to constitute the major national database which will enable the quantitative assessment of forest resources over time.

3.3.1.1 The Forest Cover Mapping Project

The Directorate of Forestry has implemented a Forest Cover Mapping Project of communal lands north of 20 degrees south. The project covered the entire northern communal areas and was started in 1992 and completed in 1998 with financial and technical assistance from the Government of Sweden. Data is being reviewed and refined with ground-truthing on an ad hoc basis as and when the opportunity arises.

The project used 21 LANDSAT satellite images provided by the Swedish Space Corporation, as the basis for the visual tracing of areas of different vegetation cover types as determined by different surface area colours depicted on the images. This was followed by ground-truthing in the field, definition of final legends, final interpretation and predigilising checks. Data is presented in the form
of maps and detailed statistical tables by map sheet and by political Region (RoN.1995)This methodology provides a simple and relatively inexpensive (though time consuming) way of monitoring change of area of different forest types over time. It is also a methodology that is conceptually simple and visually attractive. As such, it is to be hoped that it will be repeated at periodic intervals. This could involve more frequent monitoring of forests near to more densely populated rural areas and urban areas. At the time of writing medium and long-term plans to repeat the mapping project have yet to be drawn up.

Results of the vegetation mapping exercise for the Kavango Region completed in 1996 are shown, for example, the Table below summarises the findings of the mapping exercise throughout the areas mapped. This data was made available by M. Chakanga of the Directorate of Forestry, and will probably incorporated into indicators being developed for Namibia's National Criteria and Indicators for Sustainable Forest Management and the FAO's Global Forest Resources Assessment 2000. It will also be incorporated into one of the State of the Environment Indicators being developed (see Part 5).

Table 3.8 Summary of vegetation types and their areas in the Kavango Region

<table>
<thead>
<tr>
<th>Vegetation type</th>
<th>Area (ha)</th>
<th>Percentage of total area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivation within forest areas</td>
<td>112,587</td>
<td>3</td>
</tr>
<tr>
<td>Cultivation within savannah areas</td>
<td>82,073</td>
<td>2</td>
</tr>
<tr>
<td>Intensive cultivation</td>
<td>7,858</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Total area cultivated</strong></td>
<td><strong>194,660</strong></td>
<td><strong>4</strong></td>
</tr>
<tr>
<td>Forest &gt;5m ht, dense (70%)</td>
<td>299,276</td>
<td>7</td>
</tr>
<tr>
<td>Forest &gt;5m ht, medium (40-70%)</td>
<td>1,427,363</td>
<td>34</td>
</tr>
<tr>
<td>Forest &gt;5m ht, open (10-40%)</td>
<td>1,044,884</td>
<td>25</td>
</tr>
<tr>
<td>Forest &gt;5m ht, very open (2-10%)</td>
<td>240,504</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total forest area</strong></td>
<td><strong>3,011,827</strong></td>
<td><strong>71</strong></td>
</tr>
<tr>
<td>Savannah 2-5m ht, dense (&gt;70%)</td>
<td>46,166</td>
<td>1</td>
</tr>
<tr>
<td>Savannah &lt;2m ht, dense (&gt;70%)</td>
<td>490</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Savannah 2-5m ht, medium (40-70%)</td>
<td>463,257</td>
<td>11</td>
</tr>
<tr>
<td>Savannah &lt;2m ht, medium (40-70%)</td>
<td>96,629</td>
<td>2</td>
</tr>
<tr>
<td>Savannah 2-5m ht, open (10-40%)</td>
<td>256,384</td>
<td>6</td>
</tr>
<tr>
<td>Savannah &lt;2m ht, open (10-40%)</td>
<td>31,233</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Savannah 2-5m ht, very open (2-10%)</td>
<td>90,721</td>
<td>2</td>
</tr>
<tr>
<td>Savannah&lt;2m ht, very open (2-10%)</td>
<td>37,161</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total savannah area</strong></td>
<td><strong>1,022,041</strong></td>
<td><strong>24</strong></td>
</tr>
<tr>
<td>Grasslands (&gt;2% shrubs or trees)</td>
<td>38,318</td>
<td>1</td>
</tr>
<tr>
<td>Omuramba</td>
<td>4,441</td>
<td>0.1</td>
</tr>
<tr>
<td>Marshly/swamp</td>
<td>9,267</td>
<td>0.2</td>
</tr>
<tr>
<td>Open water</td>
<td>3,556</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total Area</strong></td>
<td><strong>4,284,112</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

(Pers Comm. M Chakanga)
### Table 3.9 Summary of vegetation types and their areas in all Regions mapped

<table>
<thead>
<tr>
<th>Vegetation type</th>
<th>Kunene (000 ha)</th>
<th>Omusati (000 ha)</th>
<th>Oshana (000 ha)</th>
<th>Ohangwena (000 ha)</th>
<th>Oshikoto (000 ha)</th>
<th>Kavango (000 ha)</th>
<th>Caprivi (000 ha)</th>
<th>Grootfontein (000 ha)</th>
<th>Tsumkwe (000 ha)</th>
<th>Total (000 ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dense forest: &gt;70% crown cover, tree height &gt;5m</td>
<td>126</td>
<td>0</td>
<td>0</td>
<td>48</td>
<td>39</td>
<td>299</td>
<td>202</td>
<td>55</td>
<td>45</td>
<td>814</td>
</tr>
<tr>
<td>2. Medium forest: 40-70% crown cover, tree height &gt;5m</td>
<td>236</td>
<td>3</td>
<td>0</td>
<td>253</td>
<td>238</td>
<td>1427</td>
<td>619</td>
<td>81</td>
<td>294</td>
<td>3151</td>
</tr>
<tr>
<td>3. Open forest: 10-40% crown cover, tree height &gt;5m</td>
<td>32</td>
<td>0</td>
<td>0</td>
<td>156</td>
<td>175</td>
<td>1045</td>
<td>502</td>
<td>100</td>
<td>262</td>
<td>2272</td>
</tr>
<tr>
<td>4. Very open forest: 2-10% crown cover, tree height &gt;5m</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>53</td>
<td>183</td>
<td>241</td>
<td>212</td>
<td>33</td>
<td>99</td>
<td>832</td>
</tr>
<tr>
<td>5. Dense savannah: &gt;70% shrub cover, &lt;2m</td>
<td>136</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>17</td>
<td>0</td>
<td>0</td>
<td>52</td>
<td>5</td>
<td>215</td>
</tr>
<tr>
<td>6. Dense savannah: &gt;70% bush cover, 2-5m</td>
<td>254</td>
<td>43</td>
<td>2</td>
<td>56</td>
<td>189</td>
<td>46</td>
<td>2</td>
<td>196</td>
<td>65</td>
<td>854</td>
</tr>
<tr>
<td>7. Medium savannah: 40-70% shrub cover, &lt;2m</td>
<td>1243</td>
<td>134</td>
<td>17</td>
<td>3</td>
<td>165</td>
<td>97</td>
<td>0</td>
<td>229</td>
<td>131</td>
<td>2018</td>
</tr>
<tr>
<td>8. Medium savannah: 40-70% bush cover, 2-5m</td>
<td>358</td>
<td>283</td>
<td>30</td>
<td>16</td>
<td>668</td>
<td>463</td>
<td>3</td>
<td>820</td>
<td>476</td>
<td>3117</td>
</tr>
<tr>
<td>9. Open savannah: 10-40% shrub cover, &lt;2m</td>
<td>727</td>
<td>159</td>
<td>22</td>
<td>0</td>
<td>75</td>
<td>31</td>
<td>0</td>
<td>320</td>
<td>111</td>
<td>1446</td>
</tr>
<tr>
<td>10. Open savannah: 10-40% bush cover, 2-5m</td>
<td>1382</td>
<td>104</td>
<td>27</td>
<td>25</td>
<td>311</td>
<td>256</td>
<td>6</td>
<td>523</td>
<td>225</td>
<td>2861</td>
</tr>
<tr>
<td>11. Cultivation within forest</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>145</td>
<td>113</td>
<td>82</td>
<td>0</td>
<td>0</td>
<td>342</td>
</tr>
<tr>
<td>12. Cultivation within savannah</td>
<td>0</td>
<td>394</td>
<td>19</td>
<td>0</td>
<td>170</td>
<td>81</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>670</td>
</tr>
<tr>
<td>Total forest</td>
<td>394</td>
<td>3</td>
<td>0</td>
<td>457</td>
<td>452</td>
<td>2771</td>
<td>1323</td>
<td>236</td>
<td>601</td>
<td>6237</td>
</tr>
<tr>
<td>Total savannah</td>
<td>4112</td>
<td>723</td>
<td>98</td>
<td>156</td>
<td>1608</td>
<td>1135</td>
<td>224</td>
<td>2174</td>
<td>1112</td>
<td>11342</td>
</tr>
<tr>
<td>Total cultivation</td>
<td>0</td>
<td>394</td>
<td>21</td>
<td>0</td>
<td>315</td>
<td>194</td>
<td>85</td>
<td>3</td>
<td>0</td>
<td>1011</td>
</tr>
<tr>
<td>Total land</td>
<td>5657</td>
<td>1390</td>
<td>511</td>
<td>1067</td>
<td>2658</td>
<td>4291</td>
<td>1984</td>
<td>2497</td>
<td>1833</td>
<td>21888</td>
</tr>
</tbody>
</table>
3.3.1.2 The National Forest Inventory Project

The project started in late 1995, with support from the Government of Finland, and aims to inventory forest vegetation so far mainly in the northern communal areas, as well as in the Tsumkwe, Okarara and Otjimbinie Districts. Inventories are being presented on a Regional basis. These will be supported by more detailed inventories of selected smaller areas. Detailed forest inventories, employing greater sampling intensities, which are designed for operational forest management purposes, are being prepared for the Caprivi State Forest (Caprivi Region), the Nkurenkuru proposed Community Forest (Kavango Region), the Government’s Eucalyptus Plantation (Kavango Region), the Okongo proposed Community Forest (Ohangwena Region), the Ongandjera proposed Community Forest (Omusati Region), and the Uukwaludhi proposed Community Forest (Omusati).

To date reports are available covering the Caprivi Region and the Tsumkwe, Okarara and Otjimbinie Districts. Reports on the Oshikoto, Omusati, Ohangwena and Oshana Regions will be ready in the year 2000, while that for Kavango Region is expected to be complete in the year 2001. The Kunene Region has not been addressed.

The National Forest Inventory methodology uses a combination of data from satellite imagery and forest cover maps with data gathered from ground-based inventory of GPS-referenced permanent sample plots. As such the data gathered is amenable regular up-dating through monitoring sample plots selected by means of stratified random sampling. At the time of reporting there are no plans for monitoring in the future.

In the detailed inventories information is recorded (i) on the type classification of the woody vegetation, (ii) on forest and tree characteristics including species, numbers, volumes, heights, biomass and canopy cover, (iii) on shrubs characteristics, (iv) on grass and herb cover, and (v) on the surrounding biophysical environment.

A number of the sample plots have been selected as permanent sample plots to be re-measured periodically to generate growth information on different species under different conditions. Work is currently progressing to develop a scientifically valid and cost-efficient methodology for determining growth with the assistance of the National Forest Research Centre, the University of Stellenbosch, and services in Germany.

3.3.1.3 Forest Permit System

The aim of the Forest Permit System is to monitor and control the harvesting, transport, and export of forest products. Six different permits are issued by the Directorate of Forestry. These are a Harvesting Permit, a Transport Permit (for commercial purposes), a Transport Permit (for own consumption purposes), a Marketing Permit, an Export Permit (for commercial purposes), and an Export Permit (for own consumption purposes).

In theory, the permit system should provide information on forest product utilisation, which taken together with information on existing stocks, growth, and fire, should provide a comprehensive picture of the state of forest resources. However, the permit system currently in use is recognised to be cumbersome and inefficient, and efforts are underway to streamline procedures. Included in these efforts will be the development of a database to capture all the information gathered by the permits, for its later analysis for information purposes. The weaknesses of the system include its failure to include non-wood forest products, and its user-unfriendliness which results in a considerable, and unknown, proportion of forest product extraction taking place illegally and without monitoring.

Given the Directorate of Forestry’s limited resources, and the difficulties inherent in trying to exert State control of forest product utilisation over the huge areas of Namibia’s forest, it is recognised that it will probably be a better use of scarce resources to develop systems of community control and monitoring of forest resources, based on community self-management plans for community forests as provided for under the draft Forest Bill, than to expend major efforts in perfecting the State controlled current system. Hence, while the draft Namibila Forest Development Policy (RoN. 1999) states:
"Permits are currently the main policy instrument used by the Directorate of Forestry to regulate private sector forestry activities. A permit is required for harvesting, transportation and marketing of forest products, from both commercial and communal areas." (Page 7)

It also states:

"Regulation of private sector (farmers, local communities, enterprises) forestry activities will only take place in cases where incentives to induce voluntary policy implementation are ineffective and the assignment of property rights and mechanisms for negotiated settlements are insufficient." (Page 2)

3.3.1.4 Forest Fire Monitoring System

As part of its Integrated Forest Fire Management project, the Directorate of Forestry has studied satellite images in eastern Caprivi which clearly depict fire scars throughout the year. Satellite images allow comparisons to be made between areas burned from year to year. Two drawbacks of this approach for indicator purposes are the uncertain accuracy of the images, and the complexity of the relationship between fire intensity, fire sequence and forest ecology. Despite these, the presentation of satellite images of fire scars combined with an albeit simplified narrative could be developed into a powerful indicator for public consumption.

3.3.1.5 Namibia Tree Atlas Project

This project, which commenced in October 1997, implemented by the National Botanical Research Institute under the auspices of the Namibian National Biodiversity Task Force, aims to produce a snapshot, over its three year duration, of the distribution of different tree and shrub species throughout Namibia. It does not record information such as tree density, and associated vegetation. Information is provided from a number of sources, most notably members of the public. As such the project partly aims at raising public awareness of forest issues.

The data that will be produced by the project, which will be presented in the form of maps showing the distribution of large woody plants, and related narrative reports, may be expected to form useful baseline data on tree species distribution. To an extent this can be compared with previous records from different sources. Further, it is expected that the project should be repeated in future, in which change should be revealed.

3.3.1.6 National Botanical Research Institute’s Vegetation Mapping Project

Having started in 1997 in south-eastern Namibia the project is gradually working its way throughout the country, which is expected to take at least 10 years to complete. The methodology is similar to that employed by the National Forest Inventory Project being based on selected GPS-referenced sample plots. Data on all plant species is collected, including grasses and herbs, which the National Forest Inventory Project omits. Much less detailed information on trees is collected by the Vegetation Mapping Project than the National Forest Inventory Project. Some of the findings of this project are discussed in chapter 3.1.1.2.

3.3.1.7 Ad hoc studies

Several localised studies on deforestation in Namibia have been carried out. For example, a study in the western part of the Chavengwa Region compared two series of aerial photos, the first taken in 1972 (scale: 1/50,000) and the second taken in 1992 (scale: 1/30,000) (Renaut & Pelkonen, 1994). This study surprisingly found that despite significant increases in the numbers of dwellings sited, the area of forest cover itself had barely decreased in the 20 year period studied. It is suggested that this may have been because of limited new settlement in the area, and on the contrary significant out-migration from the area, during the liberation war. Another possibility suggested is that headmen allocated crop and settlement land where forests had already been significantly thinned through the collection of fuelwood or abandoned through out-migration during the war.
3.3.2 Bio-physical Indicators

Deforestation may be defined as "the complete clearing of trees from the land and replacing them with other land uses, e.g. arable land. Overgrazing, selective logging and repeated fires may, but do not necessarily, result in deforestation." (Erkkiä & Silskonen. 1992) They do however result in forest degradation, as both biomass, canopy cover, and biodiversity is diminished.

While we can gain a good picture of the current situation, at least in the northern communal areas, from the work of the Forest Cover Mapping Exercise and National Forest Inventory projects, we are reliant for information on change over time on the historical record.

Excessive tree felling by settlers was already recognised as a problem in the late 1800s, resulting in an ordinance issued by the German colonial authorities limiting tree cutting in the Police Zone. Some of the main species to suffer included Acacia erioloba (Camel Thorn) used for fuel and fence posts, and Spirostachys africana (Tambotl) used for mine props.

Wholesale deforestation has, however, occurred only in specific areas, most notably where population pressure is greatest. These areas include parts of the Cuvévelal Delta area, and around water points and some rivers, where population densities commonly reach 100 persons per square kilometre, and livestock are in abundance. For instance, deforestation and field crop cultivation along the Okavango River or beside oshana are sometimes reported to have resulted in high rates of siltation and damage to river and wetland ecology. Other areas to suffer include the sparsely populated south of the country where woody biomass is low and regeneration slow due to low rainfall.

Settlement patterns in nineteenth century Ovamboland saw communities living in discrete kingdoms in relatively densely settled areas cleared of forests except for selected fruit and other trees, separated from each other by Colososphermum mopane (Mopane) forests. Missionary reports vividly indicate the rates at which these forests where cleared (Erkkiä & Silskonen. 1992). For instance, the missionary Hugo Hahn reported in 1866 how the Ondonga and Uukwanyama kingdoms were separated by 60 km of forest. Successive missionaries reported how, over the next 100 years, this distance gradually shrank till cleared areas occupied by the two communities joined. During the same period the population of former Ovamboland is estimated to have grown from about 100,000 to 600,000.

In the Kavango region evidence suggests that Bantu speaking people only migrated to the area from the north-east in the 18th century (Malan. 1995). These people were cattle farmers, cultivating only small patches of millet, but relying mainly on wild foods from the forests (Gibson et al. 1981). More recently, the Kavango region is perceived to have suffered significant loss of tree cover. This is mainly as a result of field clearance for crop cultivation beside the river, and along the inland omuramba and tarmac road. The latter was first cleared, though leaving important fruit bearing species, to a distance of 300 to 500 metres from the road by the SADF in the 1980s. Other importance causes of deforestation include concessions given to commercial loggers, the cutting of hardwoods by carvers. Fire is also a cause for concern. Estimates from satellite images suggest that up to 75 per cent of the region was subject to forest fires in 1997. This clearly has an effect on the resource (Flower & Van Rooyen. no date).

Evidence of loss of specific tree species includes the results of work on Makalani palm (Hines & Cunningham. 1992) which showed a major decline in numbers in eastern Kavango through cutting of plants for palm hearts. This has deprived basket weavers in the area of raw materials and they have sought to harvest from the Mahangu Game Reserve. Despite the estimate that nearly 90,000 leaves could be sustainable collected annually from the park, which would have supplied 1,136 small-scale producers, the MET has not granted permission for this to take place.

Otherwise, the evidence of change in forest resources comes from evidence of the biophysical results of this change. Some of these results are noted below.

Local rainfall distribution may be affected by changes in so called "Albedo effect" resulting from deforestation and the consequent exposure of light coloured soils. The latter has occurred in the densely populated Cuvelal basin area, as shown strikingly by satellite photos, though what its climatic consequences may have been can only be tested using meteorological models. Other biophysical
costs of deforestation derive from the contribution made by trees to watershed protection, groundwater recharge, and biodiversity maintenance.

Other types of biophysical evidence of changing forest status that are theoretically useful include evidence of physical soil erosion. In some areas it is clear that soils have been eroded as trees are left with their roots hanging in the air. There appears to be little information on soil run-off and consequent high river silt loads and effects on fish stocks. In any case, the causal relationship between loss of forest cover and soil erosion is far from clear-cut. For example, it may be argued that in Namibia's savannah type forests, thick canopy cover which prevents the growth of grass and other soil-binding undergrowth may result in a greater vulnerability to soil erosion caused by heavy rain and run-off than open forests where undergrowth thrives. This argument may even be extended to comparisons between different types of forest cover and different rain-fed field crops. Less controversially, perhaps, as an indicator of loss of trees, is increasing soil erosion and sand blasting caused by wind.

### 3.3.3 Socio-economic indicators

The destruction of forests has direct socio-economic consequences. Communities in the northern communal areas rely on trees for fuel, fruit and nuts, medicines, fencing, furniture, tools, the construction of palisade kraals. As trees are cleared around settlements, people, especially women, are forced to spend longer collecting wood for fuel, as well as building and fencing. This continues until the resource close to human settlements is used up and it becomes economic for those with the means to travel increasingly long distances to collect supplies which diminish in quantity and quality the further away from settlement and roads one moves. The poor who are unable to travel to collect wood must pay for it. This creates income generation possibilities mainly for the already better-off and costs for the poor, thus increasing income inequalities and class formation. Ultimately, wood is replaced for many purposes by other items. For instance, in the Oshana and neighbouring regions houses are increasingly built from bricks and corrugated iron sheets.

A 1994 study (Quan et al. 1994) in the Uukwaludhi area of the Omusati Region, used theoretical models to assess the costs of fuelwood and fencing in the absence of local free forest resources. It calculated that a household required a minimum of one bundle of fuelwood @ N$ 2 per day for cooking (about N$ 700 per annum), and required wire and poles costing N$ 400-640 to replace 1/5th of fencing around fields. However, this tells us little about the real value of wood to the household or of the real situation of household economics. For instance, as noted in section 3.1.2, on arable land, tree clearance can result in costs due to soil erosion and sand blasting of crops due to increased wind speeds.

In the absence of detailed field studies of changing patterns of wood and non-wood forest product use in Namibia, it has been suggested that one means of monitoring extraction could be the permit system operated by the Directorate of Forestry. However, as noted above, the current system of issuing permits for cutting individual trees is ineffective and variable from one area to another. Hence data related to permits issued provides little evidence of wood use. Likewise, on the other side of the coin, policing of permits is low-key. Hence data on fines issued to those commercial wood users who have been caught without permits indicates more the conscientiousness of the enforcement agencies than the amount of wood that is being illegally cut and used.

### 3.3.4 Causes of Forest Resource Degradation

#### 3.3.4.1 Proximate causes

**Selective Cutting and Lack of Forest Management**

Large scale removal of selected trees occurred up until recently through logging concessions in the north east over which communities have no control. Excessive use of wood for construction of dwellings (especially the traditional Ovambo dwellings) and fencing, for fuel and carving for the tourist trade, as well as clearing fields for cultivation, has led to problems of deforestation, particularly in northern Namibia. Much of the current use of forest products is selective and could be sustainable, if the number of people involved in their use is not too high as occurs in urban and peri-urban areas.
The question of the sustainable use of forest products is however not straightforward. Sustainable extraction rates cannot be determined by theoretical production and consumption figures alone. The human element, and specifically people's naturally unsustainable wood extraction practices, unless planned and controlled, is the overriding factor. While we may be able to say that a particular region's demand for fuel wood could be supplied by expected forest regrowth, this alone in fact tells us little. Ollikainen (1991) estimated a per capita consumption of wood of 1.3 m³ for the Kavango Region. Thus, the Kavango Region's population of 116,830 (1991 population census) would consume 151,879 m³ of wood annually. This would mean that the regions' total area of forest of 3,011,827 would need to produce only 0.05 m³/ha/annum, which is well below what is projected.

However, wood is of course not harvested according to sustainable extraction plans. It is actually taken from as close to people's homes as possible. Forests near to population centres are excessively harvested while those far from population centres are left untouched. This continues until the resource close to human settlements is used up and it becomes economic for people to travel increasingly long distances to collect supplies of wood which diminish in quantity and quality the further away from settlement and roads one moves.

Active management of forest resources in communal areas is limited or non-existent except when carried out by forestry staff in declared areas. Reforestation practices introduced in the early 90s focussed on tree planting while protection and management of naturally germinated trees has been neglected. Awareness is being increased through focus on agro-forestry and community forestry as management tools. New forestry legislation is expected to enable the development of community-based forest management, and several pilot projects are engaged in efforts to prepare for this.

**Forest clearance for crop production**

While selective extraction of trees leads to forest degradation in terms of canopy cover, wood volume and biomass, and so forth, land clearance for cropping results in complete deforestation. Traditionally, when settling in a new area, a family kills most of the trees in his crop fields, and the trunks and branches are used to make his home. It was not allowed to cut fruit trees such as *Sclerocaryta birrea, Berchemia discolor, Diospyros mespiliformis* and *Hyphaene ventrosoa*. Such rules were strictly enforced in some areas, and fines were payable to headmen. Farmers also left a number of shade trees such as *Baikiaea plurijuga* and *Peltophorum africanum*.

The increasing use of ox-drawn and tractor-drawn ploughs for land cultivation, and the concern that farmers have that trees near to their fields will harbour pests, particularly birds, leads farmers to clear-felling.

Clear-felling of trees as a pre-requisite is being actively promoted by the government for what is perceived as a goal of agricultural development in the northern communal areas: modern, tractorised farming. Small-scale farming using traditional technologies, which would allow for valuable trees to be left in fields, is perceived as backward and underdeveloped. This notion has been vigorously pursued by most official agricultural service organisations for the past few decades. The ploughing services offered by the second tier administrations and taken over by the MAWRD, the NDC Farmer Support Programmes, and the Agribank crop loan scheme are all examples of the official orthodoxy. The Agribank, for instance, insists that land should be cleared of trees and destumped as pre-condition for the issuing of crop loans (though the NACP scheme failed to monitor this, amongst other pre-conditions). The MAWRD likewise requires clear and cleaned fields as a condition for provision of tractor services. It is only in the last few years that voices calling for a different approach, promoting draft animal powered cultivation and agroforestry, are beginning to be heard.

Figures from the Vegetation Mapping Project indicate significant areas have been clear-felled. These areas are significantly greater than areas actually cultivated in most Regions. Where this occurs it can be assumed that land is either being left fallow or has been abandoned altogether. In some cases land is abandoned for cultivation purposes altogether.

**Forest clearance for settlement**

As the rural population of forest areas grow, so they require land not only for crop production but also for housing, roads, water points, pipelines and so forth.
Fire as an agent of deforestation

Forests fires are a natural phenomena to which Namibian forest and savannah ecosystems are adapted. Problems occur when frequent man-made fires disturb forest ecology destroying trees, retarding tree growth and hampering seedling regeneration. They may lead to short or long-term damage to forest ecosystems and to alteration of hydrological regimes.

Burning of forests and rangelands in preparation for regrowth of grazing and for hunting purposes is a traditional practice, sometimes one with deep-rooted spiritual and cultural significance. Shifting cultivation also depended on fire. In recent times, with increased population density the incidence of deliberate fire-setting which is uncontrolled and of accidental fire has become a major problem. It is estimated that 3-5 million hectares of forests, bush and grassland is burned every year in Namibia. In the eastern Caprivi alone, an estimated 840,000 to 1 million hectares burn annually. The National Forest Inventory project has found that 90 per cent of all trees in north-eastern Namibia have been damaged by fire.

Often the most severe damage is caused by the burning in vegetation zones, such as Kalahari Woodlands, where there has been a build-up of inflammable materials because of insufficient grazing and lack of burning. Another cause of a build up of dry biomass is the opening up of previously closed canopy cover by selective tree cutting. In Caprivi, it is estimated that cutting of trees to enable grass growth lead to the increase in grass and plant biomass under the forest from 200-500 kg per hectare to 2,000 - 4,000 kg per hectare.

Inventory studies (e.g. Geldenhuyse, 1992) in north east Namibia show large stocks of smaller diameter classes of more fire-tolerant *Pterocarpus* and *Burkea* but far fewer than expected small diameter class stems of the less fire tolerant *Baikiaea* and *Guibourtia*. On the other hand the picture was reversed for large diameter classes. This suggests the damage done by fires in more recent times when the area has been subject to increased man-made fires.

Forest fires were controlled by the traditional authorities. In recent times this role was taken over by the government. However, until 1995, government efforts to limit forest fires were limited to State Forest areas where fire towers were erected and fire lines were cleared. Thereafter, the efforts of the Directorate of Forestry have began to raise awareness of the damage that is caused by fires (in the Caprivi this was aided by the death of cattle from starvation after drought followed the burning in the 1995/96 season), and to involved communities in fire protection, control and suppression activities. Community action needs to be supported by basic fire information, training, technologies and infrastructure. Fire management practice involves the removal of fuel loads by periodic controlled burning, as well as the clearing of fire-breaks.

**Unknown causes**

Finally, In this section it must be acknowledged that our knowledge of many aspects of forest ecology in Namibia is lacking. In particular, the influence of factors such as wet and dry climatic episodes and disease epidemiology on forest status, amongst others, remain largely unknown.

### 3.3.4.2 Ultimate causes

Population growth and rural poverty increases demand for forest products and land, particularly as the majority of Namibia's population live in areas supporting forests. It is a tautology to say that as the number of people dependent on the exploitation of forest resources increases in a particular area, so, without proper forest use planning and management, the pressure on those resources also increases. The example of population growth in the former Ovamboland area has already been given.

The main point however is that population pressure on its own is not the concern. Indeed, it may be considered to a large degree a given. Rather, the issues are dependency on forest resources due to lack of appropriate and affordable alternatives, and failure to plan and manage forest use. These are issues over which society has a good deal of influence. Part 4 of this report will be reviewing the progress being made towards dealing with these issues.

The failure of society to construct ways and means of planning and managing sustainable forest use is a major cause of forest resource degradation, deforestation and failure to reafforest. On the one hand, individuals and communities in communal areas lack tenure rights over land and forest
resources, and consequently have not developed community structures to plan and manage these resources. On the other hand tenurial rights of individual trees (e.g. certain fruit and shade trees) have contributed to their protection.

Most forests are essentially a free-for-all, and suffer the classic symptoms of the so-called "tragedy of the commons". Throughout Namibia there are great expectations as to the community management approaches the new Forest Bill will enable once enacted. But this will be but one plank in a raft of new approaches that will be needed. The implementation of land use planning and environmental impact assessments can make important contributions to local planning. But implementing capacity in both fields is woefully inadequate (see Part 4).

Policy failure with regard to sustainable forest management can be identified in a number of issues. As noted above, the failure to address the tree and forest user and tenure rights of individuals and communities is a clearly identifiable constraint to management efforts. Likewise, the lack of capacity in the areas of land-use planning and environmental impact assessment have also been mentioned. The 1992 Forest Policy itself, and its stress on environmental benefits of forests over and above the economic benefits, and state over community responsibility, cannot escape some blame. On the other hand, the Namibia Forestry Strategic Plan (RoN. 1996) rectifies policy orientation when it says: "The management of forests for the benefit of the welfare of the people should be the raison d'être for their protection." Following from this, are new approaches to deal with the inability of traditional state forest reservation to protect resources. Whereas the 1992 policy statement called for at least 10 percent of Namibia's land area to be gazetted as State forests, the 1996 policy document states: "The reservation of land for state forest management should take place only when communal and private ownership: a) is unwilling or economically unable to give the land continuing and productive forest management and b) cannot conserve special public interests like watershed and biodiversity conservation, which are important in many forest areas."

Complex of causes
It is important to remember that usually, natural resource degradation results from a number of ultimate and proximate causes acting in unison. For instance, the main causes of forest resource degradation have been identified as (RoN. 1996).

- the effect of uncontrolled and accidental fire;
- increasing population pressure and demand for forest products, and for forest land for farming;
- the inability of traditional state forest reservation to protect forest resources;
- inadequate partnership between the Government and non-governmental stakeholders in forestry development;
- ill-defined forest policy that constrains access to and use of forest resources by people dependent on them;
- policy failure outside the forestry sector.

Only, if these issues are addressed collectively will real progress be achieved.
3.4 Groundwater Resources

Namibia’s general aridity and the fact that perennial sources of surface water are only present on its extreme northern and southern boundaries (with the exception of some large dams), means that the vast majority of farmers in the country are reliant on groundwater to a greater or lesser extent. Groundwater resources are, therefore, of crucial concern to the agricultural sector. This section of the report is based largely on the recently completed SOER on Water in Namibia (WET, 1999) and Namibia’s Water: A decision makers’ guide (Heyns et al., 1998).

3.4.1 Current Status Of Groundwater Resources

3.4.1.1 Introduction

The nature (quality) and quantity of groundwater is determined by several factors, which include:
- The geology of the water-bearing strata,
- The depth of water from the surface
- The yield of the borehole, spring or well
- The recharge rate
- The chemical composition of the water source
- The risk of pollution

A broadscale classification of groundwater aquifers in Namibia has been proposed by WET (1999) and the principal characteristics of each aquifer type is summarised below.

3.4.1.2 Alluvial (Sand) Aquifers

This type of aquifer refers to the water resources held in the inter-granular pore spaces of alluvial deposits in river beds. They are an extremely important source of groundwater in Namibia and supply water for towns, industries, agriculture and domestic consumption. Many of these aquifers may be of limited storage capacity but they experience relatively rapid recharge after significant run-off events. Alluvial aquifers are of particular importance in the west-flowing ephemeral rivers of the Kunene and Erongo Regions. Most of the smaller west-flowing rivers have some degree of water abstraction from the alluvial aquifer. Most of the abstraction is from wells, hand pumps and some boreholes and is generally for domestic and subsistence agricultural use. Major state abstraction schemes supplying towns and the mining industry are found in the Kuiseb, Omaruru, Khan, Swakop and Okahandja.

The recharge of alluvial aquifers is provided primarily by flow in the ephemeral river channels with a minor contribution from direct infiltration of rainfall. Recharge rates are not directly proportional to annual runoff in a particular river system, but recharge is generally greatest after high intensity runoff events. The recharge and stored volume reserves of the major alluvial aquifers is monitored by the Geohydrological Division of NamWater. The general trend of stored reserves in alluvial aquifers is downwards, as abstraction exceeds recharge.

The water chemistry of alluvial aquifers is highly variable and depends to a large extent on the nature of the material that the groundwater passes through during infiltration and throughflow. High levels of organic materials in the alluvium results in high levels of sulphides and nitrates which are undesirable in water.

Alluvial aquifers are generally systems with high permeability and are, therefore, susceptible to pollution. The nature and extent of pollution in alluvial aquifers has not been widely researched in Namibia, but it is known that there is some pollution of groundwater resources near certain mining operations.

The alluvial aquifers of the west-flowing ephemeral rivers are extremely important in terms of the subsistence agricultural systems associated with these rivers. Farmers are dependant on these aquifers for water supply (for domestic, livestock and limited irrigation use) as well as being dependent on the aquifer for the maintenance of important vegetation resources, such as Ana trees Faidherbia albida, which are crucial dry season food reserves for livestock. Within these systems the issue of greatest concern is upstream disturbance of the hydrological regime. This may be in the form
of dams or weirs which reduce flood intensity and annual runoff, over utilisation of groundwater (abstraction) and upstream pollution (waste water and industrial pollutants). There is evidence that the construction of the Swakop Poort dam on the Swakop River has resulted in the die-off of large numbers of large Ana trees in the Otjimbtingwe area, resulting in problems in the livestock farming system practised there. A similar problem is expected to occur in the Oanob River following the construction of the Oanob dam near Rehoboth.

3.4.1.3 Kalahari Aquifer

A significant part (about 30%) of Namibia is covered by semi- to unconsolidated strata of the Kalahari Group. The aquifers associated with these sediments produce water of variable salinity and are generally low yielding, with the exception of the confined aquifers of the artesian basins discussed in Section 3.4.1.6 below. According to WET (1999) groundwater is not present everywhere with the Kalahari geological system, but where it occurs it is relatively easy to locate (e.g. throughout most of the Okavango and Caprivi Regions). Within the Changwena and Oshana Regions the Kalahari aquifer is relatively well studied, with a shallow freshwater "perched" aquifer in the Cuvelai area being of the greatest importance. Deeper boreholes in this area tend to be variable in quality, from hypersaline to fresh.

There is little information on the recharge and storage capacity of the Kalahari aquifers. Interconsult, 1996) has proposed that most recharge in the Kalahari system originates from fracture aquifers in bedrock and that recharge rates are very slow. No comprehensive assessment of the stored volumes of the system have been made. There are no data on abstraction rates from different parts of the Kalahari aquifer.

Water quality within the Kalahari aquifer is highly variable, with high salinity's being a particular problem over much of the country.

Water abstraction from the Kalahari aquifer is largely by means of boreholes. Most water is used for domestic purposes and the maintenance of livestock, with the exception of the Stampriet artesian aquifer which is an important irrigation resource. Some small towns are supplied by well-fields drawing on this aquifer. Given the high permeability of much of the upper strata of the Kalahari system there is a considerable threat of pollution where waste water and industrial wastes are not correctly handled.

3.4.1.4 Fracture Aquifers

Fracture aquifers occur in hard rock where fractures allow water to permeate the rock. The size of the aquifer is determined by the density of fractures and the size of individual apertures in the rock. These aquifers are generally exploited through means of boreholes through much of the country and are mostly used for domestic and livestock water supply. A number of towns are supplied from fracture aquifers, including Windhoek, Gobabis and Ojirwarongo.

Recharge of these aquifers is almost entirely through infiltration of rainfall and several good rainfall seasons are required to recharge aquifers measurably. Stored volumes are difficult to calculate. Recommended abstraction strategies are dependent on sustainable yields which in turn are dependent on the volume (and rate) of recharge from rainfall (WET, 1999).

Water quality is variable depending on the type of parent rock in which the aquifer lies. Fracture aquifers situated in Nama sediments often have high levels of nitrates which are unacceptable. Pollution risks in this type of aquifer are also dependent on the parent rock and the nature of the surface overburden.

3.4.1.5 Karst Aquifers

This type of aquifer refers to the large groundwater aquifers which typify the dolomite and limestone terrains of the Otavi Mountains. These aquifers are of such a size and scale that they are of strategic national importance and supply water to the central area (Windhoek) and Ojzondjupa from groundwater in the Grootfontein and Kombat areas.
Recharge of these aquifers is almost entirely through infiltration of rainfall and several good rainfall seasons are required to recharge aquifers measurably. Stored volumes are difficult to calculate but dewatering operations at the mines at Berg Aukas, Kombat and Tsumeb have not depressed the water table appreciably, indicating very large stored volumes of water and (or) relatively rapid recharge from incident rainfall. What depression of the water table has been measured is ascribed to lower rainfall (and hence lowered recharge).

These aquifers supply water to irrigation projects in the Kombat and Tsumeb areas. Additionally, a considerable volume of water (1Mm³) is pumped to the Oijituo area and is an important source of water for livestock in the area.

Water quality in these aquifers is high with minimal problems associated with high calcium levels.

3.4.1.6 Artesian Aquifers

Artesian aquifers form where the aquifer is capped by an impervious layer leading to the confinement of the aquifer. Where the confining pressure at the top of the aquifer is large enough to raise the water level to the surface, groundwater will flow out of any borehole drilled into the aquifer. Artesian aquifers need to be carefully developed in order to minimise leakage and waste. There are 3 major artesian aquifers in Namibia. These are:

- The Stampriet Artesian Basin. Groundwater from this basin is used for large-scale irrigation, stock watering, domestic and municipal use. This aquifer basin is a groundwater control area, meaning that permits are required for the drilling of boreholes and abstraction of groundwater. Up to 6.8 Mm³ of water are abstracted from this aquifer annually.
- An area 30 km West of Maltahoe, about which little information is available.
- The Oshiwelo-Namutoni artesian aquifer which draws its water from a highly permeable layer in the Kalahari sediments overlain by a confining clay layer. Water quality is variable with high sodium chloride levels rendering it unsuitable for irrigation but acceptable for stock watering and domestic use.

3.4.2 Pressures and Threats to Groundwater Resources

The State holds the jurisdiction over all groundwater resources in Namibia, with the Department of Water Affairs being the institution in charge of management and control of water abstraction. The formation of the parastatal, NamWater, has seen the role of bulk water supply move away from DWA to NamWater. With the formation of regional to village level water committees taking over many rural water supply points the role of DWA is decreasing significantly in respect to management and control of water resources. It is, however, crucial that DWA continues to maintain its monitoring, collation and analytical functions in respect of abstraction from groundwater resources, as these data are crucial in planning and management.

With the exception of the major rivers along the northern and southern borders of the country there is very little surface water in Namibia. There is, therefore, a heavy reliance on groundwater resources for development and fully two thirds of the population is already dependent on groundwater for their water supply. Demand is likely to increase in the future, not least of all within the agricultural sector. However, the current knowledge and understanding of Namibia’s groundwater resources is sketchy with major information gaps regarding:

- The nature and extent of the majority of aquifers
- Recharge rates and the sustainable yields of aquifers
- Current and projected abstraction rates from aquifers
- The relationship between abstraction rates, recharge and water quality
- Pollution risks and long-term effects of pollution.
- Environmental demand (i.e. the amount of water which is necessary to maintain the processes and services provided by water in natural ecosystems)

For development to be sustainable in the long term these gaps in current understanding need to be addressed. With regard to current practices within the agricultural sector the greatest concerns lie in the fields of aquifer depletion and pollution. The current monitoring system for abstraction rates
includes very few boreholes on commercial farms and in the communal areas, with the exception of those abstraction projects controlled by NamWater. Aquifer depletion may take place over extended periods of time and it is only through regular monitoring that this trend would be detected. Water quality monitoring has largely been restricted to NamWater projects and the current understanding of water pollution risk is poor, particularly regarding agricultural pollution of groundwater around boreholes used for both livestock and domestic purposes. The issue of environmental demand has not been widely considered in the development of water resources over much of the country but has wide implications, especially for the maintenance of current farming systems in the ephemeral rivers and the Cuvelai system.

The current SOER on Water in Namibia (WET, 1999) defines four key indicators which would adequately address the shortfalls in the current understanding of the demand for groundwater and the implications of management practices for the agricultural sector in Namibia. These indicators are fully detailed in Section 4.9.5 of that report and include:

- The monitoring of groundwater pollution
- The routine monitoring of water levels in non-strategic, regional aquifers
- Calculation of the months of adequate abstraction in strategic aquifers
- Monitoring of ambient changes in water quality.

In addition to these indicators, it is recommended that DWA and NamWater develop a defined policy regarding "environmental demand" such that essential ecological processes and services are maintained particularly within the system of ephemeral rivers and the Cuvelai. This policy should of necessity include the provision of consultation with all interested and affected parties such that current recognised users of water can maintain their share within a given aquifer.
3.5 Wetlands

Wetlands in Namibia are generally rare (covering less than five per cent of the surface of the country) and most are ephemeral. However, Heyns et al. (1998) estimate that about two thirds of the population lives in or near major wetlands, with the highest densities being recorded in the Cuvelai and along the Okavango River. The often small size, scattered distribution and high degree of ephemeralism of most Namibian wetlands belies the extremely important roles they play in maintaining essential biophysical processes, as well as providing services and functions in the livelihoods of many rural communities in Namibia. Exploitation of wetlands for agriculture is widespread and well established throughout the country, and it is wetlands which form the basis of most farming systems throughout the country.

3.5.1 Current Status of Wetland Resources

3.5.1.1 Introduction

There are many definitions of what constitutes a wetland (Cowardin, 1974; Rogers, 1997; Breen & Begg, 1987). Within Namibia a widely used definition of wetlands is that proposed by the Ramsar Convention on Wetlands and is given as:

those areas of marsh or water, whether natural or artificial, permanent or temporary (ephemeral), with water that is static or flowing, fresh, brackish or saline, including areas of marine water the depth of which at low tide does not exceed 6 metres.

For the purposes of this study the coastal and marine wetlands included in this definition are excluded and the focus is on the wetlands (including artificial impoundments) of the interior of the country.

A detailed classification of Namibia’s wetlands has been proposed (Barnard et al 1998) but for the purposes of this study wetlands and surface water resources have been broadly divided into:

- Perennial systems, including the perennial rivers on the northern and southern borders of the country and the major dams on ephemeral river systems.
- Ephemeral, seasonal, non-permanent systems.

The emphasis in the discussion below is on the range of goods and services provided by wetland systems with agriculture as the central focus. The details of the hydrological regimes pertaining in each of the systems can be found in the SOER on Water in Namibia (WET, 1999).

3.5.1.2 Perennial Wetland Systems

Orange River

The Orange River rises in the highlands of Lesotho, traverses South Africa and forms the southern border of Namibia with South Africa. This river is highly regulated within South Africa with several large dams along its length. This has had a major impact on natural flows and abstraction possibilities particularly in the lower reaches along the Namibian border. Modelling has shown that some 60% of annual runoff is lost to regulation and abstraction in the South African section. However, regulation has led to there being continuous low flow all year round allowing irrigation in the lower reaches of the river.

Agriculture is limited in Namibia to livestock farming (with limited irrigated cropping) along much of the length of the Orange, with a single large scale irrigation project at Auskenheir west of Noordoewer. The scale of water abstraction for agricultural purposes along its length in Namibia has not been evaluated in any detail.

Kunene River

The catchment of the Kunene River lies almost entirely within Angola and the river is regulated by several dams and barrages along its length. The hydrographic record indicates considerable differences between years as rainfall is unreliable and erratic over much of the catchment.

Agriculture along the length of the Kunene is largely restricted to livestock farming with a few small irrigated gardens at certain sites. The narrow river valley, poor soils, generally poor grazing (there are no floodplains in the Namibian section) and variable run-off all determine that the potentials for agricultural development are poor. Water abstraction for agricultural is unlikely to increase markedly.
in the future. However, water is abstracted to Omusati and Oshana via the Calueque canal and demand on this water resource is likely to increase in the future. Of concern here is the fact that minimum flow levels in the river coincides directly with maximum demand in these regions (October).

Okavango River
The Okavango River and its main tributary the Cuito rise in the central highlands of Angola and most of the runoff in these rivers is derived from the upper catchment. There are no dam developments along the entire length of the Okavango River making it one of the few major rivers in southern Africa which is free of any regulation along its entire length.

The vast majority of people living in the Okavango Region are dependent on the river for a significant part of their livelihoods. It is estimated that between 80-90% of the population of the region resides within 10 km of the river (Bethune 1991). A wide variety of goods and services are provided by the wetlands along the river and these form the basis of the subsistence economy in the region.

The principal reason for settlement along the margin of the Okavango River is access to water. Water supply for human consumption is controlled by the Department of Water Affairs through Rural Water Supply. The majority of users along the river are not directly supplied but are required to collect water by hand. Despite the perennial supply of water very few people have access to safe water supplies and most households (80%) do not have access to any safe sanitation.

The vegetation of the Okavango River valley is heavily utilised both as a grazing resource for domestic livestock and for other domestic uses. The extensive alteration of much of the riverine terrace system in recent years, from woodlands to agricultural fields and the lack of active management practices to improve or maintain production levels means that more and more natural vegetation is being lost. This has important implications in the maintenance of stock numbers and the relative (economic) cost of domestic wood and construction materials.

With about 70% of the regional herd dependant on water and grazing along the river, the estimated stocking rate is about 1 Large Stock Unit (LSU) per hectare (Masdar 1993) which is well in excess of the estimated carrying capacity of 1 LSU per 5-8 ha (Page 1980). The floodplain system obviously has a great degree of resilience and is able to recover to some degree to be able to support such heavy grazing pressures, but the increased sedimentation and currently expanding herd has implications for the sustainable utilisation of the riverine resources. Already there are areas which are noticeably overgrazed being largely denuded of ground cover, resulting in extensive (and expanding) erosion along the river. Considerable emphasis will have to be placed on active herd management and grazing in the future if this aspect of the regional economy is to be maintained in its current condition or improved in the future. According to recent studies (IFAD, 1996) range inadequacy can be attributed mainly to the scarcity of forage within the floodplain component during the peak of the dry season. In the wet season, range inadequacy is not a problem. Given the loss of Cynodon lawns and the conversion of some grazing lands to agricultural fields, there is undoubtedly some reduction in the extent of the high value floodplain grasslands. The significance of these reductions over time, compounded by a slowly increasing regional livestock herd, has not been evaluated and warrants further research in the future.

Other than grazing resources for domestic livestock there are a number of uses of vegetation which have significant economic and domestic values. These are:

- **Fuelwood** - The fuelwood demand in the region has not been quantified in recent years, but is undoubtedly increasing as populations increase. The fact that there is a ready trade in fuelwood around urban centres attests to the decreasing supply close to homesteads and villages. The use of dung for fuel is not well established, but a conflict for this resource in terms of fertiliser is likely to occur in the future.

- **Building material** - Poles, reeds for walls and thatching grass are all used for the construction and maintenance of houses. There is also a need for trees from which canoes can be made. Most of the wood resources along the river have been over-exploited or cut-out to make way for fields, with most of these resources now being supplied from the dry Kalahari woodlands well away from the main areas of settlement. The demand, supply and management of these woodlands has never been studied in any detail and so changes in economic and financial values of these resources remains unclear. *Eucalyptus* plantations
have been established at two sites near Rundu but these have very low rates of increase and are not yet used for construction material.

- **Craft wood** - There is a burgeoning woodcarving and basic furniture industry specifically aimed at the expanding tourism market in the region. The principal woods used in this industry are *Pterocarpus angolensis*, *Terminalia sericea* and to a lesser degree *Guibouria coleosperma*. These species are rare on the riverine fringe and most of the wood is taken out of the Kalahari sand areas to the South of the river.

- **Non-wood forest products** - This category includes plants used for food, medical uses, palms for basketry and bee-keeping. The value of plants in this category has declined markedly in recent years, with traditional taboos regarding the eradication of valued food plants being openly disregarded. Several consultancies (GTZ and ODA have both supported consultancies, but no reports could be found) have investigated the viability of bee-keeping as a supplementary income in the Okavango Region, but nothing has come of these. Although honey is highly sought after, bee-keeping is a poorly developed tradition in the region, probably as a result of the single flowering season for most plants and the fact that many species (e.g. *Burkea africana*) are wind-pollinated (C.Hines pers. obs). Basketry palms (*Hyphaene ventricosa*) are a highly sought after resource, with considerable trade in the leaves between areas along the river (Hines & Cunningham, 1992). The resource has declined markedly in recent years, with the best remaining stands of palms now limited to the Mahango Game Reserve.

Commercial scale agricultural systems are limited to a number of large scale irrigation schemes and a dairy farm scattered along the Okavango River at Museses, Vungu-Vungu, Shitemo and Shadikongoro. These farms were established in the late 1970's and early 1980's through government expropriation of communal lands. The areas taken over represent some of the best arable soils along the Okavango River. Of the registered users of water in the Okavango Region these four projects owned by NDC are the largest users of water (> 50% of total water use) in the region, with one of the facilities at Shitemo using up to 2,000 m³ of water per day. The effects on the riverine system of pesticides and herbicides used on these schemes has not been established, but must pose some risk to the system.

About 90% of the regional population lives within 10 km of the Okavango River and of these 82% are engaged in rural subsistence farming. The general farming system is sedentarised, mixed farming comprising the cultivation of millet as a staple crop, coupled with extensive livestock (principally cattle) production. The majority of cultivated land in the region lies within 10 km of the river, but increasingly, shifting cultivation is being practised at greater distances from the river. The average size of arable land holdings is about 4 ha per household (Yaron et al., 1992), usually with some fragmentation into 2 or more fields. Agricultural output is extremely low per ha and seldom exceeds 400 kg/ha of pearl millet (mahtangu), with production declining to 120-150 kg/ha in poor rainfall years. Isaacson (1995) suggests that the low productivity is largely due to the fact that existing farming systems have not adapted to changing circumstances and are now generally highly unsuited to the present environment. Historically, fields were located near settlements along the riverine terraces. Settlement placement was determined largely by access to water for domestic use and by livestock. The rapid increases in population, 140% from 1970-1991 (CSO, 1994) has created tremendous pressures on the land in close proximity to the river. The net result has been the abandonment of traditional crop rotational and fallowing practices, as households are compelled to cultivate and produce on the same piece of land. However, traditional practices such as ploughing down or across contours, broadcasting of seed, hand weeding and no manuring or fertilising still persist with the net result that there is a progressive exhaustion of the soil, loss of topsoil through erosion and a general decline of soil resources along the river. This has important implications for the functioning of the river and wetlands along its course. As more soil from upland sites is washed into the river, so the system becomes increasingly terrestrialised (through infilling), waters become increasingly turbid (declining water quality) and the risks of pollution from herbicides, pesticides and fertilisers increase.

Fishing is a central part of the livelihood and well-being of the population and some 50% of the people here actively fish through the year, with fish providing subsistence for about 91% of the riverine households. Small scale sales provide cash incomes to about 45% of households (Tvætten et al., 1994). As may be expected, fishing greatly enhances household food security. Fish, therefore, represent an invaluable resource for social and economic wellbeing in the Okavango Region, but it is
widely perceived to be a resource in decline. The lack of longterm data relevant to stocks, size and diversity of populations and productivity precludes any definitive statement of trends. However, 90% of people involved in fishing indicated that catch rates and fish size have declined over recent years. Reasons given for the decline are manifold but all lack supporting data. Overfishing, habitat degradation, and other environmental variables subject to human interventions all contribute in a complex way. Whatever the reasons, the declines (whether real or perceived) present massive challenges for future management. Dependency on fish as a resource is high and any further negative changes in resource availability are likely to have important repercussions within the socio-economic framework of the region. For local people the social and economic values of fish far outweigh biological threats and as such, the fish resources are only as valuable as their contribution to income and food security. Any future attempts to develop, conserve and manage this resource need to take the socio-economic values and not only the biological values as the basis of any planning.

Other than the generalised evaluation of environmental water requirements given by Ellery (1997) there have been no other attempts in the past to quantify or qualify environmental water demand within the Namibian section of the Okavango River. Ellery (1997) estimated that about 15 120 m$^3$/km/day of water is lost along the section between Rundu and the Cuito confluence with most losses going in the form of evaporation from the water surface and transpiration by riparian and floodplain vegetation. The amount of water lost as groundwater recharge is unknown, but Simmonds & Schumann (1987) and Namibian Groundwater Development Consultants (1991) felt that groundwater aquifers were largely unaffected by recharge from the river. The amount of water required to support the natural vegetation, wildlife and processes of the riverine system needs to be clarified, especially in the light of planned water abstraction from the system. Given the high degree of dependency of the human population along the river, there is also a need to evaluate the domestic and livestock demand for water and the long-term projected trends in these demand patterns.

Kwando-Linyanti System
The system comprising the Kwando River, the Linyanti Swamps and the Chobe River are usually described as a single unit, as the one unit leads into the next in a downstream direction. For the purposes of this discussion the Chobe River component is treated as part of the Zambezi system as it is currently more influenced by the Zambezi than by the Kwando. The Kwando River rises in eastern Angola and has a relatively limited catchment with a resultant low run-off. The grade of the river is low along much of its length and this has resulted in a narrow river channel meandering across a broad (5km) flat floodplain. Flood events are rare with the last major flood occurring in the late 1980’s. There are no impoundments on the Kwando River.

Little research has been done on farming systems along the Kwando river in Namibia. The floodplains are extensively used for livestock (cattle) grazing and the extensive alluvial deposits are cultivated for maize, sorghum and millet production. The role of flooding in maintaining the agricultural system has not been investigated. A large thatch grass industry is based on the floodplains but the value of the enterprise has not been evaluated. Current threats may include the increased clearance of wetland/floodplain habitat for agriculture, increased livestock numbers (and hence, grazing pressures) partly due to the control of tsetse fly in the region, increased use of fire for the provision of green fodder during the dry season resulting in the combustion of important peat beds and other vegetation resources, deforestation of the flanking woodlands and floodplains and possibly overfishing.

This section of the Zambezi Basin warrants considerable further research.

Zambezi-Chobe System
The Zambezi is the largest perennial river in Namibia with its catchment in Zambia and Angola. The Zambezi is relatively narrow and does not have well defined floodplains until about 20 km downstream of Katima Mulilo where a low, broad plain lies between the Zambezi and Chobe Rivers. This plain, the so-called Eastern Floodplain, comprising about 330 000 ha, is regularly (but variably) inundated during flood events largely driven by the hydrological regime of the Zambezi. The degree of flooding does not correspond to the amount of rainfall in the area but depends entirely on what has happened in the upper catchment. Floods typically last between 4 and 6 weeks reaching their peak between mid-April to early May. Floodwaters follow a network of shallow depressions, channels and permanent backwaters and eventually spill out over extensive grasslands. During flood periods it is common for water to flow back up the Chobe from its confluence with the Zambezi and this has been the principal source of flooding in the Chobe for at least the last 15 years.
Human habitation of the eastern floodplains has increased in recent years but the population is fairly widely distributed with most households being situated on higher lying woodland areas or on the floodplain fringe. The majority of households utilise wetlands in their immediate vicinity for their various livelihood strategies, of which agriculture is the most important. Although not as heavily settled as the Okavango River, the use of resources and services provided by wetlands is likely to be much the same.

Approximately 120 000 head of cattle use the floodplain grasslands for grazing and densities in some local areas can be as high as 60 cattle per square kilometre. Such stocking rates are about 4 times in excess of the suggested rates. As with the Okavango system, parts of the floodplains, particularly *Cynodon* lawns are under particular pressure, but livestock numbers and herd sizes are increasing annually (Mendelsohn & Roberts, 1997). There is a limited amount of transhumance along the margins of the floodplains with a significant proportion (> 40%) of cattle moving into the fringing woodlands during peak flood periods.

Crop production is centred on selected soils of which the organic, peat-rich *sitapa* soils are the most prized. Maize is the principal crop grown on *sitapa*, which is often double cropped in a single year. Other crops include millet, sorghum, melons, pumpkins and vegetables. Grain crop yield vary from 30-700 kg/ha depending on a variety of soil, moisture and climatic conditions. Many households in the Capriví face staple food shortages during moderate to poor rainfall years and the dry upland areas are more likely to be affected by crop failures than the wetter floodplains. Floodplain maize production can, however, reach about 1000kg/ha and this is generally sufficient for feeding an entire household for a year. The importance of the wetland contribution to crop production is thus not only in the absolute value of the crops but also its contribution to regional food security.

The wetlands of the eastern floodplain are extremely important in maintaining the local fish resource in that they are thought to be the principal breeding grounds for many species. However, the Zambezi-Chobe fishery has not been particularly well studied, following the drying up of Lake Liambezi, and much work remains to be done on sustainable yields, the ecological processes defining the dynamics of fish production and the development of management strategies for the fishery. There is, however, a perception that fish stocks are declining and commercial exploitation of the fishery is an important factor in this decline.

Current threats to maintaining wetland functioning on the eastern floodplains of the Zambezi-Chobe system include:

- increased clearance of wetland/floodplain habitat for agriculture;
- increased livestock numbers (and hence, grazing pressures) partly due to the control of tsetse fly in the region;
- increased use of fire for the "improvement" of grazing resources during the dry season resulting in the combustion of important peat beds and other vegetation resources;
- deforestation of the flanking woodlands and floodplains;
- unsustainable exploitation of the fish resource.

**Dams and impoundments**

Dams and impoundments are a common feature of the catchments of the majority of rivers within Namibia. The largest of these are used for bulk water supplies to municipalities, industry and agriculture. There are also countless small dams scattered across the country which are used for domestic consumption and stock watering. The characteristics of the main storage dams (controlled by DW&A) are given in Table 3.10. Of these dams, only two are of particular importance in terms of agriculture. Hardap Dam at Mariental, supplies water to the largest irrigation scheme in the country and Naute Dam supplies water to an irrigated date palm project. The only dam in a communal area, the Olushandja Dam, is important in terms of stock watering and some recession agriculture which occurs in the drawdown zone along the dam margin.

Namibia's dams are large compared with the annual runoffs of the rivers on which they have been constructed. As such they have major impacts on the downstream component of rivers in that they cause flood attenuation, alter recharge characteristics of alluvial aquifers and cause a significant reduction in annual runoff of catchments. In order to mitigate these effects DW&A is developing a policy of compensatory releases to fulfill environmental demands. Although much smaller, farm dams
on catchments have much the same effect but as yet there is no policy on the management of dams in river catchments in Namibia.

### Table 3.10 Namibia’s Main Storage Dams

<table>
<thead>
<tr>
<th>Dam Name</th>
<th>River</th>
<th>Full Storage Capacity (mm$^3$)</th>
<th>Dead Storage volume (mm$^3$)</th>
<th>Purpose of Dam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swakoppoort</td>
<td>Swakop</td>
<td>63,489</td>
<td>1,431</td>
<td>Urban water supply, Research</td>
</tr>
<tr>
<td>Von Bach</td>
<td>Swakop</td>
<td>48,560</td>
<td>2,073</td>
<td>Urban water supply, Recreation, Research</td>
</tr>
<tr>
<td>Omatako</td>
<td>Omatako</td>
<td>13,399</td>
<td>4,073</td>
<td>Urban water supply, Research</td>
</tr>
<tr>
<td>Goreangab</td>
<td>Gammams</td>
<td>3,621</td>
<td>0,010</td>
<td>Recreation, Fishing, Education</td>
</tr>
<tr>
<td>Avis</td>
<td>Avis</td>
<td>2,417</td>
<td>0,010</td>
<td>Recreation, Education</td>
</tr>
<tr>
<td>Otjivero Main</td>
<td>White Nossoob</td>
<td>9,808</td>
<td>0,066</td>
<td>Urban water supply</td>
</tr>
<tr>
<td>Otjivero Silt</td>
<td>White Nossoob</td>
<td>7,795</td>
<td>0,096</td>
<td>Urban water supply</td>
</tr>
<tr>
<td>Tilde Viljoen</td>
<td>Black Nossoob</td>
<td>1,224</td>
<td>0,028</td>
<td>Urban water supply</td>
</tr>
<tr>
<td>Daan Viljoen</td>
<td>Black Nossoob</td>
<td>0,429</td>
<td>0,000</td>
<td>Urban water supply</td>
</tr>
<tr>
<td>Hardap</td>
<td>Fish</td>
<td>284,593</td>
<td>4,299</td>
<td>Urban water supply, Recreation, Irrigation, Fishing, stock watering</td>
</tr>
<tr>
<td>Naute</td>
<td>Lowen</td>
<td>83,520</td>
<td>1,320</td>
<td>Urban water supply, Irrigation, Recreation</td>
</tr>
<tr>
<td>Oanob</td>
<td>Oanob</td>
<td>34,505</td>
<td>0,417</td>
<td>Urban water supply, Recreation</td>
</tr>
<tr>
<td>Dreihuk</td>
<td>Hom</td>
<td>15,493</td>
<td>0,206</td>
<td>Urban water supply</td>
</tr>
<tr>
<td>Bondels</td>
<td>Bondels</td>
<td>1,103</td>
<td>0,007</td>
<td>Urban water supply</td>
</tr>
<tr>
<td>Olushandja</td>
<td>Cuvelai &amp; feeder canal</td>
<td>42,331</td>
<td>4,000</td>
<td>Urban water supply, Fishing, Balancing dam and emergency water supply to Oshakati</td>
</tr>
<tr>
<td>Omaruru Delta</td>
<td>Omaruru</td>
<td>41,288</td>
<td>5,000</td>
<td>Recharge enhancement, Urban water supply</td>
</tr>
<tr>
<td>Omatjene</td>
<td>Omatjene</td>
<td>5,063</td>
<td>0,200</td>
<td>Urban water supply</td>
</tr>
</tbody>
</table>

Source: State of the Environment Report on Water

Water chemistry data is collected as a matter of course by NamWater. Generally Namibia’s dams are highly turbid during the wet season (when runoff is greatest) but there are no chemical characteristics which are of concern in terms of agricultural production. Bilharzia has been found at Olushandja dam and this affects both human and livestock health.

#### 3.5.1.3 Ephemeral Wetland Systems

The majority of rivers in the interior of Namibia are ephemeral or seasonal rivers. These systems can be divided into 4 broad groups which are discussed below.

**Ephemeral rivers in southern Namibia**
The ephemeral river systems of the southern part of Namibia are not well studied. The Fish River and its numerous tributaries is the largest ephemeral river system in the country. Hardap Dam is situated on this river and has severely altered the flow characteristics of the river in the downstream compartment. Naute Dam is situated on the Lowen River, a major tributary of the Fish. One other river system is of importance in the south. This is the Auob-Nossob river system which traverses the Kalahari, flowing south-east through the country. The Oanob Dam is constructed on a major tributary of the Auob River in its upper catchment near Rehoboth. These river systems are important in terms of agriculture, supporting large numbers of livestock and game in these southern areas. However, little is known regarding abstraction rates, water quality and the impacts of agriculture on these systems.
West flowing ephemeral rivers
This group of rivers includes the Kuiseb, Swakop, Omaruru, Ugab, Huab and Hoanib systems. There
are numerous smaller rivers along the western escarpment but these generally have limited
catchments and although they are not dealt with here, their characteristics are much the same as the
bigger systems. The hydrological, ecological and socio-economic environments of these rivers is
reviewed in Jacobson et al. (1995).

The water resources of these rivers are generally held in the alluvial aquifer (see Section 3.4.1.2,
above) and seasonal surface flows of water are intense but of short duration. These river systems
traverse commercial farm land, communal lands, as well as state conservation areas and so
management systems are highly variable. However, it is clear that all agricultural practices in these
areas is highly dependent on the rivers for water, watering construction materials and irrigation. In the
communal areas of Kunene and Erongo regions the catchments and riparian vegetation resources are
the basis of all rural livelihoods derived from agriculture (and tourism). The people of these regions
are highly dependent on access to these riparian resources, but there are several issues of concern
with regard to the sustainability of the resources. These include:

The Cuvelai system
The Cuvelai system, which forms part of the Omusati, Oshana and Ohangwena Regions is
undoubtedly the most important wetland system in the country in terms of sustaining people.
Approximately 600 000 people live in the 10 000 square kilometre system, most deriving at least part
of their livelihoods from land in this area. The socio-economy, ecology and hydrology of this system
has been reviewed by Marsh & Seely (1992) and is the current focus of a large-scale environmental
review within the MET.

The Cuvelai or Oshana system is a network of low-lying, interconnected, ephemeral water courses
that flood irregularly. The system rises in Angola but little is known of the upper catchment. The
oshana area itself is one of low relief, with floodwaters rarely reaching more than 0.5m/s. These
wetlands are important in recharging the groundwater aquifers of the region, filling wells and shallow
dams, renewing grazing resources, bringing fish into the area and providing water for humans and
livestock. It is the continued functioning of the flooding and the wetland system as a whole that have
determined the pattern of settlement of people in the region and the farming systems employed here.

The farming system here is broadly described as agro-silvi-pastoral (Marsh & Seely, 1992), being a
mixed farming practice where crops, trees and livestock are all important. Crops are primarily
omahangu (pear millet) and sorghum, with a small quantity of maize being planted annually. Crops
are generally cultivated on the higher ground, outside of the potential flood zone. All cropping is
rainfed, as irrigation potentials are low due to poor soils and problems of salinisation. Livestock are
an important component of the agricultural system here, with some 400 000 head of cattle being
dependent on the Cuvelai for water, grazing and browsing for at least part of the year. Large numbers
of goats and donkeys also occur in the area. Indigenous trees form an important part of the farming
systems applied here, with a well developed system of individual tree tenure established throughout
the Cuvelai. Important trees include marula Sclerocarya birrea, omuve Berchemia discolor and palms
Hyphaene petersiana, all of which provide fruit and/or other products important in the local economy.

The actual dependency of the farming system in the Cuvelai on the flood regime/wetland system has
not been established but these functions are likely to be closely linked. Some issues of concern in the
Cuvelai are:

- Flood attenuation, particularly as a result of road and pipeline construction. Most oshanas run
  North to South and any structures running across the direction of flood cause downstream
  problems. This is most noticeable in the lower reaches of the system where floods are
  becoming increasingly rare in Lake Oponono and the Ekuma River. The Etaka has been
  canalised with the effect that the flood areas are limited and grazing resources have
  diminished.

- A quantitative understanding of the hydrology of the Oshana system is lacking but is essential
  if this system is to maintain the current population and agriculture in the future. The role of
  flooding in groundwater recharge, replenishment of wells and maintenance of grazing
  resources (which get rested while covered with water) needs to be investigated in the future.
3.5.2 Priority Issues concerning Wetlands

3.5.2.1 Perennial Wetland Systems

Within the context of this discussion on wetlands, a number of aspects regarding the long term sustainability of the resources associated with the major perennial rivers of northern Namibia are consistent across wetland systems.

A noticeable feature is that a large percentage of the regional population is dependent on wetland resources to a greater or less extent and there is consequently a high demand for land and natural resources within these limited areas. Population increases, changing tenure systems, the increased sedentarisation of livestock and people, and poor agricultural practices along the wetland and river margins have led to a general loss of productivity of the systems. The resource base supporting some of the highest human population densities in Namibia is being compromised through poor understanding of environmental linkages between processes and practices, overexploitation, poor extension and no management. There is an urgent need to address the overall management issues involved if continued utilisation is to be sustainable. There is an urgent need to manage the river as a system and not view it as a variety of separate components subject to ill-defined sectoral responsibilities. For example, in the Okavango system, agricultural practises fall under MAWRD, water issues under DWA/NamWater of MAWRD, fisheries under MFMR, health issues under MHSS and conservation issues under the MET, but there is little recognition that because all these institutions are involved with utilisation of wetland resources, there are manifold repercussions to any sectoral decision. The ultimate challenge for policy makers, managers and users of the system is to maintain or improve productivity in the face of ever increasing resource demands and human pressures.

Some of the major issues which warrant further investigation, support and management assistance are:

- The development of cross-sectoral extension programmes emphasising the inter-related nature of the defining processes within the wetland systems. For example, the fact that upslope agricultural practices affects fisheries production through siltation, loss of floodplain habitats and pollution.
- The expansion of a farming systems research programme with its focus on the whole issue of agricultural practises within wetland systems and how they could be adapted or improved to safeguard river wetland functioning. It is imperative that agricultural development programmes reinforce and improve systems rather than replace them.
- The development of an understanding of the extent of the fisheries component of the local economy. There is currently a need to understand demands on the system, as well as defining the production capacity of the system to clarify sustainable yields. The non-financial values of fisheries in the economy also need to be better defined (i.e. what is the value of local fisheries in terms of community health). The results could be used to influence decision makers at all levels to be pro-active in conserving the system in such a way that off-takes are sustainable in the long-term.
- The development of incentive schemes for the rehabilitation of riverside and upslope agricultural lands. There is a need to improve production levels through fertilisation, reduce runoff through terracing, tree planting and slope stabilisation.

3.5.2.2 Ephemeral Rivers

- Reduction of mean annual runoff (MAR), through construction of dams in the upper catchments. Any reduction in MAR results in a reduction in flood levels, the distance a flood with travel down a river and also results in a reduction of alluvial aquifer recharge. This has happened in the Swakop River following the construction of the Swakop Poort Dam which severely curtailed floods in the river, resulting in a marked depression of the alluvial aquifer which in turn has resulted in marked die-off of important riparian woodlands.

- Poor upper-catchment agricultural management can have important impacts on the downstream compartment of a river system. There is evidence that alluvial aquifer recharge in some rivers is being depressed because clays and silts, eroded from the upper catchments

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because of overgrazing, have sealed off the alluvial aquifer by forming and impervious layer in the river bed.

- The management of catchments and the riparian resources is often poor because there is no (or poorly developed) tenure. Access to these limited resources is granted by a wide range of authorities (national, regional, local, traditional) and when good rains occur in an area there can be a considerable influx of people from areas well outside the catchments. Management and landuse planning is poor as a result.
3.6 Freshwater fisheries

This chapter starts with a review of research, inventory and monitoring programmes directed at providing information on the status of Namibia's freshwater fisheries. Biophysical and socio-economic indicators of changing status derived from the findings of some of these programmes are then discussed. Thereafter, the chapter looks at causes of changes in the status of freshwater fisheries resources that have been identified.

3.6.1 Research, inventory and monitoring programmes

Little systematic research has been carried out on the changing status of the resource and on causes of change. Pre-independence and more recent ecological surveys (Skelton, 1987; Bethune & Roberts 1991; Holtzhausen, 1991; and Hay et al.) have provided a growing body of data on the distribution of species in Namibian freshwater fisheries. Much less is known about, amongst other things, fish size, fish populations, size of fishing nets, number of fisherfolk, size of catch, and so forth.

Hay (Hay, 1995) is of the opinion that fish catches from the Okavango along the Namibian border comes close to, or may even exceed, the maximum sustainable yield for the system. Evidence for this comes from (i) declining stocks, (ii) the declining size of the individual fish caught, and (iii) the diminishing proportion of long-lived species in the total catch. For instance, he reports a decline in yields of 49 per cent between 1992 and 1994, though different river conditions at the time make it difficult to attribute causation. An Index of Biotic Integrity based on fish numbers and condition, and habitat condition and health, indicates that stocks have declined significantly since 1984 in certain places, though not inside the Mahangu National Park where they are protected (Hay et al. 1996). Referring to this apparently most vulnerable of Namibian rivers, the government's 1995 White Paper on Responsible Management of the Inland Fisheries of Namibia (RoN, 1995) stated: "Researchers differ in their estimates for the exploitation rate. Indications are that over-exploitation occurs at least in some areas of the river but the degree of over-exploitation is poorly known."

Though less studied, the Caprivi river systems have also suffered notable declines in bream and catfish stocks. At this stage monitoring is sporadic on the Namibian side. Evidence is thus largely anecdotal.

Likewise, in other river systems scientific evidence of resource change is lacking. While there is considerable anecdotal evidence of larger catches in the past, the reliability of some of these "fishing tales" is open to question. Nevertheless, indigenous knowledge may be a potentially important indicator in the absence of and to complement scientific alternatives. For instance, in the Kavango Region people recognise that stocks are dwindling, and relate this to reduction in river flows and flooding, increased quantities of sand on the river bed, and the loss of reeds and their replacement by trees (Tvedten et al. 1994).

3.6.2 Proximate causes of change

The Namibian National Biodiversity Task Force (Barnard Ed., 1999) notes four threats to freshwater fisheries biodiversity: over-exploitation by subsistence fisherfolk, translocation of species from one basin to another mainly through pipelines and canals, hydrological regulation of rivers, and loss of vegetation. The study also lists 16 species of conservation concern. Though it is not always clear which of these is threatened by which factors, it would seem that overfishing is not one.

3.6.2.1 Overfishing

Clearly, one of the main proximate causes of declining stocks of certain non-threatened fish species is likely to be overfishing. Although there has been little study of sustainable management practices, there is little doubt that the use of dragnets and fine mesh gill nets for commercial exploitation purposes is having a damaging effect in certain areas. Dragnets, very often consisting of shade cloth, catch eggs as well as all sizes of fish.
3.6.2.2 Habitat change

Changes in ecosystems, including destruction of fishes' habitats, invasion by alien species, and reduced and inadequate floods are also altering fisheries. For example, it is estimated that some 78 per cent of Namibian fish require flood plains for their larval and juvenile stages (Holtzeusen, 1991). Thus, damming of rivers and consequent sudden fluctuations in levels of flood plain waters can severely disrupt habitats. Van Zyl & Hay (Van Zyl & Hay, 1994), for example, note that *Tilapia rendalli* in the Kunene river have been affected by the more than one metre daily fluctuations in water level resulting from the operations of the Ruacana dam. Likewise, natural fluctuations in flood water levels can have major effects. For instance, in the Kwando-Linyanti system, where no nets are used for fishing, it is likely that lack of floodwaters to replenish stocks in recent years, is a major factor.

Of particular concern is the fact that these causes may be experienced in neighbouring countries and still have an effect in Namibia. The upstream and downstream areas of all Namibia's perennial rivers lie in neighbouring states. It is in these areas that Namibia's stocks often breed, and from these areas that Namibia stocks are replenished. Hence, habitat change and altered flooding regimes (as well as overfishing) in the Okavango, Kwando and Cuvéval rivers in Angola, for instance, can have a major effect on the stretches of those rivers in Namibia.

3.6.3 Ultimate causes of change

3.6.3.1 Breakdown of traditional management systems

It is generally agreed that traditional fishing control practices are breaking down, especially amongst the young. For example, traditional management of fishing in Capriv Region involved controlling access to fishing areas. Rivers were divided into zones, each under the jurisdiction of a headman, with sub-zones allocated to particular communities. In floodplain depressions or *molapos* individuals have usufruct rights to cultivate and fish on specific areas of land. Certain traditional authorities issue permits for fishing and try to control the size of gill nets. Fishermen using the wrong size nets can be fined up to five cattle. This system is not sanctioned by government (Jansen & Kamweshe, 1989).

Although still practised in much of the eastern flood plains and areas with active conservancy initiatives, in some others, such as the area of the Mamili National Park and in the Kwando-Linyanti system, these controls are reportedly breaking down (Tvedten et al. 1994). Both traditional fishermen and traditional authorities are losing their authority and rights in some areas.

3.6.3.2 Failure of the State's management efforts

Without traditional regulation, there is essentially no regulation of freshwater fisheries in northern Namibia. Another related problem is lack of cooperation between services of riparian neighbours. For example, while Botswana-based businessmen are unable to fish in the Chobe National Park, they simply employ Namibians to do so, without control from any regulatory body, from the Namibia side of the river (Jansen & Kamweshe, 1999).

Legislation on fisheries is still to be promulgated (see chapter 5), but resources allocated to freshwater fisheries management by government to date would suggest that implementation of the legislation will be difficult. Hence, one can assert that another ultimate cause of deterioration of Namibia's freshwater resource is simply neglect by State authorities. In part this may be attributed to the continuing allocation of responsibility for freshwater fisheries issues to an institution (the Ministry of Fisheries and Marine Resources) whose over-riding interest is in safeguarding the economic benefits to be gained from Namibia's marine resources.

3.6.3.3 Population pressure

In the background to all these causes of change is that of population pressure and consequently increasing exploitation of the fisheries resource. Because of Namibia's limited rainfall, and lack of surface or easily accessible groundwater, people tend to settle near the rivers where fisheries exist. For the poor fisheries can make an important contribution to household food security, particularly in...
times of stress. On the other hand, a major cause of overfishing, that is the exploitation of some fisheries for commercial purposes, has little to do with population pressure.

3.6.3.4 Climate variability

Finally, mention must again be made of the influence of climate. As has been noted repeatedly in this report, river floods seem to be declining in all Namibia’s river systems. Perhaps the most obvious examples are in the oshana system, where periodic efundja floods seem to be a thing of the past, the Kwando-Chobe-Linyanti river system where annual floods have been in decline for about 20 years, and Lake Liambezi, which, when full, occupied some 10,000 hectares at an average depth of 6 metres, but which has been dry, and cut off from its source the floodwaters of the Zambezi, since 1985.
3.7 General Discussion of Ultimate Causes of Agricultural and Land Resources Degradation

Notwithstanding the discussion of ultimate causes of resource change in the preceding sections, it is notable that there is significant commonality. This section attempts to summarise some of the major themes and adds some new ones.

A number of attempts have been made in recent years to define the factors which influence people to over-use and mismanage agricultural and land resources in the ways noted above (Seely and Jacobson, 1994, Ashley, C. 1994, Ashley, C. et. al. 1995, Byers, B.A. 1997). Lists vary from report to report, but the themes remain fairly common. This report identifies the following fundamental or ultimate causes of degradation common to most agricultural and land resources:

- Lack of environmental understanding
- Poverty and population growth
- Policy failure
- Climate change

3.7.1 Lack of environmental understanding

Many people have a limited understanding of the way the natural environment functions, and of how the status of renewable natural resources can be degraded, sustained or enhanced. This situation has many contributing causes which include the system of land tenure, government controls, education and experience, and the speed at which change is occurring.

Until recently, most Namibians lived a semi-nomadic existence depending mainly on variably available water and grazing for their livestock. The basic limitations of the agricultural and land resource environment directly controlled people’s livelihoods. After colonial settlement, the movement of people and livestock in search of resources was reduced. Alternative livelihood opportunities were introduced and people’s ability to live in balance with the natural environment decreased.

Exacerbating this situation is limited scientific research into the natural environment resulting in a scarcity of data on the nature and extent of the country’s natural resource base, and its degradation. As a result, as noted elsewhere in this section, there remains much controversy over the attribution of cause and effect regarding the changing state of agricultural and land resources.

Another cause of lack of environmental understanding is the country’s education system. Until independence, most of the text books and materials used for teaching came from less arid areas such as Europe or South Africa. The functioning of arid environments was not, until recently, included in the curriculum. Today, understanding of arid environments is growing, but population pressure, poverty and existing livelihood patterns hinder appropriate responses.

Nevertheless, it is important not to dismiss local people’s perceptions, knowledge and understanding of resource change as an indicator. A recent study (Tshikesho. 1998) has revealed a fair level of appreciation by rural people in the study area in northern Namibia of the concepts of deforestation and overgrazing, but little of over-cultivation of arable soils. This may be partly a reflection of the differing degrees of seriousness these processes have on people.

3.7.2 Poverty and population growth

Namibia is an arid country with low and variable rainfall, and hence low and variable agricultural and land resources productivity. This means that the number of people who can make a living directly from the land is also low. As the population density, and the number of people living in poverty increases, more and more people are expecting to make a living, directly or indirectly, from a constant or decreasing natural resource base. Without proper management practices, the resource base is over-exploited and hence at risk of degradation. Alternative methods of production and income could contribute to slowing this process of degradation as population increases and poverty decreases.
However, unless alternative livelihoods, not based upon natural resources, can be developed, population growth and poverty will continue to be closely linked. The continuing inability of other sectors of the economy to develop and create alternative sources of income and livelihood can therefore also be seen as a cause of additional pressure on natural resources.

One area of controversy which continues to cloud attempts to deal with these closely linked problems, is lack of agreement between those adhering to neo-Malthusian ideas that population growth is a priority problem that needs to be addressed, and those who consider poverty and failure to manage resources to be the fundamental problem. Adherents to the latter cause suggest that only if poverty and resource management issues are addressed will population growth rates decline. The latter camp would acknowledge that environmental change is inevitable and must be managed, while the former tend to stress environmental conservation. As noted above, in the section on arable lands, it can also be argued that lack of labour is sometimes the biggest constraint to improving arable soil management. There is evidence that increasing population and hence labour, albeit supported by diversified livelihood opportunities, is one key element in breaking the cycle of poverty and resource degradation.

Lastly, in this regard it may be noted that it is likely that population policy and strategy are likely to undergo reassessment in the coming years as the impact of the HIV-AIDS epidemic on fertility rates becomes better understood.

3.7.3 Lack of policy and policy failure

Another important cause of environmental degradation is policy failure. A number of outstanding policy issues are discussed in Part 4 which have a direct bearing on agricultural and land resource degradation. Those of most immediate concern include: lack of land tenure policy leading to the disfunctioning of communal farming systems, existing resettlement policy leading to the disfunctioning of private-tenure farming systems, and existing water pricing policy resulting in excessive use of irrigation waters.

The case of drought policy can serve as a case study of how policy can be used to promote sustainable resource management. Prior to 1998, Namibia, like many other countries, had no drought policy. Government's response to drought was often ad hoc and the subject of pressure from interest groups. Two consequences of this approach which are recognised to have done considerable harm to agricultural and land resources are noted below.

Emergency assistance to livestock farmers: Because of the regular availability of emergency assistance, livestock farmers tended to expect and rely on it, while ignoring the natural variations in land productivity. Farmers' abilities to cope with drought were reduced and their vulnerability to natural aridity was increased. Some forms of assistance, particularly subsidised fodder, were used as a way to maintain livestock on land which has temporarily lost its productive capacity because of low rainfall. Under these conditions the livestock remain on the land and continue to forage on any remaining natural vegetation, thus reducing its productivity and ability to respond to good rains in a succeeding year. The soil and its associated seed banks will also be degraded, and it is consequently less able to respond to good rains.

Emergency provision of water: Before the proliferation of artificial water points, livestock were herded from place to place where water and grazing were available. The establishment of permanent water points, however, leads people to settle permanently, reducing their mobility and that of their livestock. The result usually is the overuse of land around water points and settlements.

The National Drought Policy and Strategy discussed in Part 4, seeks to do away with both of these approaches to drought relief.
3.7.4 Climate change

There is evidence that Namibia’s climate is changing. Predictions of global warming deriving from recent events, such as the increase in atmospheric greenhouse gases, suggest Namibia’s climate is becoming hotter and drier. That this process may have started long ago is suggested by studies in Karoo vegetation change going back several centuries (Bousman and Scott, 1994). Local climate change may also be a feature. It is important to study climate so that we may adapt to it rather than fight it (and loose). The implication for planners of a hotter and drier climate is that all the natural resources discussed in this section will be degraded in terms of their potential to support human demands. Some would argue that acceptance of this will demand a major reorientation of government development policies in several sectors.

3.7.5 Conclusion

Namibia’s natural environment is harsh and its natural resource base correspondingly fragile. On the other hand, in many respects it is resilient, as are its people and their traditional livelihood strategies. The major natural phenomena which affects the state of its natural environment is the climate. Then comes pressure exerted by humans. Natural resources have been subject to large-scale human intervention for the only the last few centuries, during which time much change has taken place.

It is concluded that, the environmental crises facing much of Namibia does threaten sustainability; but too often its extent has not been carefully analysed, and its causes have been mis-diagnosed. Also, to characterise all environmental change as degradation is unhelpful. Quantifying the value of degradation is really only possible with data on the long term nature of degradation which does not always exist currently. Sustainable development requires that an holistic view is taken. Where forests have been replaced by productive fields or grazing, or by roads and urban settlements, for instance, change cannot necessarily be referred to as degradation, except in a narrow sense. Further, much of what is sometimes characterised as resource degradation is often so only in the short-term. Changed resource-use practices coupled with rare climatic events (for instance, years of exceptionally high rainfall) can be expected to see a reversal of some processes of degradation over the longer term.

Much change, no matter how temporary, has socio-economic impacts. The benefits of changes in the status of natural resources tend to be reaped by the better-off minority, while an increasing number of poor people loose their access to these resources and consequently become resource-poorer. With a less productive resource base they currently have no way out of their poverty. This, it could be argued, is not the result of the change in the status of natural resources, but of the failure of the country’s political economy to come to terms with that change.

It should be general rule of thumb that traditional land use systems are as good a place to start to look for sustainability as any. These are usually dynamic and resilient, and they offer many practices that can be improved upon to assure sustainability in the face of increased population densities and other ultimate threats. It is important that we learn more about the status of our natural resources and the processes which threaten them so as to be able to manage them sustainably on an informed and rational basis. It is hoped that a description of resource status change, and the analysis of causal relationships with proximate and ultimate factors seen as responsible for these changes, will enable us to see more clearly how we can better manage our resources. It should help us to identify what actions we can take to deal with the problems that can upset the balance between productivity and sustainability that we should strive for in the management of our agricultural and land resources.
PART 4. THE ROLE OF SOCIETY AND ITS INSTITUTIONS

Introduction: Sustainable Agriculture and Land Use

While the Pressure-State-Response model adopted as a framework for this SoER is largely self-explanatory, the critical concept of societal response merits particular discussion. The definition of indicators of societal response implies that we know what that response should be. In other words, we must first have a clear idea about the nature of responses which will lead to sustainability. But, in many fields of agriculture and land use this is a matter of on-going theoretical debate and practical experimentation. It is clear that there are few examples of models of successful sustainable agricultural and land resources systems in the sorts of ecological and socio-political environment found in Namibia.

This report proposes to adopt a model for societal response aimed at sustainable development. Sustainable agriculture may be defined as agriculture which meets today's needs without preventing the needs of neighbours or future generations from being met. As such it includes ecological, economic and social dimensions. Such an holistic approach means working across many disciplines at the same time, and is therefore a challenge to conventionally trained scientists.

Developing sustainable agricultural and land use systems which are adapted to an arid climate prone to drought requires inputs on a number of levels. These cannot be dealt with in isolation. Development interventions must look at all these levels in combination if their work is to be of real benefit. This Chapter will characterise the different conditions necessary for sustainable agriculture under three main headings, as follows.

- An enabling environment, including the overall policy and regulatory framework.
- Supporting institutions and services, including community organisations, government and non-government organisations which provide services.
- Resource conserving management practices and technologies.

This model proposes that sustainable agriculture and land resource use is not only about appropriate technologies and management practices but also about supporting institutions and services which empower resource users to implement improved technologies and practices, and about an overall enabling policy and regulatory environment.
4.1 Enabling Policy and Regulatory Environment

4.1.1 National Policy and Strategy Framework

4.1.1.1 The Constitution of the Republic of Namibia

The Constitution states that the State shall promote and maintain the welfare of the people by adopting policies aimed at:

"...the maintenance of ecosystems, essential ecological processes 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; in particular the Government shall provide measures against the dumping or recycling of foreign nuclear and toxic wastes on Namibian territory...".

Furthermore, Article 91(c) states that the Ombudsman shall have:

"...the duty to investigate complaints concerning the over-utilisation of living natural resources, the irrational exploitation of non-renewable resources, the degradation and destruction of ecosystems and failure to protect the beauty and character of Namibia."

4.1.1.2 The First National Development Plan

The Government has established four broad national development objectives, as expressed in its first National Development Plan (NDC. 1995) which was ratified by the National Assembly in November 1995.

- To revive and sustain economic growth,
- To create employment opportunities,
- To alleviate poverty, and
- To reduce inequalities in income.

Environmental sustainability is important in contributing to all of these objectives. Firstly, sustainable management of natural resources promotes economic growth and employment creation. Sustainable natural resources management is vital for the future of the Namibian economy and people. Mining, agriculture, fisheries and tourism are the sectors which contribute most to the Namibian economy. All are dependent on natural resources, and the latter three are dependent on renewable natural resources. In other words, unless these natural resources are managed sustainably, so that they can be renewed naturally, their future as generators of economic growth, employment and income is uncertain. Thus, the future growth of three of the main sectors of the economy is dependent on sustainable resource management.

Secondly, concern for sustainability is important insofar as it contributes to poverty alleviation and the reduction of income inequalities. Approximately 70 per cent of Namibians live in rural areas. The poorest of this group, who are also the poorest Namibians, are the most dependent on the land and what it can produce. They raise livestock, grow crops, gather wild foods from the forests and waters, obtain energy and timber from forests, and depend in many other ways on what the land can support. The poor are the most vulnerable to the vagaries of the natural environment change, including drought and pestilence. The poor therefore stand to benefit directly and immediately from effective sustainable land use policies and practices.

Conversely, it is important to recognise and guard against the potentially negative effects of the above mentioned policy objectives on sustainable use of natural resources. If policies undermine sustainable natural resource use they actually undermine themselves in the medium to long term.
For example, economic growth and poverty reduction can have conflicting implications for natural resource use. Economic growth and poverty alleviation can reduce degradation through reducing dependence on the land and primary production. But, economic growth and poverty alleviation can also increase the demand for natural resources from industries and for services such as water and energy.

This heightens the need to ensure that the structure of growth promotes rural poverty reduction and that growth occurs in sectors which place relatively little demand on natural resources. Useful Government interventions are likely to include:

- extending investment incentives to service sectors (such as tourism).
- promoting growth in rural areas.
- promoting growth in high value-adding activities.

The first National Development Plan contains a range of both policy and strategy statements pertaining to different sectors. These are supported by numerous individual sectoral policy statements. Several of these relating to agricultural and land resources management have been adopted by the Government in recent years. Some of the main ones are noted below.

4.1.1.3 Land policy and tenure reform legislation

A National Land Policy was approved in 1998. Unlike the first seven years of Independence when the emphasis of government fell on land redistribution, the White Paper on National Land Policy has very little, if anything to say on land redistribution. Beyond reiterating government's policy to alleviate poverty, nothing of substance transpires with regard to redistribution and resettlement.

Communal land receives most attention in policy proposals regarding rural as opposed to urban land. To start off with, the White Paper confirms that in terms of the Constitution, all communal land vests in the Government of the Republic of Namibia, which undertakes to administer this land in trust and for the benefit of traditional communities. It requires that natural resources are used sustainably.

With regard to land tenure, the Policy proposes a 'unitary land system in Namibia' in which all citizens will enjoy, amongst other things, security across a range of tenure and management systems. More specifically, the policy promises equal legal status to all tenure systems. The forms of land rights which will be recognised are the following:

- customary grants;
- leasehold;
- freehold;
- licences, certificates or permits; and
- state ownership (Republic of Namibia 1998: 8-9)

Without any further qualification, the National Land Policy states that all tenure rights allocated in terms of it or subsequent legislation will include all renewable natural resources on the land, subject to sustainable utilisation and the details of sectoral policy and legislation. These natural resources include wildlife, tourist attractions, fish, water, forest resources and vegetation for grazing (Republic of Namibia 1998: 18)

The intentions of these provisions are not entirely clear. As was pointed out above, local tenure systems need to be understood as bundles of rights which are attached to a particular piece of land. While bundles of rights include rights to all of the above resources, this does not imply that the 'owner' of a piece of land enjoys equal rights to all of them. A literal reading of the above proposal suggests that a right to a piece of land automatically includes rights to all resources on that land. This would amount to a major change in local tenure systems.

While any rights allocated will be exclusive rights, enforcement of which will be supported by the law, sharing of resources by neighbours will be encouraged (Ibid.: 19). In identifying categories of land right holders, the Policy includes 'legally constituted bodies and institutions to exercise joint ownership rights' (Ibid.: 9). The Policy refers to 'a strategy to promote group tenure' which is nowhere expounded in any detail (Ibid.: 22).

Agriculture & Land Resources SoER Consortium
Whether 'legally constituted bodies and institutions' include community based organisations is not clear from the White Paper. It should be added that the Communal Land Reform Bill makes no provision for group tenure. The White Paper is also ambiguous on the issue of land enclosure. On the one hand, it recognises the right of individuals or groups to fence off or otherwise land to which they have formal rights 'subject to appropriate spatial planning and consultation with users of land neighbouring the area to be enclosed' (Ibid.: 25). On the other hand, the White Paper declares an immediate end to any new fencing of land for non-residential or crop land (Ibid.: 25).

The Communal Land Reform Bill provides for the allocation of two types of rights in communal areas: customary land rights and rights of leasehold. With regard to the former, the Bill does not propose to change the present allocation mechanism in so far as traditional authorities will continue to make allocations as in the past.

An innovation, however, is the proposal to enable the registration of leasehold rights over portions of communal land. The principal intention of this innovation is to regularise and legalise communal land enclosures. The Bill provides for an adjudication procedure to ensure that no prior rights are being infringed by a proposed lease agreement. Such rights are not specified in any detail in the Bill. At face value, therefore, the Bill may make it possible for rural communities to reclaim land that was fenced for private purposes.

**Strategies**

In terms of the White Paper, government will redress the unequal distribution of land by implementing a redistributive land reform. In terms of this strategy, it will acquire land in the commercial farming sector either on the open market or by compulsory acquisition for redistribution to people in need of land. In addition an inventory will be made of all agricultural land owned by the state for the same purpose.

The White Paper suggests that such land will be redistributed by sale, lease or customary grant to Namibians who 'do not already have adequate land holdings' (Republic of Namibia 1998: 23).

The Agricultural (Commercial) Land Reform Act of 1995 - which preceded the White Paper by three years - spells out the procedures for acquiring and redistributing commercial agricultural land. It is not very specific on a number of important issues such as economic farm sizes, for example. However, it provides for the establishment of a Land Reform Advisory Commission which is composed of a range different stakeholders, whose task it is to advise the Minister of Lands on general and specific matters regarding land acquisition and distribution. The LRAC was first established in 1995. As its proceedings are secret, little if anything is known about its activities since then.

Although the Land Reform Act provides for a prefererent right of government to buy land, it also lays down certain principles which protect the interests of commercial farms. Amongst other things, it commits government to fair compensation for land purchased, as well as an institutional and legal framework to hear and decide on disputes that may arise between buyer and seller.

Despite an acknowledgement in the White Paper that stakeholders should be involved in the decision making process for land policy to be effective, land redistribution and resettlement remain a highly centralised activity. Beneficiaries are selected at ministerial level, and each resettlement project, i.e. farm on which people have been resettled, has an official project manager.

The Communal Land Reform Bill proposes to decentralise certain land administration functions to Regional Land Boards. Apart from being expected to exercise control over the relocation and cancellation of customay land rights by traditional leaders, Land Boards will also play an important role in administering lease agreements for fenced land in communal areas.

It must be concluded that both the White Paper on National Land Policy, the Agricultural (Commercial) Land Reform Act, 1995 and the Communal Land Reform Bill make no provision whatsoever for communities of land - and natural resource - users to obtain property rights on a community basis to their land and resources. This seems all the more significant in view of the fact that precedents exist for conferring property rights over natural resources to rural communities.

In terms of the Nature Conservation Amendment Act, 1996 groups of people residing on communal land are entitled to establish conservancies. Once a conservancy has been established according to the provisions of the Act, communities which have established conservancies have rights and duties with
regard to the consumptive and non-consumptive use and sustainable management of game and derive benefits therefrom. The principle underlying this policy and legislation is the conviction that an important incentive to communities to manage their land and natural resources sustainably is to enable them to make decisions about how the land and resources are being used. Fundamental to this is the right to exclude people from using the land or resource (Republic of Namibia, n.d.).

In a similar way the Department of Water Affairs has accepted that group management of public water facilities may go some way to manage water resources more responsibly. The responsibility to manage public water in the communal areas will be gradually transferred to Water Point Committees which will be given legal status.

4.1.1.4 The National Agriculture Policy

The National Agriculture Policy of 1995 (MAWRD, 1995) has amongst its main objectives:
- to promote the sustainable utilisation of the nation’s land and other natural resources;
- to create and sustain viable livelihood and employment opportunities in rural areas; and
- to improve the living standards of farmers and their families, as well as farm workers.

Achieving the sustainable management of natural resources in agriculture is a principle tenet of the policy and will be pursued by, amongst other policies:

- Agricultural growth should not be pursued at the expense of the environment.
- Government will, where possible, devolve decision-making power and resource management initiatives to the lowest possible level. For this purpose all who are engaged in the agricultural sector will assist in the formulation and implementation of a national resource-use strategy.
- Government will address the serious problems of desertification and environmental degradation.
- Environmental impact studies for new development activities will become a prerequisite under the conditions laid down by the National Land Use and Environment Board.
- To counteract the negative impact of bush encroachment on long term viability of livestock and wildlife systems. Government will promote the establishment of economically viable and environmentally-friendly bush clearing and utilisation industries.
- Land-use options must be compatible with the country’s fragile eco-systems.
- Government will review the existing Soil Conservation Act and other relevant legislation relating to environmental protection and natural resource utilisation.
- The implementation of the Environmental Impact Assessment Policy will be strictly enforced.
- To safeguard the environment natural resource user fees will be introduced.
- Government will enforce laws and regulations on the protection of existing forests and the demarcation of new forest reserves. It will also promote sustainable utilisation of forest resources including the use of alternative sources of energy.
- Idle and under utilised land must be put to more productive use.
- The promotion of sustainable agricultural development will be based on the identification of agro-ecological zones.
- Private ownership will only be respected if land is used in a socially and environmentally responsible and productive way.
- Limits will be put on farmers wishing to sub-divide and fragment commercial farm land.
- Sub-division will be allowed to broaden access to commercial land but on condition that units of an economically viable size and long term sustainability of natural resources and agricultural production will be secured.
- Large scale communal-tenure farmers will be supported to buy freehold land on condition that they renounce their traditional grazing rights in communal-tenure areas.
- The Government will stabilise and diversify food production in areas of the country where environmentally sustainable potential exists.
- Where agricultural potential is limited, the Government will encouraging alternative means of income generation, particularly those using agricultural raw materials as inputs;
- The Government will encourage proper management techniques of wild foods;
4.1.1.5 The National Forestry Policy

The National Forestry Policy of 1992 states, amongst its objectives of relevance, that:

- The provision of sufficient fodder, fuel and pasture, especially in areas adjoining forests, is necessary in order to prevent depletion of forests beyond the sustainable limit. Since fuelwood continues to be the predominant source of energy in rural areas, programmes of afforestation should be intensified with special emphasis on augmenting fuelwood production to meet the requirements of the rural people.

- Forestry should play a key role in the contribution to sustained food production and must therefore be closely integrated with other sources of livelihood such as animal husbandry and farming in order to improve nutrition in the country. Forestry must be included in agricultural and other rural development projects; and

The 1992 forestry policy statement, perhaps inadvertently, undermined the role of communities in forest management with its emphasis on State-run forests. The policy saw the need to manage forest resources while ensuring rural communities' rights to subsistence products from the forest. However, it states that "The derivation of direct economical benefit must be sub-ordinate". While acknowledging the need to work with communities the emphasis was on the role of the government in forest management. The policy recommended that all uninhabited land should be administered by the state ("All uninhabited land covered with forests or vegetation should be administered by the Government through the Directorate of Forestry"), and that large areas should be set aside for forest reserves in order to contribute to the national goal of having 10 per cent of Namibia’s land area under tree cover ("The national goal should be to have a minimum of one tenth of the total land area of the country under forest of tree cover").

In 1996 a Strategic Plan was developed, ostensibly to implement the forest policy. A flavour of the Plan and its concerns is demonstrated from the following excerpt.

"Forestry sector goals

to satisfy rural households basic needs; to maintain forests protective functions; and to strengthen forestry institutions."

The fulfilment of the sectoral goals will entail the following tasks:
- Conserving of natural ecosystems for their biodiversity and values. Protection of the natural forests will ensure sustainability of the environmental services (conservation of soil, water and biodiversity) of forests for the welfare of the present and future generations.
- Contributing to increased agricultural productivity through soil and water conservation. Forests and trees on the farm help to conserve soil and water resources which are vital to agricultural production.
- Supporting national efforts aimed at poverty alleviation and equitable development. By promoting rural development, forestry programmes can contribute effectively to poverty alleviation and equitable development.
- Protection of biodiversity and preventing climate change. Conservation ensures some amount of forest growth which in addition to protecting the existing biodiversity, sequesters carbon to restrict potential climate change."

Some commentators view the Plan as representing to a large degree a reorientation of the policy, in particular stressing community involvement in forestry. This in turn has prompted the revising of the National Forestry Policy. It is expected that the new policy statement should be completed in the year 2000. In addition, a new Forest Act has been drafted, and is the process of gaining approval.
The proposed objectives of the draft policy statement are:

- To reconcile rural development with biodiversity conservation by empowering farmers and local communities to manage forest resources on a sustainable basis.

- To increase the yield of benefits of the national woodlands growing stock through research and development, application of silvicultural practices, protection and promotion of requisite support projects.

- To create favourable conditions to attract investment in small and medium industry based on wood and non-wood forest raw materials.


4.1.1.6 The National Drought Policy and Strategy

The National Drought Policy and Strategy of 1998 arose mainly out of concerns over the impact of past practise on environmental and financial sustainability, and sets out an approach to drought which aims to deal with these concerns in ways that are both equitable and efficient.

A general perception has developed in Namibia over the past few decades that droughts, warranting Government funded relief, are frequent events; even the norm. Farmers have been receiving substantial drought relief assistance from Government since the 1950s. From the time of Independence to 1998 livestock farmers (often amongst the wealthier members of society) have received an estimated NS 315 million (US$ 72 million) in livestock-related assistance alone (National Drought Task Force. 1997). Furthermore, the readiness with which Government has been willing to provide assistance has been recognised as discouraging farmers from adopting risk-management practices adapted to Namibia’s natural aridity. On the contrary, a number of interventions, such as subsidies on fodder provision, have led to unsustainable practices by encouraging farmers to keep stock when they should be marketed. This in turn inhibits the recovery of grazing.

The case of the provision of subsidised livestock fodder and licks as a drought relief measure is a clear example of a policy instrument which undermined sustainable agriculture. Subsidised fodder and licks were intended to enable livestock farmers to maintain their core breeding herds in times of drought. However, these relief measures were usually provided too liberally, and are widely credited as being responsible for encouraging farmers to overstock during droughts and thus overgraze and degrade their land. The National Drought Policy should put an end to the provision of fodder, rather promoting restocking and restocking mechanisms, and, in extremis, the transport of livestock to, and leasing of, emergency grazing. However, to some extent any livestock-related drought intervention by Government will affect the behaviour of farmers negatively, as they will tend to wait and see whether relief programmes are triggered rather than take precautionary management measures. Hence, many would argue for the complete abandonment of livestock-related drought relief measures.

The National Drought Policy and Strategy, formally adopted in 1998, aims to shift responsibility for managing drought risk from the Government to the farmer. It argues that previous perceptions of the degree of drought warranting relief measures, were misconceived. Drought relief should only apply when a disaster drought, defined in terms of its extremity and rarity in relation to normal and conditions, occurs. The policy seeks rather to emphasise long term measures that support the management of risk by farmers. Short term assistance to support crop and livestock farmers will be limited to disaster droughts when conditions are so severe or protracted that they are beyond what a farmer would be expected deal with in terms of normal risk management.
This calls firstly for an objective definition of drought which cannot be subjected to the dictates of political expediency. Relief assistance to private-tenure farmers should in future be financed mainly by farmers themselves and agro-industry levies. Other policy reforms aim to promote sustainable farming practices by supporting mechanisms which will stabilise farm incomes under conditions of extreme climatic variability. Reforms are needed in the tax regime to which farmers are subject, and incentives are needed to promote investment in diversified farming and non-farming operations. For equity reasons, communal-tenure farmers will continue to receive Government-financed drought relief. Support for communal area livestock farmers in disaster droughts will take the form of livestock marketing incentives, and in extreme cases for the preservation of core breeding stock, through financial support to the leasing of emergency grazing and associated livestock transport.

It is also proposed that long-term programmes be instituted to ensure that all communal area crop farmers have access to, and can afford, the inputs for production in the year after a disaster drought, flood or pest damage. Free seed handouts should be abolished on condition that seeds are readily available and affordable.

4.1.1.7 Environmental Policy

Environmental policy (Brown, C.J. 1993) has been elaborated in a number of different policy statements. These include statements on:

- Conservation and biotic diversity and habitat protection;
- Land use planning;
- Namibia's Environmental Assessment Policy;
- Namibia's Park Management Plan Policy;
- Natural resource management and utilisation in communal areas.

Namibia's Green Plan of 1992 (Brown, C.J. 1992), contains a number of policy and strategy statements aimed at ensuring that all development policies are sustainable and not implemented at the expense of the environment. This applies not only to livestock and crop production, but also to the use of wild food, freshwater fish and other traditional foods. Strategies for the management of water resources, wetlands conservation, the use of wildlife and indigenous plant life aim to establish sustainable systems for the benefit of both local communities and the country as a whole. The two most comprehensive statements of environmental policy to date are the First National Development Plan (NDP1) Chapter on Environment and Namibia's Policy to Combat Desertification.

Namibia's environmental problems, priorities and policies are described in the First National Development Plan (NDP1). The relevant chapter in the NDP1 is primarily based on Namibia's 12 Point Plan for Integrated and Sustainable Environmental Management (April 1993) and Namibia's Green Plan (September 1993). In this regard, Namibia's environmental commitment fully complies with the fundamental objectives of 'Agenda 21' of the UNCED Conference of 1992.

The over-riding objectives for the environmental sector during the Plan period and beyond are to:

- promote sustainable development within all sectors and across all regions to ensure that present and future generations gain optimal benefit from the equitable and sustainable utilisation of Namibia's renewable resources; and
- protect biotic diversity and maintain essential ecological life-support systems.
Additional objectives, which contribute to the above, are to:

- promote the training of Namibians and strengthen institutions in the field of environmental management;
- democratise environmental planning and management, and promote integrated planning and management of land, forestry and other natural resources with increased involvement of rural communities, women and local institutions;
- educate the Namibian public on environmental issues; and
- establish an appropriate policy framework of legislation, market incentives, regulation, procedures, rights and responsibilities to ensure more sustainable resource management.

If these environmental objectives are not achieved, key national objectives will be undermined. Given the country's dependence on natural resources, if these resources are not used sustainably, economic growth will not be sustainable. The sectors of agriculture, fisheries and tourism all depend directly on renewable natural resources, while all sections of the economy require water and the functioning of essential eco-systems. Key sectors with potential for expanding employment are fishing, fish processing, and wildlife-based tourism. The long-term future of each depends on wise management of resources.

Namibia's Policy to Combat Desertification of 1994 committed the Government to:

- promote the sustainable and equitable use of land and renewable natural resources, in keeping with Namibia's variable climatic conditions;
- recognise that poverty and population growth are interlinked with the processes of desertification, and to support and develop programmes addressing these issues;
- aim to understand and positively influence the proximate and ultimate factors affecting the processes of desertification, including bio-physical, socio-economic, policy and legislative framework factors;
- encourage broad-based participation and strengthening of, and communications between, relevant organisations and individuals, at all levels;
- promote awareness, education and training at all levels through the preparation and distribution of appropriate materials, and through the active interaction of individuals and institutions.

4.1.1.8 The Water Supply and Sanitation Policy

The Water Supply and Sanitation Policy of 1993 includes the following key elements: essential water supply and sanitation services should become available to all Namibians on an environmentally sustainable basis, and be accessible at a cost which is affordable to the country as a whole; and the equitable improvement of services should result from the combined efforts of the Government and the beneficiaries, based on community involvement, participation and responsibility.

Water pricing

Water providers can respond to increasing demand for water either by increasing (sustainable) supply, if this is possible, or through a combination of demand management techniques, including public awareness campaigns to reduce waste and improving the efficiency with which water is used, and by ensuring that the price of water limits consumption to sustainable levels.
The Government has made great strides in expanding the sustainable supply of water resources, for example, through the use of conjunctive sources. Progress has also been made in certain areas of demand management (more efficient use of water by mining and other industrial enterprises, water awareness campaign and stepped pricing in Windhoek).

However, there remains much to be done to ensure that the pricing of water ensures sustainable use of the country's limited water resources, both now and in the future. The current pricing principles for water, as set out in the 1993 Water Supply and Sanitation Policy (WASP) (amended for rural areas as part of the on-going review of cost-recovery), are as follows:

**Urban**: a low price for a defined minimum lifeline volume of water and progressively increasing rates for increased consumption; commercial enterprises and industries (including mining) should as far as possible recover the full financial cost of water supply.

**Rural**: payment by the community should cover operation and maintenance costs over the next three years (1997-2000), increasing over the next six years to full cost recovery by 2006, although there will be cases where a subsidy applies.

**Irrigation**: in all cases where irrigation water is supplied by the State it is to be charged for at an economic rate which may be reduced through a special subsidy determined by the value of the produce relative to its socio-economic benefits.

Progress towards these goals has not been as fast as desired. It was intended that bulk water supply (largely urban areas) would achieve full cost recovery five years after the WASP was introduced (partly because the sector is to be commercialised under NamWater). However, on average, bulk water tariffs still need to double or triple to meet full cost recovery levels. Irrigation tariffs remain a very small proportion of the actual cost. The Etunda irrigation project, for example, pays nothing for the water it consumes.

The failure to achieve full cost recovery has created unsustainable expectations amongst consumers and has meant that additional sources, such as the Okavango River, have had to be considered earlier. In the case of irrigation, there is also a concern that water is being committed now to projects with a 20-30 year lifespan when that water will have a far greater value in other activities (domestic and industrial use when the country's population is twice its current level). In addition, scarce water resources are being used for the irrigation of low value crops such as maize.

The speed of cost recovery in the bulk water sector will be increased. The WASP target of five years (1998) is now as having been unrealistic, but Government has recommitted itself to full cost recovery by the year 2000. To protect poor consumers, Government will continue to promote the policy of stepped-pricing, which effectively represents a cross-subsidy from high users to lifeline-volume users. In this way, water price increases for poor, low-volume users can be minimised. Research shows that increases to cost recovery levels will not adversely impact industrial or commercial users, even where water is a major input.

This may not be the case with agricultural irrigation. If irrigation users are charged the full cost of supply, then many commercial users will have to switch to higher value crop production and more efficient irrigation technologies, or go out of business. In the case of irrigation schemes with smallholders, the WASP states that a subsidy may apply. In the past there has been little attempt to quantify what this socio-economic benefit is worth.

**Other issues**

Government will ensure that regional variations in costs are reflected in regional variations in price in order to promote sustainable development by encouraging people and industries to locate to areas with relatively secure water supplies.
Government will also consider ways of ensuring that water prices reflect the costs passed on to other users, and find some means of compensation (for example, in the case of ephemeral river degradation as a result of upstream use.

In the future, if demand continues to rise and water supply cannot increase, Government will have to consider either rationing of water or price increases, or both, to opportunity cost (the price where sustainable supply equals demand). Such price increases in the long run may make many existing irrigation schemes unviable, and the planning of such projects will have to take increased tariffs into account.

4.1.1.9 The Food Security and Nutrition Policy for Namibia

The Food Security and Nutrition Policy for Namibia of 1995 has the overall objective of improving the food security and nutritional status of the population. It takes into account policy initiatives in other sectors, particularly agriculture and health. The policy identifies three key areas requiring actions and enabling policies to address the underlying causes of food insecurity and malnutrition in Namibia. These are:

- Improving access to adequate resources to grow or purchase necessary food commodities. This can only be achieved by improving and stabilising levels of household resources by a combination of (1) increased, stabilised and/or diversified subsistence production of nutritionally sound food commodities, (2) increasing income earning opportunities available to the population, including the sale of surplus agricultural production, and (3) establishing effective social security and nutritional safety nets for the vulnerable segments of the population. Improving and diversifying sources of household level resources will contribute significantly to the sustainable use of natural resources in Namibia. All such initiatives must be planned and implemented so as to ensure the inclusion of women and marginalised households amongst the beneficiaries.

- Improving the knowledge and understanding needed to use those resources to their best advantage. Increasing the resources available to poor households to increase their access to food, can only be achieved in the medium term. Families must be assisted to make the best use of resources currently available to them. Natural resources must not be over-used and degraded. Foods must be stored and preserved so as to maintain their nutritional value. Members of the family, particularly small children and pregnant women, must have access to appropriate foods. Health and sanitation practices must support good nutritional practices.

- Improving access to appropriate services. While encouraging self-reliance amongst the population, the Government is committed to developing appropriate institutions, such as well-functioning markets and effective rules and regulations, to enable families to help themselves. In addition, the Government accepts responsibility for social and support services such as agricultural extension, safe water supply, and health clinics, to enable the full exploitation of resources.

4.1.1.10 Resettlement Policy

The Government's Resettlement Policy aims to alleviate desertification by moving poor farmers to commercial areas and alleviating pressure on communal-tenure land. However, in practice, resettlement is moving very slowly, and has been criticised for having detrimental effects on the land which is being resettled. The main problems are that a small budget, high unit costs and continued dependency of settlers on the Government mean that fewer people can be resettled. The resettlement programme as currently conceived inadvertently promotes land degradation both because its high unit costs mean that few people can be moved from stressed communal-tenure areas, and because, in some cases, management practices do not appear to respect the constraints of the farming system (e.g., permanent grazing without resting) with too many settlers being placed on each purchased property for viability.
In order to reduce degradation in communal-tenure areas to assist the majority of poor farmers who live there, Government aims to reorient the programme away from intensive support to a small number of farmers to settle on land purchased on an ad hoc basis simply where it becomes available in commercial-tenure areas. Resources will be more efficiently and effectively used to relieve pressure by:
- the purchase of farms adjoining communal-tenure areas;
- the purchase of such farms in blocks;
- opening up of some new areas (not marginal areas which cannot be used sustainable);
- supporting the movement of large communal-tenure farmers to private-tenure areas.

The applicability of some of these approaches is currently constrained by existing policy and legislation including the willing-seller willing-buyer principle applied to land purchasing by the Government, and the existence of the Veterinary Cordon Fence which restricts movement of stock to private-tenure areas. Further to this, delays between time of purchase and settlement is cause for concern.

4.1.1.11 Freshwater Fisheries Policy

An Inland Fisheries Bill has been prepared and, at the time of reporting, is about to be presented to Cabinet. Significant policy objectives stated in this draft include:
- the conservation and promotion of the sustainable utilisation of the freshwater fisheries of Namibia;
- the protection and conservation of ecosystems and habitats on which freshwater fish are dependent;
- to ensure that the benefits from freshwater fishery resources are justly and equitably distributed, in particular that traditional and subsistence fisher people are not deprived of the resource;
- to enter into co-operative agreements with neighbouring states whose freshwater catchments are shared with Namibia.

A White Paper on the Responsible Management of the Inland Fisheries of Namibia of 1995 aims, in summary:
- to allow sustainable use and to protect biodiversity, for instance by having closed seasons and closed areas (or breeding sanctuaries), by banning of certain fishing methods, by developing an appropriate licensing system, and by bag limits and size restrictions;
- to develop different management approaches for different systems;
- to protect the interests of subsistence households;
- to control fishing by gear restrictions, preferring “passive” to “active” gear, and traditional to modern gear.
- to police fishing activities using police officers and Ministry officials;
- to allow local communities to share the income generated from fish;
- to support research, and to develop regional co-operation where needed.

4.1.1.12 Industry Policy

The White Paper on Industrial Development of 1992 focuses attention on fostering manufacturing growth while reducing geographical and ownership concentrations, increasing diversification and linkages, and creating manufacturing employment. Growth in the small scale and informal sector will be encouraged.

Namibia: Policy and Programme on Small Business Development of 1997 aims to support small businesses which are thought to provide employment and income to about a third of the national workforce, and through this support the relatively disadvantaged sections of society. The aim is to increase economic diversification, create employment opportunities and raise incomes. Such aims are essential elements in the development of sustainable rural livelihoods. The policy is being implemented by means of a three main initiatives: (i) the removal of barriers to establish businesses and the provision of incentives for growth; (ii) pro-active programmes to identify and create opportunities and remove
constraints to business expansion; and (iii) institutional support and advocacy in favour of small and medium enterprise development. One of the key needs for this policy to be a success is broad-based and co-ordinated support by governmental and non-governmental organisations.

4.1.1.13 Others

Namibia’s population policy, formally adopted during 1996, aims to address the currently high rate of population increase relative to the growth of the economy as a whole, and the agriculture sector, upon which most people depend at least partially for their survival, in particular. The policy aims to provide the necessary information, education, and reproductive health and family planning services, to enable people to make rational choices regarding family formation, and ultimately reduce the overall level of fertility, morbidity and mortality.

The main objective of the National Co-operatives Policy of 1992 is stated as being “to create an economic, legal and institutional environment which is conducive to the development and growth of all types of co-operatives in Namibia”.

Importantly, the policy states that “co-operatives are part of the private sector and that they are an important option for socio-economic development but that co-operatives are not an instrument of the state”. As such, “the co-operative movement will develop without undue interference from the state.”

The policy notes that legislation will minimise external interference in the workings of co-operatives while safeguarding the co-operative principles. The policy recognises the full range of possible co-operative enterprises, and supports the internationally recognised co-operative principles. It also provides for a government service to work alongside a range of other relevant government and parastatal agencies, non-governmental and private sector organisations, supporting co-operative development by providing:

1. education, training information and advice on and to co-operatives, and
2. accounting and auditing services, monitoring of co-operative performance and facilitation of supportive actions, assisting with preparation of co-operative by-laws and project proposals.

Many other policy initiatives are relevant in terms of a discussion of society’s response to environmental concerns. These include, for example, Government’s Decentralisation Policy and its Gender Policy, both of which seek to deal with fundamentals without which rural development in Namibia cannot be expected to make significant progress.

A range of policy initiatives on health, education, and social welfare aim to improve levels of household resources and to improve knowledge, attitudes and practices related to drought and natural resources management.

Social welfare policy aims to expand service provision and reduce inequalities in existing provisions through improved coordination of services and targeting of assistance to the needy, encouraging greater community, private sector and non-governmental organisation involvement for providing for the disadvantaged; and reducing dependency on Government assistance by encouraging self-reliance. All people over sixty years of age are eligible to receive an old age pension. This is an important and indeed often vital source of income for many families.

The Government is in the process of reorienting health care services by emphasising primary health care approaches. Food and nutrition issues are addressed directly or indirectly by the Government’s Maternal and Child Health Programme; the Expanded Programme on Immunisation; the Control of Diarrhoeal Diseases and Acute Respiratory Infections; the Food and Nutrition Programme; the Tuberculosis Control Programme; the Malaria Control Programme; the Environmental Health Programme; and the Emergency Preparedness Programme.
The Government's education policies aim to improve access to education and education quality. Human resources development is widely recognised as being an area in which Namibia has inherited a significant deficit. The Constitution stipulates that all six year olds should be able to attend school and remain there for ten years. To achieve this an increasing proportion of government current expenditure is spent on education.

4.1.1.14 The Limits of Policy-led Societal Response

The rate at which Namibia is actually implementing its official policy statements is a matter of increasing concern. This section looks at a number of issues which constrain effective policy-led action.

Lack of Strategy

Despite the large number of policy statements as noted, it is widely observed that the planning of natural resource use and development often occurs as a short-term response to an immediate problem rather than as the outcome of policy. This can undermine the sustainable use of resource if the short-term response is not viable in the long-run.

Considering, for instance, the development of water resources, concerns have been raised with regard to the emergency development of water supply sources in times of drought. Pipelines have been laid and boreholes drilled which were intended as temporary measures but which have been used on a permanent basis. This can create increased stress on natural resources, especially where once seasonal grazing areas are permanently grazed.

While reactive planning of water is largely a problem in the rural sector, there are similar developments in urban areas. For example, although it may be necessary now to extend the pipeline to the Okavango to avert a potential water shortage in Windhoek in the next few years, care must be taken to ensure that the availability of water from the Okavango River does not create unsustainable expectations. There are very limited options for bringing additional water to the central areas of the country once the Okavango water has been tapped, and it should be accepted that this source will have to meet the area's development needs for many years to come.

Dealing with income inequality and chronic poverty requires long term thinking and broad vision. While the Government hopes that it has put in place a platform of policies that will lead to economic growth, increasing employment opportunities, and thus ultimately poverty reduction, there is a growing awareness that, in view of the extremity of Namibia's poverty problems, more direct action may be required. The indecision which has characterised the Government's approach to poverty reduction is perhaps illustrated by its attempt to establish a mechanism to direct and coordinate a national poverty reduction programme. Partly in response to the World Social Summit in Copenhagen in 1994, the Government committed itself to address the poverty problem. However, the initiative is still stalled at the first hurdle: the establishment of institutions to coordinate and implement programmes. There is indeed no sign of the Poverty Commission, which was reportedly to be established in the Ministry of Labour and Human Resources Development to direct the national programme to reduce poverty.

Rather than adopt a comprehensive poverty reduction strategy, the problem is addressed in band-aid fashion. A good example of the activities resulting from this approach is food assistance programmes. In times of declared drought large number of people receive food assistance from the government. Otherwise, food assistance is stopped, except for programmes targeting special groups such as the school feeding programme. However, it is well known that many of the chronically poor, many in settlements excluded altogether from drought aid assistance, are in need of assistance on a long-term basis because of poverty. In other words, no distinction is made between those needing food because of poverty and those needing food because of drought.

The main reason for failure to achieve policy objectives is the lack of effective strategy. This is revealed by a number of consequent problems, including policy failure, policy contradictions, and lack of cross-sectoral coordination and poor institutional development. Examples of each of these are given below.
State of the Environment Report on Agriculture and Land Resources

Policy failure
Policy failure may be considered to have occurred when a policy designed to achieve one objective has an unintended negative impact on another objective (NAPCOD. 1996). The case of the provision of subsidised livestock fodder and licks as a drought relief measure is an example of a policy instrument which has undermined sustainable agriculture. Subsidised fodder and licks are intended to enable livestock farmers to maintain their core breeding herds in times of drought. However, they have usually been provided too liberally, and are widely credited as being responsible for encouraging farmers to maintain high stock levels during droughts and thus overgraze and degrade their grazing land.

Policy contradiction
An example of a persistent source of confusion in statements of government policy is the failure to distinguish between food security and food self-sufficiency objectives.

Food security may be defined as access by all people at all times to enough food for an active, healthy life, involves assuring an adequate supply of food, irrespective of its source. Access to food supplies comes through generating effective demand via income growth or transfers. On the other hand, food self-sufficiency concentrates on ensuring that the supply of food adequate for the country’s total population is produced from a country’s own resources; it is not concerned with improving accessibility to food. To the extent that the implementation of these policies involves competition for scarce resources, these policies are often seen as being in contradiction to each other.

The Government has given contradictory indications as to whether it is pursuing food security or self-sufficiency objectives. For instance, the National Agricultural Policy (MAWRD. 1995) states that “the Government will pursue food self-sufficiency objectives only to the extent that it is financially rewarding and economically viable to do so. More important will be efforts to improve household food security and to promote improved food consumption of poor families”. On the other hand the First National Development Plan’s medium term policy objectives include “to achieve self-sufficiency in basic foodstuffs”.

In practice both policy objectives are being pursued. The problem lies in the resources allocated to the latter. The Government has, for instance, invested heavily in irrigation projects producing maize, and continues to subsidise drought-prone large-scale maize producers. The dropping of food-self sufficiency policy objectives would lead to existing irrigation users being charged the full cost of supply, so that they would switch to higher value-added production of non-food and food export crops and thus enhanced income generation, and more efficient irrigation technologies. This would create more jobs than current low value crops, and would earn the Government income, which along with the funds saved from subsidising irrigated food crop production, would contribute considerably to small holder production promotion and poverty reduction programmes to increase household food security.

Poor cross-sectoral coordination
Given the lack of decentralisation characteristic of the functioning of the Government’s line Ministries, cross-sectoral coordination at the national level becomes essential to avoid duplication and waste, and to deal with cross-sectoral issues such as rural development, natural resource management, land reform, rural infrastructure, poverty reduction, food security and nutrition, and drought and emergency management.

However, there is a natural tendency towards sectoral specialisation and bias within government in the planning and delivery of services and programmes. From the perspective of an Implementing Ministry, there are few obvious incentives to coordinate with other affected Ministries: programmes can be, and often are, delayed, and objectives can be changed or diluted.

This lack of cross-sectoral coordination can have a major impact on natural resources. For example, the failure to consider environmental impacts led to damage to the Okavango system with the development of roads and canals which cut across the natural drainage.
Government has undertaken a number of initiatives since independence to try to deal with this problem, including:

- the introduction of an environmental assessment policy which requires that policies and programmes, in addition to projects, be appraised for their impact on natural resources
- the requirement for all Government projects to analyse possible environmental impacts (if not a full feasibility study) before approval and incorporation in the Capital Budget.

In practice, while numerous coordinating institutions (such as those dealing with emergency management, food security and nutrition, and land use and environment) have been established at the national level, they themselves are uncoordinated, resulting in a situation where the institutions are ineffective, and coordinating line Ministries have little incentive to participate in their time-consuming procedures. There is an urgent need for an overall structure for coordinating cross-sectoral issues to be established.

In addition, such coordinating institutions as there are tend to be poorly developed. This is true at the national, regional and local levels. Institutions such as the National Land Use and Environment Board, chaired by the National Planning Commission and consisting of representatives of all affected Ministries, Regional Land Boards, and Regional Councils have a vital role to play in ensuring effective drought and sustainable resource management. It is recognised that significant effort will have to go into institutional development and capacity building if these institutions are to be effective.

**Discussion of the Value of the Existence of a Conducive Policy and Strategy Framework as an Indicator of the State of the Environment**

Namibia’s policy framework, ten years after independence, is impressive to behold. No doubt there are areas in which policies are yet to be clearly formulated, most notable amongst these is the issue of land policy, and others where existing policies need improvement, as in the case of water policies. But, perhaps of greater significance as an indicator is the issue of policy implementation. Here, it is difficult not to conclude that objective measurement of policy implementation is difficult at best, if not impossible.

One indicator of policy implementation that might be considered is that of the existence of policy prioritisation, supported by implementation strategies, plans and budgets. Where these elements can be demonstrated one can at least infer that there is a reasonable chance that a particular policy measure is being pursued.

To summarise, in terms of indicators, this study proposes that the mere existence of a government policy statement is of little value as an indicator. Instead what is proposed for consideration is that certain key policy statements are isolated, and the degree to which they are being implemented is considered in terms of the existence of strategies and budgets.

### 4.1.2 Legislative Framework

On gaining independence, Namibia inherited South Africa’s Roman Dutch common law as well as customary law. Many of these laws were inappropriate for an independent nation focussing on sustainable development in a newly liberalised world trade environment. Reform is ongoing and often slow partly due to the consultative approach adopted and partly due to limited institutional capacity to deal with law reform.

This chapter discusses legislation deemed to be of significance in terms of societal response to the changing state of the agricultural and land resources environment, and which aims to enhance sustainable agricultural and land resources management. It contains a review of pertinent legislation being administered by the Ministry of Agriculture, Water and Rural Development and the Ministry of Environment and Tourism. Issues pertaining to land tenure reform have been discussed in chapter 4.1.1.3.
4.1.2.1 Ministry of Agriculture, Water and Rural Development

Department of Agriculture and Rural Development

Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act 36 of 1947) work is in progress on a new "Plant Protection Improvement Bill" covering quality control of pesticides, farm feeds and fertilisers, and their right use. The Bill adopts international standards for the registration, distribution and use of agro-chemicals, and makes the role of customs and agricultural extension officials clear.

Agricultural Pests Act, 1973 (Act 3 of 1973) has been revised and it is expected that a new Pest Quarantine Bill will be tabled in 1999. It aims to control the movement of crop pests and diseases into (including provisions for quarantining) and within the country according to international phytosanitary standards.

Because of international trade in agricultural and related products this legislation is of direct significance to the state of the environment. The Act also provides for crops to be declared pest free, and therefore not subject to international trade related quarantine regulations. This is of importance for trade purposes and should enable Namibia to develop an international in situ gene bank for dates.

It may be noted that this piece of legislation provides another good example of the importance of implementing capacity. There are real concerns that current provisions whereby customs officials and Meat Board officials are supposed to enforce the Act at border posts are inadequate given the highly technical nature of the work involved. On the other hand, for adequate capacity to be developed some 15 new officials at borders would be required, as well as scientific back-up staff and capacity. The questions to be balanced are: can the State afford this, and can the State afford a potential pest epidemic?

The objective of the Sub-division of Agricultural Land Act, 1970 (Act 70 of 1970) is to prevent the break up of commercial holdings into small units the size of which is considered insufficient for the generation of an adequate income from farming. The rationale behind the Act is that if units become too small farmers will be more likely to farm too intensively and so damage the natural resources.

Before independence the minimum farm size was one which could carry 400 large stock or 2,000 small stock or which included 40 ha of irrigated land. It was considered that rainfed crop farming could not be practised on its own but, when combined with stock farming, 100 ha of rainfed crops could substitute for 50 cattle. After independence, these rates were cut in half. In 1994, proposals were made to cut rates in half again. This was predicted to enable a farmer of average managerial ability to earn an income of N$ 25,000 and N$ 30,000 for cattle and small stock respectively.

The logic behind this objective of the Act is questionable. First, the definition of an adequate income will vary from farmer to farmer, and defined income levels constitute paternalistic income levelling on so called beneficiaries. Second, in recent years the practice of diversification of income sources has become established so that few farmers are wholly dependent on their farms. Third, the link between size of holding and propensity to over-utilise the natural resources is assumed rather than proved. Fourth, the assessment of "economic" units did not take into account managerial objectives and abilities and farm product price and input cost fluctuations.

The question of what constitutes an adequate income is particularly contentious in a country like Namibia with its huge income disparities. One consequence of the Act is that title cannot be given to settlers in resettlement schemes where the norms of a viable economic unit are considered on a completely different basis. This is one of many issues which compromises the government's current resettlement programme.

An additional objective of maintaining a minimum size of farm holding in relation to livestock carrying or cropping capacity is to encourage full-time commercial farming (by making it possible), rather than part-
time hobby or recreational farming, or in the case of peri-urban land non-agricultural purposes, as would tend to prevail on small holdings. It is assumed that this will benefit National production and income as well as good farming practices.

The Minister of Agriculture, Water and Rural Development appointed the Meat Industry Committee which has been sitting since mid-1998 in an attempt to update the Livestock Improvement Act, 1977 (Act 25 of 1977) and Livestock Improvement Bill (25 of 1993) and the Meat Industry Act, 1981 (Act 12 of 1981). The Meat Industry Committee is considering the establishment of a Livestock and Meat Industry Council to be financed mainly by the private sector. At the time of reporting it remains unclear if the provisions of the Livestock Improvement Act, which establishes the Registrar of Livestock Improvement and the Livestock Improvement Board, the functions of which are shown below, will remain separate or will be merged with those of the new Livestock and Meat Industry Council.

A first draft Seed Bill (or Plant Improvement Bill) has recently been prepared to certify and control seed quality has been enacted and should be enacted in the next two to three years. It aims to establish the establishment of an internationally accepted seed and plant improvement certification system.

The objectives of the Soil Conservation Act, 1969 (Act 76 of 1969) are "to provide control over the utilisation of the natural agricultural resource of Namibia in order to promote the conservation of the soil, the water sources and the vegetation and the combatting of weeds and invader plants". Its ambitious aim is to enable the State to control a wide range of land husbandry practices including most, if not all of those identified in Part 3 of this report as being the proximate causes of resource status change in Namibia. Its main emphasis is on the adoption of control measures, and it also make provision for the State itself to undertake control measures and to reclaim costs from land owners, as well as for the payment of subsidies for good practice.

These objectives have been noted in full because while they may be laudable, and clearly they are of central importance to the topic of this State of the Environment Report, it is salutary to note the demise of the effort to enforce them through legislation. First, it must be noted that the original Soil Conservation Act does not cater for communal areas. Other short comings include its lack of clarity on important aspects of land and water use, and particularly weed control and bush encroachment, and the inadequacy of the prescribed capacity for law enforcement in general. A new bill, the Conservation and Utilisation of Agricultural Resources Bill was drafted in 1992.

This 40 page draft tried to overcome the short comings of its predecessor. That it never got past the first draft stage can be explained as follows:

- Narrow interpretation of the functions of legislation:
The draft legislation was prepared and analysed from the point of view of it being essentially a means of controlling farmers. On the other hand, it was argued that good land husbandry should be practised willingly on the basis of informed consent. In this case, legislation should be mainly a matter of guidance as to and positive reinforcement of good practice, with regulations being in place to control those rare transgressors that will always exist. One implication of this interpretation of the purpose of legislation is that good practice should be determined realistically and be accepted by most farmers as reasonable. This cannot be said to be case with some of the provisions of the existing and draft legislation.

- Lack of implementing capacity:
Responsibility for sustainable agricultural and land resource use remained unclear. The legislation was to be implemented by the Department of Agriculture and Rural Development, the function of whose field personnel is mainly to assist farmers with information, advice and other services. The adoption of regulatory functions would be in direct contradiction to this, and as such inherently untenable. Provision was therefore made to enable the Minister to authorise "any person" to implement any provisions. In addition, the legislation also permitted the Minister to appoint "Conservation Committees" and "Fire Protection Committees" for areas specified, as well as a national "Conservation Advisory Board" whose functions were to be mainly advisory. The fact remained however that because of the lack of local
authorities and communal land management structures at that time the link between (and accountability of) those with who would implement the legislation and those with land use rights was weak.

- Communal land tenure:
While responsibility for communal land management remained undefined, and land was essentially subject to open access, it was impossible to call individuals to account for bad practice. Thus, the Act would remain unenforceable in the communal areas.

In conclusion, this report suggests that the issue of legislation governing sustainable land resource management should be reviewed in the light of on-going land tenure legislation developments. The aim should be to give powers to new land authorities and land users themselves to promote good land husbandry practices. At the same time reasonable provision should be made to enable authorities to control those few who adopt what by national and local consensus are considered unacceptable practices.

The *Stock Brands Act, 1995* (Act 24 of 1995) was gazetted on 29 December 1995. Following the gazetting of Regulations, the Act came into force in early 1999. Key provisions of the Act and Regulations include the following:

- Director of Veterinary Services is the Registrar of Brands.
- When the Act commenced cattle owners had 6 months to apply for a brand. If someone becomes an cattle owner thereafter they will have 14 days from the day they become an owner to apply. Registration fee N$5.
- The Meat Board of Namibia has been contracted to administer the Stock Brands Act and issues Certificates of Registration giving each successful applicant a brand.
- Brands are based on Stock Brand Areas.


The *Co-operatives Act, 1996* (Act 23 of 1996) serves to:
Ensure that a co-operative is a lawful organisation serving a desirable purpose in society and possessing legal personality.
1. Show what kind of an organisation a co-operative is in terms of its objectives, membership, its control, management set-up, funding financial assets, and disposal of surpluses and losses.
2. Indicate which government agency is responsible for co-operatives for administrative purposes, for guidance and advisory services, and for inspection purposes.
3. Indicate special measures applicable to co-operatives such as taxation, training and expertise, and grants and loans.
4. Encourage the establishment of co-operatives as instruments of private sector enterprise.

Department of Water Affairs

Groundwater resources and wetlands legislation is covered by the Water Act No. 54 of 1956. This piece of legislation is essentially the Water Act of South Africa (certain articles have been made applicable to Namibia) and is currently being reviewed. It is generally considered to be inadequate in terms of our current understanding of water resources and the demands of a modern Namibia. It focuses almost exclusively on water supply (i.e. as a commodity) and does not recognise water as a habitat or agent of habitat/environmental stability.

The Water Act distinguishes between "public" and "private" water and its use and rights of access are defined in the Act. Public water is found on public land and includes above and below ground water resources. Private water occurs on private land and may be used exclusively for any purpose by the owner (Glazewski et al., 1998), but are subject to the prohibition of using it for industrial purposes without a permit and to the strict pollution provisions of the Act.

The Water Act does not specifically regulate the use of groundwater. However, in the respect of ground water occurring in a subterranean, government water control area, the Act contains specific provisions which vest the right to use and control these resources, with the Minister (Fuggle & Rabie, 1992). There is no provision in the Act to regulate the use of ground water on private land. Unless the area is a government water control area the land-owner/user can use the water as they please. The reason for the lack of controls presumably lies in the fact that where substantial amount of groundwater occurs, the government would have declared a control area. The new Act would have to clarify what the status of, and rights to, ground water are.

A generally poor understanding of the services and products provided by wetlands and the dated nature of the Act has resulted in very few legislative measures being in place for the protection of these areas. One of the reasons for this poor legislative protection is that fact that these areas cannot contain public water unless the water is derived from a public stream. Even this is open to debate given that under the Act water may change its status given certain changes in its characteristics (e.g. if it stops flowing).

Wetland protection may be partially covered in the Mountain Catchment Areas Act No. 63 of 1970, but this is not a widely used piece of legislation in Namibia.

The lack of a comprehensive national policy on wetlands and a uniform legislative system for wetland conservation/management has resulted in wetlands being overlooked as areas providing essential services in the landscape. This problem is further exacerbated by the fact that a wide range of authorities control the use of different "products" within wetlands. For example, the Water Act controls water use, the Nature Conservation Ordinance controls utilisation of plants and animals, the Forestry Act controls the use of trees, the use of freshwater fish resources is controlled by the Ministry of Fisheries and Marine Resources, and the Ministry of Health and Welfare is charged with controlling insect vectors associated with these habitats without reference to other users or agencies.

Namibia is a signatory to the Ramsar Convention on Wetlands of International Importance. Four sites are currently registered with the Convention, these being Sandwich Harbour, the Walvis Bay lagoon, the Orange River mouth and the eastern part of Etosha National Park. The main aim of the convention is to halt the decline in wetland habitats and to maintain the ecological goods and services provided by these habitats. Contracting parties agree to include wetland conservation in national planning, to promote the sound utilisation of wetlands and to develop long term management strategies. Designation of sites is seen to be a strong conservation and management tool. However, the obligations of signatories are maintained by persuasion, co-operation and moral pressure, as there are no legislative requirements under the convention.
4.1.2.2 The Ministry of Environment and Tourism

Forest Resources

Prior to 1990, forest management in Namibia was guided by two legislative documents, namely, the Preservation of Trees and Forest Ordinance 37 of 1952 and the Forest Act (Act 27 of 1968). This legislation is generally recognised as quite inappropriate for local needs.

For instance, while harvesting of wood products for domestic use (including construction and firewood) does not require the purchase of a permit from the Directorate of Forestry, harvesting, transporting and marketing of wood products for commercial purposes does. The system that has been developed is based on the Forest Ordinance of 1952 and the Forest Act of 1968. Some authorities argue that these two pieces of legislation were designed for commercial areas only (Hinz, 1995) which partly accounts for the claim that the permit system that has been designed is difficult for both users and enforcers.

In any event, many forest users would rather avoid the expense and time needed to get permits but risk getting caught. One study found that only 2 per cent of artefacts on sale from the Caprivi Arts and Crafts Association had been made from wood for which permits had been obtained. (Harrison, 1995).

The consequence of this situation is that current legislation serves neither to control forest exploitation nor to provide information for monitoring wood use.

The Directorate of Forestry has prepared an updated and appropriate legal framework in the form of a draft Forest Bill which is awaiting ratification by Parliament. This provides for different categories of protected forest in which tree use and agriculture and other land uses are prohibited. It will also allow communities to control forest and gazing resources within an area gazetted as a community forest and thereby greatly extend the benefits to be gained from the community-based natural resources management (CBNRM) approach. Five community forests have been defined on Okongo (780 km²), Ongandjera (1,282 km²), Uukwaluudhi (1,530 km²), and Uukolokwadhi (1,117 km²), which represents 9.1% of the former Ovamboland area, and should be gazetted when the new forest legislation is enacted (RoN, 1998).

The Bill proposes to give legal powers to honorary forest officers, who may be appointed by communities to enforce community rights to such forest and grazing land. The requirements for gazetting a community forest are more demanding than those for gazetting a conservancy under the Conservancies Act in that they demand that a management plan has been drawn up. A number of pilot projects are underway to establish ways in which communities can be assisted in this regard by government and non-government officials. When this Bill becomes law it may be expected to have a galvanising effect on community natural resource management efforts in the communal areas. Where a community applies for an area to be declared a community forest under the forthcoming Forest Act, and a conservancy under the Conservancy Act, they will gain control of rights to forests, grazing and wildlife resources within that areas, which will enable them to gain significant financial benefits from managing these common pool resources sustainably.

Community-based natural resources management

Until 1967 all wildlife was the property of the state and wildlife numbers outside the National Parks were in decline. In 1967 the ownership of wildlife on the freehold farms was transferred to the landowners and sustainable use of this wildlife was permitted. These farmers began profiting from wildlife and numbers generally started to increase.

In the early 1980's some wildlife conservation projects piloted paid community-appointed game guards and communities receiving some of the revenue from the local tourist trade. After independence the MET moved to extend the rights over wildlife enjoyed by private farmers to communities in the communal
areas using a two fold strategy: (i) local pilot projects enabling communities to benefit and manage wildlife, and (ii) development of policy and the revision of legislation. This resulted in the Nature Conservation Amendment Act, 1996 (Act 5 of 1996) which enables a community to register an area of land as a ‘Conservancy’ in which they have the right to benefit from wildlife through tourism, sale of live game, trophy hunting and sustainable harvesting quotas agreed with the MET.

To be registered by the MET a conservancy must have:

- defined boundaries (involving dialogue with neighbouring communities, regional councils etc);
- defined membership (none to be excluded on grounds of ethnicity or gender);
- a representative committee (the community is allowed to choose its own system of representation as long as it is accepted by the membership);
- a legal constitution (including a set of rules setting out how the conservancy will operate);
- a plan for the equitable distribution of the proceeds and a sound accounting system;
- satisfy the MET that it is able to sustainably manage the wildlife (a complete management plan is not needed at first).

Wildlife Production and Utilisation Legislation

All aspects of wildlife production and utilisation are covered by the Nature Conservation Ordinance No. 4 of 1975 and amendments, and is administered by the Ministry of Environment and Tourism. The Nature Conservation Ordinance is to be replaced by a comprehensive Parks and Wildlife Management Act which is in the process of being drafted. A comprehensive policy document relating to wildlife production and utilisation has been drafted by the MET (MET, 1998).

The current Ordinance deals with all aspects of in situ and ex situ conservation by providing for the registration of hunting farms, private nature reserves, regulation of hunting and harvesting of animals and plants. There are important disincentives for the registration of private nature reserves and other special conservation areas on private lands and a number of these reserves have been deprieved in recent years. Problems include the fact that many management initiatives (e.g. culling) have to be cleared by the MET even though the land is essentially private, adding an unnecessary bureaucratic burden on the farmer. This is clearly recognised by the MET (MET, 1998) as the fact that much of the current legislation is fragmented, contradictory, overcomplicated and out of date. The proposed new Act is designed to provide strong incentives to manage wildlife and ecosystems sustainably but there are once again some contradictions in this legislation. For example it is proposed that wildlife utilisation be taxed through a permit system which in itself is a direct disincentive.

In conclusion, it is important to note that all Namibia’s environmental legislation is currently being reviewed and revised. An all encompassing Environment Act is in the pipeline which makes provision for a new approach to and framework for regulating environmental management.

4.1.2.3 Customary Law

Finally, it important to acknowledge the importance of traditional regulatory methods for promoting sustainable resource use (Barnard, 1998). These include:

- establishing protected areas;
- regulating harvesting with quotas;
- prohibiting harvesting of designated species;
- regulating harvesting methods;
- establishing harvesting seasons and prohibited periods;
- prohibiting the introduction of alien species.

While it is clear that customary law is no longer relevant in many places, its importance lies in the future when it is likely that with increasing decentralisation of state power and a return to community-based development approaches, the use of local by-laws and regulations in environmental management will be important.
again have their day. While the Regional Councils Act (Act 22 of 1992) leaves much to be desired in terms of a clear exposition of the powers of local authorities in relation to those of central government, the Traditional Authorities Act (Act 17 of 1995) recognises the role of the traditional authorities and calls for the sustainable use of natural resources by communities.

4.1.2.4 Discussion

Namibia's approach to policy making and consequently review and revision legislation is based on comprehensive consultations. Namibia is trying to build a tradition which emphasises consensus-building and compromise over confrontation. Also, where government resources are limited, other parties may be able to contribute valuable technical inputs to the formulation of regulations. Another reason behind its consultative approach is that limited enforcement capabilities make it desirable to obtain as much voluntary compliance as possible.

Authorities responsible for specific pieces of legislation often have limited power within the government bureaucracy and therefore they need to negotiate and compromise with other government agencies as well as with the private sector and the general public. There is also a real danger that regulations, however impressive on paper, may be beyond the capacities of government to enforce and users to meet. To minimise the risk it is important for government to consult closely with those to be regulated in the early stages of formulation.

While the existence of legislation can be seen as an indicator of societal response to environmental change, it can also be argued that, in and of itself, it is not a strong indicator. This is particularly so where the legal system and property rights are not well developed as is the case in much of Namibia. This is why the government has realised that the approach adopted by the Soil Conservation Act, as discussed above, for instance, is of limited significance, and that its objectives could better be attained through the use of economic instruments and education, rather than regulation. For this reason, this report has decided not to select indicators of the state of the regulatory framework as indicators of the State of the Environment.
4.2 Supporting Institutions and Services

In assessing societal response to environmental change in terms of the institutions it has established to direct that response, one has to consider the network of relevant actors. In this chapter, we will review the key governmental, parastatal, non-governmental, and community-based actors, as well as the coordinating and policy-making institutions, all of which together aim to achieve the common objective of the sustainable management and utilisation of Namibia’s natural resources.

4.2.1 Government Institutions

The principal governmental implementing agencies within the agricultural and land use sectors in Namibia include the following:

- Ministry of Agriculture, Water and Rural Development (MAWRD) (responsible for agriculture, water development [provision and quality], state herbarium, rural development, veterinary services);

- Ministry of Environment and Tourism (MET) (responsible for flora and fauna, game and National Parks, tourism and resorts, forestry, environmental policies);

- Ministry of Lands, Resettlement and Rehabilitation (MLRR) (responsible for land administration and tenure reform, land-use planning and resettlement programmes);

- Ministry of Fisheries and Marine Resources (MFMR) (responsible for the marine sector, fisheries, resource management and conservation, marine pollution, fresh water fisheries).

Other important and related actors, which will not be discussed in detail in this report, are the:

- Ministry of Basic Education and Culture (MEC) (also responsible for environmental awareness building and dissemination of knowledge, national monuments);

- Ministry of Tertiary Education, Vocational Training, Science and Technology (MTE) (also responsible for environmental awareness building and dissemination of knowledge);

- Ministry of Regional and Local Government and Housing (MRLGH) (also responsible for issues such as forest fire control and municipal waste, community development, traditional authorities, regional government and coordination);

- Ministry of Trade and Industry (MTI) (also responsible for importation of chemicals, production of hazardous substances, industrial pollution);

- Ministry of Labour and Human Resources Development (MLHRD) (also responsible for environmental conditions at the workplace)

- Ministry of Works, Transport and Communication (MWTC) (also responsible for road construction and maintenance, harbours, airports, aspects of marine pollution);
Ministry of Justice (MoJ), Office of the Attorney-General (AG) and the Ministry of Home Affairs (MHA)
(responsible for the drafting and revision of environmental legislation, custodian of the Constitution, law enforcement).

The Coordinating and Policy Making Institutions relevant to the Sustainable Management of Natural Resources

- National Planning Commission (NDC) and its Secretariat
  (responsible for macro-economic, sectoral and inter-sectoral planning, coordination of external assistance and NGOs, statistics, Environmental Commissioner); and the

- Directorate of Environmental Affairs (DEA) within the Ministry of Environment and Tourism
  (responsible for cross sectoral environmental policy drafting and implementation, such as environmental assessments, promotion of sustainable development).

There follows discussion of those agencies most directly linked to the subject of this SoER namely the Ministry of Agriculture, Water and Rural Development, the ministry of Environment and Tourism, the Ministry of Fisheries and Marine Resources, and the Ministry of Lands, Resettlement and Rehabilitation, as well as certain inter-ministerial bodies.

4.2.1.1 The Ministry of Agriculture, Water and Rural Development

The Department of Agriculture and Rural Development

The Department is mandated to develop, adopt and execute appropriate strategies and a comprehensive range of programmes and projects. The following section summarises the core missions, policies and strategies envisaged for the Department's five Directorates.

The Directorate of Extension and Engineering Services (four Divisions of Extension, the Division of Agriculture Engineering Services and the Sub-division of Law Enforcement and Supportive Services)

The Divisions of Extension
The mission of the Divisions of Extension is to provide agricultural extension services in the form of advisory, information communications and training services aimed at empowering farmers and at encouraging the adoption of improved agricultural and related income generating technologies and practices. The intention is to realise this mission by implementing participatory and gender-sensitive Farming Systems Research Extension approaches involving situation determination and problem diagnosis, the development of improved technologies and practices, the dissemination of information on improved technologies and practices, and the coordination and facilitation of farmer support services. Extension field staff should work with groups of farmers and aim to foster the development of community organisations. Appropriate methods of mass communications are used to disseminate agricultural information.

The Division of Agricultural Engineering Services
The Division provides specialist planning and management services and technical extension services in relation to sustainable irrigation development and other civil engineering activities. The Division is responsible for the establishment of an efficient institutional structure to manage irrigation on a national basis and for the implementation of irrigation projects where they are economically viable and environmentally sustainable. The intention is that this should be done by legally establishing irrigation boards and management agreements covering all irrigation schemes. The Division aims to expand the area of land under irrigation, subsequent to positive technical assessments, financial and economical cost-benefit analyses and environmental impact assessments.
Sub-division of Law Enforcement and Supportive Services
The Sub-division of Law Enforcement and Supportive Services is responsible for reviewing, updating and enforcing most agriculture related legislation and regulations in Namibia. Existing legislation is reviewed, repealed or amended and new legislation enacted according to the provisions of the National Agricultural Policy and international agreements.

The Directorate of Agricultural Research and Training (Divisions of Livestock and Plant Production Research, and the Division of Agricultural Training)

Divisions of Livestock and Plant Production Research
The Divisions conduct agricultural research in order to promote optimal agricultural production and the sustainable utilisation of natural resources. Priorities have recently been reoriented towards demand-driven, multi-disciplinary and holistic research approaches to ensure efficiency and equity in agricultural development. Research programmes, based on participatory farming systems approaches, are being implemented in representative communal area communities through seven farming systems research and extension units, known as FSRE Units. Other research aims to improve and diversify agricultural production in market-oriented farming systems. Having identified, tested and approved new agricultural technologies, the Directorate ensures that this information is passed on, in an appropriate form, to farmers and others involved in agricultural development, in particular extension services, NGOs, farmers and farm workers' unions, and agribusiness concerns.

The Division of Agricultural Training
The Division of Agricultural Training aims to foster the development of the human resources required for the agricultural sector through coordinating provision for, and providing, formal, non-formal and in-service training. The Division ensures that formal agricultural training at the primary, secondary and tertiary levels provides the critical mass of skilled human resources required for the development of a healthy sectoral environment in the most efficient and timely manner. A multi-level system of agricultural education and training has been designed and implemented in cooperation with partners including the Ministry of Basic Education and Culture, the Ministry of Higher Education, Vocational Training, Science and Technology, and the University of Namibia. In-service and on-the-job training is provided to all agricultural extension staff, including short course formal training, management training and post-graduate training.

Directorate of Veterinary Services

The Directorate of Veterinary Services (DVS) aims to maintain and improve the health of the Nation's livestock in order to ensure safe and orderly access of Namibian livestock and livestock products to local and foreign markets. The DVS's main functions are the monitoring of the health of the national herd and the control of export abattoirs. Routine livestock inspections are linked to compulsory vaccinations in the communal areas. In private-tenure areas farmers themselves carry out vaccinations. The DVS maintains and monitors the veterinary cordon fence which is essential for zoning of health status areas as required for the international marketing of livestock and meat.

Directorate of Planning and Rural Development

The Directorate provides GRN decision-makers with information on past and future agricultural production, as well as economic analysis and advice on the efficiency and consequences of alternative policies, programmes and activities relating to agricultural development. It also houses the Divisions of Rural Development Planning and Cooperative Development Services.

The Directorate provides policy and economic analysis to management and prepares new investment projects. The impact of existing and potential input and output price and credit subsidies, and duty and tax interventions is analysed considering socio-economic policy objectives, and input and output price distortions, and recommendations made accordingly pertaining to changing existing legislation and/or institutional arrangements.

Agriculture & Land Resources SoER Consortium
Up-to-date information is provided to decision makers on agricultural production trends and prospects. A database containing farm level input-output data and aggregate agricultural production trends has been developed in collaboration with the Central Statistics Office. Food commodity surveillance and reporting systems are implemented by the Namibia Early Warning and Food Information Unit.

The Directorate also focuses on stimulating international and domestic agricultural trade and on facilitating agricultural financing and investment. Marketing structures, legislation and regulations, and the statutory marketing organisations for agricultural produce are monitored and recommendations made to reduce cost and increase demand and overall efficiency.

The Division of Co-operatives Development
The Division is responsible for registering all types of co-operatives and creating awareness of the Co-operatives Act which aims to create a supportive legal and conducive economic environment for all types of co-operatives, including the ending of current practices such as subsidised GRN ventures (e.g. tractor hire) competing directly with co-operative enterprises. It also assists in the formation of co-operatives, in developing awareness of the benefits of co-operatives, and it supports the entrepreneurial, organisational and managerial resources of the co-operative movement.

The Division provides training and training materials to all agents in the field of co-operative organisation, management, accounting and audit (both GRN and NGOs). Limited support services (including promotion, training and monitoring) are also provided directly to all types of co-operatives.

The Division of Rural Development Planning
The Division aims to facilitate the sustainable improvement in the living conditions of the rural population, with special emphasis on the participation of the poor, by coordinating the formulation of cross-sectoral national and regional development policies involving the participation of all line Ministries, NGO and interested private sector parties. The Division is responsible for overseeing the implementation of the national Food and Nutrition Policy and the Food Security and Nutrition Action Plan, by acting as the Secretariat to the Food Security and Nutrition Council and Technical Committee, and by implementing regional pilot projects. The Division supports the strengthening of the GRN’s drought preparedness and management capacity and the mobilisation of peoples’ participation and self-help initiatives through the provision of resources for the Food-for-Work and Cash-for-Work Programme.

The Directorate of General Services
The Directorate of General Services aims to provide support services to the Ministry’s technical services with the aim of enabling them to execute their respective line functions. At the start of the 1996/97 financial year, the two Directorates of General Services of the Department of Water Affairs and of Agriculture and Rural Development merged. Key Divisions include: the Division of Personnel Administration; the Division of Finance; and the Division of Auxiliary Services.

Discussion of Government Research, Extension and Farmer Training, and Veterinary Services
As background to one of the indicators identified in Part 5 of this report, the following discussion focuses on key services supporting the agriculture sector, and specifically farmers in their efforts to manage agricultural and land resources sustainably. While the Indicator looks mainly at quantitative measures of service delivery, this discussion looks at some of the background qualitative issues.

Agricultural Research
At the time of independence, little government agricultural research of specific relevance to communal-tenure farming in the NCAs had taken place. This was mainly because, within the context of the second tier agricultural administrations, economies of scale could not be generated which would justify the allocation of resources to research. It was also because conventional agricultural research, based on scientific disciplinary lines, when it did take place, was aimed at “commercialising communal-tenure
agriculture" and was unable to contribute new technologies of relevance to resource poor, risk prone, small scale, mixed farming systems prevalent in northern Namibia.

Starting with a number of small donor projects, which were initially staffed by foreign advisers, farming systems research (FSR) has now become the basic strategy for government research in the communal areas, formally accepted in the National Agricultural Research Plan (NARP) of 1985.

FSR acknowledges the biophysical and socio-economic diversity and complexity of Namibia’s farming systems. It tries to find out how farmers farm, and then to enable them to improve their farming practices. It is based on supporting the farmers' objectives which are usually to minimise risk and maximise production of a mixture of essential needs including food, fodder, wood, cash and so on. It involves working in multi-disciplinary teams and working with farmers as on-farm researchers. It also involves developing appropriate methods of disseminating findings more widely. Again, this straying into the field of extension is difficult for some researchers, who have often, in the past, been content to present their findings in research language and publications, and leave it at that.

Implementation of the NARP has been slow. This is partly because many individual conventionally-trained researchers are yet to be convinced of the merits of FSR. It is also because the tradition has grown up in Namibia that agricultural researchers are based mainly in Windhoek, where they direct research projects implemented on a network of research stations by technicians. Another constraint has been the inability of the research service (along with all Government agricultural services) to recruit and retain the services of new graduates who may be more amenable to the demands of FSR.

Extension Services
Up until recently the government’s extension service in Namibia’s communal areas was mainly involved in the provision of agricultural services, including ploughing services, the sale of farming inputs, the maintenance of farm infrastructure, and the administration of non-extension activities including a number of drought relief and credit schemes.

A new extension strategy was adopted in 1994 which stressed the provision of advisory, information communications, and farmer training services, and emphasised participatory farming systems research and extension (FSRE) approaches.

Key activities of the proposed strategy include:

1. participatory situation determination and problem diagnosis;
2. the localised development and adaptation of improved technologies and practices;
3. the dissemination of information on improved technologies and practices;
4. the co-ordination and facilitation of farmer support services; and
5. structured monitoring and evaluation.

The process as described by these five stages is essentially circular. Several cycles are expected to take place simultaneously, and at any time each cycle may be at a different stage.

Space was created for this new approach by a policy decision to the effect that the extension service should cease providing services which could be provided by the private sector. At the same time new agencies began assuming responsibility for drought relief and credit administration.

Since the Ministry’s new extension approach was signalled, it is clear that its application in practice has been limited. The extension service is in theory involved in four main activities:
• Relatively intensive on-farm research and technology development work is carried out by researchers and extensionists, using participatory methods, sometimes working in farming systems oriented multi-disciplinary teams, in a few strategically selected "focus" communities. This work aims to identify messages and appropriate dissemination methods, and properly test them before more widespread dissemination.

• Less intensive contacts between front-line extension workers (Agricultural Extension Technicians) and Farmer Extension and Development (FED) Groups to promote localised technology adaptation and adoption by farmers, and mainly employing traditional top-down transfer of technology dissemination methods such as standardised demonstrations and farmer training.

• The use of mass communications technologies such as radio as part of broader efforts to disseminate agricultural information.

• The continuing delivery of farmer support services, employing streamlined procedures in anticipation of the increasing involvement of and ultimately hand-over to partner organisations.

Some Regions, and some individual extension staff, have tried to develop the capacity to implement certain elements of the participatory FSRE approaches. These include diagnostic surveys and joint farmer-extension programme planning, the promotion of farmer experimentation and localised technology adaptation, and the promotion of farmer-to-farmer dissemination methods. However, because of the extension service's inexperienced front line extension worker, subject matter specialist, field researcher, and management staff resources, and its inherently top-down bureaucratic organisational structures and management practices, traditional, top-down, transfer of technology dissemination methods are the mainstay.

Considerable Government and donor funding has gone into developing the extension service in the last few years. It is essential that positive results are forthcoming and demonstrated in the near future, if the current direction of extension activity is to continue receiving the political and thus budgetary support it needs. An area needing particular attention is that of fostering cooperation between Government extension services and other farmer support agencies.

Veterinary Services
Because of the socio-economic value of livestock and livestock produce, farmers throughout Namibia tend to identify animal problems as amongst the most significant they encounter. In fact, partly because of its dry climate, animal disease is less significant in Namibia than in most other countries in sub-Saharan Africa.

In the NCAs, the Directorate of Veterinary Services has concentrated on the control of scheduled diseases, so classified because of the threat they pose to the commercial sector and its export markets. Scheduled diseases include foot and mouth disease, contagious bovine pleuro-pneumonia, anthrax, brucellosis and trypanosomiasis in cattle, sheep scab in sheep, African swine fever in pigs, and Newcastle disease in poultry and ostriches. Most attention in the north is focussed on the first two of these. In line with internationally-approved practice, there has until recently been compulsory annual vaccination of cattle and regular inspections. In addition, no livestock or meat is allowed to cross to the south of a Veterinary Cordon Fence unless it has been through quarantine procedures. The Veterinary Service also provides limited clinical and outreach services, and information and advisory-type extension services.

The National Agricultural Policy calls for increased attention to be given to the communal areas. The reform of the foot and mouth disease surveillance system which now takes place by roving inspections, the development of Veterinary Service infrastructure including new offices and accommodation, and the training of community members to work as veterinary auxiliaries, will greatly improve the services capacity to respond to farmer demands regarding treatment of non-scheduled diseases. Much will depend, however, on the provision of additional personnel and other resources to the DVS; and

Agriculture & Land Resources SoER Consortium
indications are that the Government's overall policy of down-sizing may make a casualty out of the Service's good intentions. This would be at odds not only with efforts to develop sustainable agriculture, but also with one of the Government's objectives which is to make the NCAs a disease-free zone, so as to enable the translocation of the Veterinary Cordon Fence northwards to the Angolan border. This is intended to allow, in turn, the NCA's livestock produce to enter the private tenure farm market and the export market without costly restrictions and procedures.

The Department of Water Affairs

The Department of Water Affairs (DWA) is the principal institution charged with management of water resources within Namibia. The DWA administers the Water Act, promulgates regulations and policy, is responsible for water allocation, monitors and controls water pollution, and implements water resource management programmes. The details of the functioning of the DWA can be found in the SoER on Water in Namibia (WET, 1999). The DWA has developed and supported community and village level "Water Committees", which are charged with management of local water supply issues. The devolution of water management to the lowest possible levels are a stated aim within this programme.

NamWater is a commercialised parastatal institution responsible for bulk water supply to municipalities and the Directorate of Rural Water Supply within the DWA.

The Ministry of Environment and Tourism has a number of important functions relating to water resources. The MET is responsible for administering the environmental assessment process on all projects, programmes and plans being implemented around the country. This includes all water development projects. The Namibian government is signatory to a number of important environmental conventions that relate to water and the MET is responsible for these conventions. These include:

- The UN Convention on Biological Diversity which is directed towards the sustainable use and conservation of genetic resources, species, habitats and ecosystems including water and wetland resources.

- The Convention on Wetlands of International Importance (also known as the Ramsar Convention). This convention provides the framework for international cooperation for the conservation and "wise use" of wetlands.

- The UN Convention to Combat Desertification. Through ratification Namibia pledged to combat desertification and mitigate the effects of drought through rehabilitation, conservation and sustainable management of land and water resources. The third phase of this programme is being managed by the Desert Research Foundation of Namibia.

- The UN Framework Convention on Climate Change. Through ratification Namibia pledged to help stabilise greenhouse gas emissions to help stabilise climate change. Impact modelling is a part of this convention and includes impacts on water resources.

Under the MET a full time wetlands biologist is employed and is responsible for overseeing those aspects of wetlands and water resources related to the above conventions and a wetland policy.

A Wetlands Working Group was established under the BioDiversity Task Force administered through the MET. This group developed a broad classification of wetlands for the country but is not particularly active.

4.2.1.2 The Ministry of Environment and Tourism

The Ministry of Environment and Tourism's (MET) Mission Statement is "to maintain and rehabilitate essential ecological processes and life support systems, to conserve biological diversity and to ensure that the utilisation of natural renewable resources is sustainable for the benefit of all Namibians, both present and future, as well as for the international community".
The Ministry of Environment and Tourism comprises three environmental management sections, namely the Directorate of Resource Management (DRM), the principal operating agency responsible for parks and wildlife management, and the Directorate of Environmental Affairs (DEA) and the Division of Specialist Support Services (SSS), which both incorporate research and policy development functions. The Ministry also includes one tourism Directorate (discussed below) and one forestry Directorate. The DEA concentrates its attention on community-based wildlife management and tourism, environmental assessment, desertification and biodiversity and the economic valuation of natural resources, while the SSS deals mainly with biological research.

Ten years after independence, the MET still exhibits signs of uncertain strategic direction and weak structural coherence. It is felt by many that of late a corner has been turned and that the Ministry is now embracing a common vision in which community-based approaches to wildlife and other natural resources management feature prominently.

This different sections of this Ministry will be discussed in other State of the Environment Reports in the series, notably that covering issues of biodiversity, parks and tourism. Of most direct relevance to this SOER is the Directorate of Forestry which is discussed below.

**Directorate Forestry**

The Directorate of Forestry was created after independence in the Ministry of Agriculture, Water and Rural Development. In 1984 it moved to the Ministry of Environment and Tourism. As guided by the Namibia Forestry Strategic Plan of 1999, the main activities of the Directorate of Forestry are:

- protection of trees and forests against illegal and unsustainable exploitation through supervision and control by law enforcement on both private and communal areas;
- supporting community-based reforestation programmes;
- forestry extension and awareness campaigns;
- forestry research;
- human resources and institutional capacity building.

The main activity of Regional forestry staff is the administration of forestry legislation. It does this through the issuing of permits, collecting revenues for wood exploitation, raising awareness about the importance of trees and forests, and encouraging and assisting people to plant trees. In addition, the Directorate of Forestry has been involved with attempts to develop small plantations (e.g. at Hamoye in the Kavango Region) and in preparations to gazette forestry reserves. However, little forest reserve has been gazetted. This is partly because of the need to wait for the new Forest Act to come into force, which may be expected to be in the year 2000.

**Division: Forest Management**

The Forest Management Division is responsible for management, conservation and development of the country's forest resources for sustained provision of forest products. Some of its main activities are: protection of trees and forests against illegal and unsustainable exploitation by enforcing the permit system, protection against uncontrolled fire, production of tree seedlings, setting up woodlots, facilitating the gazetting of community forests, creating forest awareness, and supporting sustainable bush utilisation on private farms.

**Division: Forest Research**

The Forest Research Division aims to support sustainable forest development through two sub-divisions: Field Research and National Remote Sensing Centre. It operates a number of research centres, notably the National Forestry Research Centre and National Tree Seed Centre at Okahandja, the Hamoye Research Station in Kavango Region, and the National Remote Sensing Centre and related projects.
4.2.1.3 The Ministry of Fisheries and Marine Resources

Having recognised the importance of the fisheries sector, the GRN upgraded the Department of Sea Fisheries (of the former Ministry of Agriculture, Fisheries, Water and Rural Development) to a full Ministry (MFMR) in 1991. The initial major task of the Ministry was to draft the fisheries sectoral policy, published in 1991 as a White Paper under the title, Towards Responsible Development of the Fisheries Sector. The translation of the policy into a legal framework followed in 1992.

The Ministry's responsibilities include the following:

- conservation of living marine resources within the EEZ and encouragement of their efficient exploitation;
- protection of Namibia's sovereign rights over the 200 nautical miles EEZ;
- promotion of in-land fisheries conservation and sustainable utilisation;
- establishment of a legal and administrative framework necessary for regulating fisheries activities;
- continuous assessment of the environmental, economic and social impact on resource exploitation; and the
- establishment of the institutional framework for the training of the human resources needed by both the fishing industry and the administration.

The Directorate of Resource Management

The Directorate undertakes research on marine and fresh water fish to provide advice on the optimal utilisation of fish resources. It includes the Fisheries Research station at near Mariental in the Hardap Region.

The Directorate of Operations

The Directorate is in charge of the practical management, registration and control of the exploitation of both marine fish species and freshwater fish. It is responsible for the application and enforcement of all fisheries legislation, and the specific management measures and conditions applicable to fishing rights. In addition to providing administrative services to the MFMR, the Directorate manages the administrative process of aquatic resource utilisation (i.e. the application of rights of exploitation and fishing quotas, issuance of licences, collection of quota fees, etc.). The Directorate is also responsible for inspection services and compliance control.

4.2.1.4 The Ministry of Lands, Resettlement and Rehabilitation

The Ministry of Lands, Resettlement and Rehabilitation (MLRR) was created after independence to deal with issues related to land reform and the acquisition of land; the resettlement of ex-servicemen, displaced people, returnees and the landless; and to assist the integration of disabled people into the mainstream of economic activity. The Ministry consists of two technical Directorates. The Directorate of Lands advises on the planning and administration of land on an inter-sectoral basis. The planning and administration of resettlement and rehabilitation are handled by the Directorate of Resettlement and Rehabilitation. The two Directorates are in turn divided into five Divisions, of Land Reform, Survey and Mapping, Deeds (all within the Directorate of Lands), Resettlement and Rehabilitation.

The Commercial Land Reform Act provided for the creation of the Land Reform Advisory Commission consisting of 16 members from the public and private sectors. The Commission advises MLRR on all issues pertaining to the Act.
State of the Environment Report on Agriculture and Land Resources

The Directorate of Lands

The Directorate of Lands advises on the planning of land as well as its administration on a broad inter-sectoral level. This includes advice to the Directorate of Resettlement and Rehabilitation which deals specifically with the planning and implementation of resettlement schemes, which at the moment are mainly directed towards agricultural land uses.

The Division of Survey and Mapping provides a wide range of services which ultimately are all related to support proper planning and administration of land. Although the Division provides basic information for the planning exercises of the Directorate of Lands, this is only a minor part of their duties and responsibilities which include the provision of services to many other governmental and private institutions as well as the general public. The services provided by this Division are to a substantial degree directed to support the planning and administration of land in urban areas, which are not included in the land-use planning exercises.

At national level, a division of Land Use Planning and Allocation headed by a deputy director was established in 1998. The role of this new division is to establish a legal framework to guide land use planning activities in Namibia and to provide decision makers with necessary spatial information on which to base land resource management procedures. Additional functions of the division are:
- To provide baseline information on natural resources and socio-economic environment of the regions
- Map and update the spatial distribution of different land uses
- Give suggestion on improvement of present land use systems
- Indicate the land form with high productivity rating
- Offer alternative land use options for different areas

- Plan the use of land in a sustainable way with respect to future needs in terms of resources usage and food security etc.

However, there is still no suggestion from GRN as to how the vital component of inter-sectoral and inter-ministerial coordination can be introduced.

Progress has been achieved in terms of documentation that documents on Principle of Land Use Planning and one on Land Use Planning Guidelines are available in the MLRR for used by land use planners. The legality of these guidelines and enforcement thereof is however uncertain as these are not approved by cabinet yet.

On the other hand, a pilot regional land use plan has been completed for Kunene Region, which is to serve as a model for the development of other land use plans. This model is yet to be approved by cabinet for implementation. There is still not yet a land use policy and no agreed zoning categories for the land use planning process to be pursued in full vigor. The land use zoning categories are to be agreed upon by all stakeholders to minimise land use conflicts. The lack of skills is another constraint in the MLRR and in the Regional Council offices. There are only 3 qualified land use planners at the central level and 11 assistant land use planners deployed in the 10 regions to work with the Regional Land Board once they are established. At the moment these assistant land use planners collect biophysical and socio-economic data necessary for land use planning with guidance from the Land Use Planning division in Windhoek.

4.2.1.5 Inter-Ministerial Structures

Issues relating to the sustainable utilisation of natural resources can only be properly addressed when incorporated into an integrated approach which addresses constraints to development in general. However, it is generally agreed that one of the most critical shortcomings of government services in general is the lack of cross-sectoral planning.

Not only are communications sometimes poor, whether inadvertently or not, between Ministries, but also often between Departments, Divisions and Directorates within a particular Ministry. Thus gaps, duplication and overlaps occur. In addition, there is insufficient communication between the government and the private sector. Opportunities for utilising the experience and expertise from the latter are frequently lost.
The need for adequate cross-sectoral communication is obvious. What is not so obvious are the gaps and conflict of interest that occur and exist. For example, with MFMR/MET there is the issue of the seal population with MAWRD/MRLGH there is conflict regarding community development. Should freshwater aquaculture fall under MFMR or MAWRD? Where does Forestry and indeed agroforestry belong - with MET or MAWRD? If it is accepted that agriculture has the largest single impact on the environment, where does the ultimate responsibility for soil conservation lie - with MET or MAWRD? Some observers say that there are already dangerous trends regarding soil tillage practices being used by MAWRD in the Northern areas; who monitors these?

The Land Use and Environmental Board

Apart from the Odendaal demarcations of land in the communal and commercial areas, Land use planning is a very new concept in Namibia unlike Botswana with more than 25 years history of its use. Land use planning as a tool for land management has only been introduced since independence with the establishment of the Ministry of Lands, Resettlement and Rehabilitation (MLRR). About five years after independence the situation in Namibia with regards to land use planning was still somewhat confused as there was no legal structure or guidelines for the various ministries and agencies to adhere to. Many ministries and institutions had their own 'Land Use Planning Unit'. In the absence of the land use guidelines, each agency followed its own course often pursued by donors with respect to land use planning. For example the Ministry of Environment and Tourism formulated its own Land Use Planning policy in 1994 entitled 'Land Use Planning Towards Sustainable Development'.

This resulted in conflicts of interests and at times in controversies over the implementation of various plans by different ministries and agencies (Tipuaya 1999, Director of Land Reform pers. comm.).

To try and resolve the uncoordinated land use planning in the country and to increase communication between ministries dealing with land use planning issues, the MLRR through the Danish funded Lands Project established an Inter Ministerial Standing Committee for Land Use Planning (IMSCLUP) in 1993. The function of this committee was to promote the exchange of information and create awareness among its members towards the development of multi-sectoral land use planning policy.

At the beginning the objective of this committee attracted senior officials from the line ministries such as MLRR, MRLGH, MAWRD, NPC, MET, MWTC and MFMR who held meetings to discuss the way forward. However, the committee, despite its noble intentions, could not function as intended because it lacked any statutory power and this resulted in apathy and consequently its demise.

Another initiative from the Ministry of Lands to coordinate land use planning was the establishment of the Land Use and Environmental Board (LUEB) this board was to facilitate communication and collaboration between sectors and disciplines. In the same way this board's activities started well but could not be sustained. The reasons for the failure are not clear, it could be that integrated planning system in the country was not well understood at the time and sectoral planning and achievement was seen as a priority.

National Rural Development Coordination Council

To achieve the goals set in NDP1, the government stated its intention in 1996 to establish a National Rural Development Coordination Council (NRDCC). The NRDCC was planned to be composed of Permanent Secretaries of line Ministries involved in rural development, and representatives of identified NGOs and the private sector. The Council was to be supported by sub-committees responsible for natural resources and land use planning; rural/regional extension services; food and nutrition; rural research and information; drought and rural disaster management and rural poverty alleviation. The Council has yet to be established.
Namibia's Programme to Combat Desertification

The overall goal of Namibia's Programme to Combat Desertification (NAPCOD) is "to combat the process of desertification by promoting the sustainable and equitable use of natural resources suited to Namibia's variable environment for the benefit of all Namibians both present and future". The programme is one of many cross-sectoral components of the strategy to operationalise Namibia's Green Plan and NAPCOD's objectives can be summarised as follows:

- key players are identified and their capacity is established/improved;
- mechanisms for information collection, analysis and communication are established, strengthened and functioning;
- integrated planning and strategies at all levels developed and introduced on the basis of clearly defined policies;
- appropriate inter-disciplinary research programmes elaborated and implemented;
- appropriate training and education provided according to needs at all levels;
- natural resource users and managers empowered to plan and implement sustainable management practices in an integrated and decentralised manner;
- frame conditions, incentives and decision making affecting sustainable resource management identified, monitored and influenced; and
- organisational management structure established and functional. (R. Dewdney; 1996)

4.2.1.6 Local Government Structures

There is currently little effective co-ordination of agricultural and land resources development efforts at either the national or regional or village levels. Although a number of institutions have been set up at the national level to co-ordinate different sectoral and cross-sectoral interest, they remain weak, partly because they are themselves not co-ordinated. At the regional level, government structures are even weaker as they are effectively starved by central government of human and financial resources. The inevitable result is duplication and competition between different development agencies, and ultimately a significant waste of resources. At the village level there has been a proliferation of groups set up by different agencies (including Water Point Committees, Farmer Extension and Development Groups, Literacy Groups etc.). This means duplicating effort aimed at group mobilisation, and causes confusion amongst community members. The obvious answer is to work through existing group structures (e.g. traditional leadership or churches) or multi-purpose groups which co-ordinate the activities of several agencies. While the former may often have atrophied through years of limited activity, they are probably the best vehicles available for driving rural development.

Recent proposals to establish a three-tier system of Regional, Constituency and Village Development Committees, comprising line Ministries, NGOs and CBOs, and answerable to both line Ministries and elected Regional Councils, are being discussed. However, the hesitancy of central Government to promote such structures is clear, and their establishment may consequently be expected to take time. It is important to note that this caution would appear to be a conscious political decision taken by the Government. It derives at least in part from historical tensions between the traditional and political leadership. Furthermore, it is consistent with the Government's generally careful approach to development activities. While this report would not presume to challenge the legitimacy of this position, its costs, it must be pointed out, are great. Specifically, it is contended that the Government's decision to go slow on decentralisation, is acting as a severe constraint to the development of sustainable
agriculture by inhibiting the growth of a whole range of local institutions, comprising and accountable to, farmers, deemed essential for effective communal area agricultural development.

Moves to return decision making power to the local level are beginning. New local government structures are taking form, and difficult issues such as the role of the traditional authorities and the institution of local land management boards are now being vigorously debated. Even the down-sizing of the civil service, which will return experienced former government management personnel to the non-government sector, may be expected to benefit the development of civil society generally.

Two institutions which may be expected to make an important impact on sustainable agriculture are community based organisations in the field of natural resource management and farmer organisations.

4.2.2 Paatastals and Statutory Bodies

4.2.2.1 Agribank: The National Agricultural Credit Programme

Communal-tenure farmers, who by definition lack land title, were up till recently effectively excluded from access to credit which was dependent on conventional collateral mechanisms. The Government's National Agricultural Credit Programme (NACP) implemented by the Agribank in support of smallholder communal-tenure farmers was launched in 1995. It is intended that loan accountability will be a responsibility shared by borrowers in joint liability groups. Individual loans are also provided.

The NACP was launched in mid-1995, but did not become effectively operational in the NCAs until June 1996. During its first year of operation branch offices were partially staffed and opened. Planning documentation related to the implementation of the NACP is conspicuously absent. This has resulted in a number of operational teething troubles for the Programme, such as shortages of input supplies for borrowers to purchase, and a general sense that the Programme was "making it up as it goes along".

The NACP has now been in operation for three agricultural seasons, and has a portfolio value as of 31 March 1999 of N$ 49,487,188. Outstanding arrears of principle and interest amounted to N$ 8,334,153 (individual loan arrears: N$ 1,495,357, and group loan arrears: N$ 6,834,795).

A recent evaluation exercise (RoN. 1999) found that groups were not properly formed, there was little or no bank staff training, and that basic control mechanisms failed. In its first season of operation well over double the forecast amount was loaned. As of the end of February more than N$ 17 million was committed to more than 3,000 groups and individuals in all communal areas.

At the time of reporting, most of the NACP staff time is spent on loan recovery, and the scheme has effectively ground to a halt. Equally, although the National Agricultural Policy states that □ A demand-led, supervised credit system will be anchored on the viability of agricultural investment projects, in practice the applicants' ability to repay is judged on the basis of assets (though there is no mechanism for checking the veracity of declarations). It would appear that large sums were loaned at highly subsidised interest rates to relatively wealthy individuals. Certainly, the Programme makes no pretensions that it aims to be accessible to the mass of poor farmers, who are instead supposed to be assisted by "a separate comprehensive support package" (RoN. 1999).

4.2.2.2 Meat Board of Namibia: Livestock, Meat and Meat Product Marketing, Processing and Trade

The Meat Board, established through the Meat Industry Act (Act No. 12 of 1981) aims to facilitate the marketing, processing and trade of livestock, meat and meat products both nationally and internationally. In future it is intended to establish a new structure, tentatively named the Livestock and Meat Improvement Council.
4.2.2.3 The Namibian Agronomic Board: Crop and Crop Product Marketing, Processing and Trade

The Namibian Agronomic Board is a statutory body instituted by the Government of the Republic of Namibia in terms of the Agronomic Industry Act (Act 20 of 1992). The Board consists of representatives of commercial and communal crop farmers, crop marketing agents, crop processors, crop product traders, consumers, and the government. It currently employs a Secretariat of six persons. Funding comes from producer levies, and purchasing and import levies, as well as from the rendering of contracted services including project implementation for various clients.

From its original inception in 1985 until 1997, the Namibian Agronomic Board aimed to facilitate the production, processing and marketing of controlled agronomic products, namely maize, wheat and sunflower. This was done by implementing a one-channel, fixed-price marketing scheme, and by controlling the import and export of controlled crops and the products derived from them. The Board ensured imports from stable sources, and that local producer prices were fixed at the same level but no higher than import prices. This offered a measure of protection of the interests of the consumer.

The last few years has seen increase liberalisation in international trade relations. This means that Namibian farmers and processors cannot be protected as in the past. A new mission statement, adopted in 1997, sees the Board aiming to develop an economically and environmentally sustainable, and internationally competitive agronomic industry in Namibia through providing a range of advisory, regulatory and facilitatory services.

- The Board advises the government on agronomic matters in relation to its evolving agricultural and trade policies, and represents the industry directly, or through the government, in international trade fora.
- The Board gathers statistics on imports and exports of agronomic products by means of issuing permits.
- The Board encourages local millers to purchase all domestic maize and wheat production before resorting to imports. It determines guideline prices for local millers to purchase local grain based on the cost of imports. It also acts as buyer of last resort, and stores grain until processors are ready to purchase.
- The Board implements the Mahangu Marketing Intelligence Unit project for the government. The project aims to facilitate contacts between potential mahangu suppliers and buyers through providing information on production and prices. It has also developed a mahangu grading system.
- The Board manages and supervises a number of consultancies for the government.

4.2.2.4 Namibia Development Corporation

The Namibia Development Corporation (NDC) has recently undergone significant restructuring and downsizing. Two of its three new Divisions provide services in support of development of agricultural and land resources. The Operations Division provides financial assistance, business advisory services, feasibility studies, project brokering, support to industrial parks and SMEs, while the Special Projects Division manages agricultural development projects on behalf of government, runs a farmer support scheme providing services to emerging commercial farmers, and offers business support services and financial assistance to agricultural businesses.

4.2.2.5 Development Fund of Namibia (DFN)

The mission of the DFN is "to financially and technically assist historically disadvantaged entrepreneurs who intend to establish manufacturing and processing enterprises in less developed and neglected areas in Namibia". As such they are interested in supporting enterprise development schemes in rural areas but avoid any endeavour in agricultural production, whilst supporting agro-processing.
4.2.3 Non-government Organisations

Important *national* NGOs in the agriculture and land sectors include the

Agrifutura
Desert Research Foundation of Namibia (DRFN)
Integrated Rural Development and Nature Conservation (IRDNC)
Namibia National Farmers Union (NNFU)
Namibia Agriculture Union (NAU)
Namibia Nature Foundation (NNF)
Namibia Economic Policy Research Unit (NEPRU)
Namibian Development Trust (NDT)
Nyae Nyae Development Foundation;
Rössing Foundation.
Rural People's Institute for Social Empowerment in Namibia (RISE-Namibia)
The Legal Assistance Centre (LAC)
Women's Action for Development (WAD)

The most active *international* NGOs include:

ACORD (Action for Cooperation and Development); and
African Development Foundation (ADF)
Aficare
Care-Austria
Deutscher Entwicklungs Dienst (DED);
Development Assistance from People to People (DAPP);
Oxfam Canada
World Wide Fund for Nature (IUCN);
UNDP
UNFAO
UNICEF

The most important *umbrella* organisations, committees and NGO networks include the:

Community Based Natural Resource Management Programme (CBNRM); and the
Namibia NGO Forum (NANGOF);
Namibian Environmental Education Network (NEEN).
Namibian NGOs (NANGOS);
4.3 Agricultural and Land Resource Management Technologies and Practices

Sustainable utilisation of agricultural and land resources in Namibia requires that resources users must adopt technologies and management practices adapted to its often marginal conditions and arid climate. They must make the best use of the limited natural and other resources available to them in such a way as to ensure that these resources continue to be available to them. Given the unpredictability of the rainfall (and other factors such as pestilence and floods), this requires technologies and practices which minimise the risk to the farmer of their losing resources, be they natural resources such as grazing or soil fertility, or economic resources such as labour and other inputs, in the event of a poor season. At the same time, new technologies should fulfill other socio-economic objectives including increasing productivity and income generation, and in the subsistence sector, decreasing labour requirements, particularly of women.

At the same time traditional strategies and "best practices" for sustainable resource utilisation should be encouraged, and used as the basis for improving the sustainability and productivity of farming and other land use systems. Important areas of innovation currently being promoted in Namibia include the following.

4.3.1 Community-based Natural Resources Management (CBNRM)

CBNRM and privatisation of entitlements (e.g. by fencing) have emerged as two, often opposing, approaches to sustainable resource use. Support for privatisation has often taken insufficient account of the spatial and temporal variability of some resources and social differentiation within rural communities. In Namibia there is considerable de facto expropriation of agricultural and land resources, much of which is likely to be unsustainable, and some of which excludes the poorest households who are most dependent on natural resources.

On the other hand, much of the enthusiasm for CBNRM stems from:

1. Wildlife/tourism projects in areas with high wildlife potential which may be expected to give rapid incremental benefits to communities, and, if managed democratically, few losers from a resource which was previously a "problem".

2. Projects in relatively isolated areas with relatively homogenous communities which traditionally had a high degree of reliance on common pool resources.

3. Projects with a high degree of compatibility between maintaining biodiversity and sustainable use of natural resources.

However, the majority of rural people in Namibia do not live in such optimal conditions for CBNRM:
- Communities are often heterogeneous
- Conflicts between different stakeholders already exist or may be precipitated by CBNRM activities
- Community management does not necessarily imply egalitarian access
- Access to traditional common pool resources is increasingly being privatised by both de facto and de jure means
- Communities and/or legal authorities are unable to enforce rules
- Sustainable management of resources used by the community does not necessarily protect biodiversity.

Despite these concerns, Namibia is embarking with enthusiasm on the CBNRM approach. The addition of rights to forests and grazing as provided by the forthcoming Forest Act to those provided by the Conservancy Act suggest room for cautious optimism. Clearly, much effort will have to go into experimentation and learning over the next few years. Ultimately, a range of models may be expected to emerge, including modified forms of CBNRM, perhaps combined with forms of privatised access.
4.3.2 Community forestry

Studies of livelihoods in north-eastern Namibia in particular (Flower, 1999; Kakukuru, 1997 etc) show that forests and trees are of vital importance to rural livelihoods. Hence, the integration of forests and trees into agricultural systems should be a major aim of land use planning and land resource management efforts.

While the promotion of community forestry initiatives is a complex undertaking, it is also a pressing one particularly where large-scale crop farming is expanding. The maintenance of the benefits of community forests should be seen as a key part of any anti-rural poverty strategy. Although government policy seeks to promote the involvement of communities in managing their forest resources, there are as yet no successful examples of this happening, and many strategic and methodological questions remain to be explored. One problem is that forests are often of most benefit to female household members and poorer households who tend to be the most marginalised from community decision-making.

On the contrary, the trend is still in the other direction. There is confusion about community rights and responsibilities over forest management. Traditional authorities appear to feel and to be increasingly powerless, for instance over the control of fires, while the relevant government services are under-resourced. At the same time, while the older generation value forests and tree resources, attitudes towards forests amongst the younger generation are increasingly negative.

A number of projects under the auspices of the Directorate of Forestry in northern Namibia are now putting major emphasis on developing experience of community forestry. The reader is referred to the section headed Draft Forest Bill in chapter 4.1.2. for further details.

4.3.3 Range management

In order to be a in a position to reach the objectives of sustainable rangeland management, to reduce man-induced land degradation practices and to improve the welfare of the rural population, it is necessary to identify and implement a strategy that will take into consideration many more elements than merely agricultural ones. The elements of such a strategy may include:

- sustainable improvement of livestock production,
- resettlement of large communal farmers to title deed areas.
- improved marketing.
- alternative income generating activities.
- frame conditions
- alternatives for capital accumulation.
- local investment packages.
- institution building.

4.3.3.1 Sustainable improvement of livestock production

Grass production and thus forage availability can vary from zero to several tonnes per hectare between two subsequent years in arid and semi-arid areas. Another phenomenon is that certain patches might have good production and are quite stable from year to year, but other patches in the same area are much more unstable and yield much lower production per hectare. The process by which animals and their feed demands are matched with available fodder sources is called tracking. Effective tracking may be achieved in four ways:
increasing locally available fodder by importing feed from elsewhere or by enhancing fodder production, especially drought feed, through investment in key resource sites.

• moving animals to areas where fodder is available.

• reducing animal feed intake during drought through shifts in watering regimes, reducing parasite loads or breeding for animals with low basal metabolic rates.

• destocking animals through sales during drought and restocking when fodder is available after the drought.

The challenge for researchers, extension officers and pastoralists is therefore not to transform pastoral systems into ranching systems, but to increase the efficiency of tracking under conditions of restricted flexibility especially in the communal areas of Namibia. It is common knowledge that pastoralists used to be more flexible in animal movement in order to find enough fodder for their herds. Conditions like National borders, Wildlife conservation areas, commercial farms and even the new phenomenon of so-called “defensive fencing” in the communal areas, make it more and more difficult for pastoralists to be flexible in their efforts to match animal feed demands with available fodder production. Hence the solution for Namibia (commercial/communal) will be a combination of elements from both the ranching model and a more flexible open system of rangeland management.

Against the background of the fact that farmers find it more and more difficult to move around with their animals in search of fodder, the emphasis should however be to improve the rangeland management and livestock production in the very area the community is residing most of the time. For emergency reasons during periods of excessive food scarcity, moving of animals to other areas, should be considered as a possible option by the farmers (Kruger, 1995).

4.3.3.2 Rotational resting under normal and good rainfall years

Strategies will have to be worked out whereby maximum benefit can be achieved as far as range rehabilitation is concerned during years of average or above average rainfall. When those years occur, it will be most beneficial for the range to recover in terms of seed production and restoring the carbohydrate reserves of individual plants to tolerate heavy utilisation and drought periods. The only way this can be achieved will be to introduce rotational resting practices. With proper infrastructure like camps and adequate water distribution on a title deed farm owned by one person, it has proved to be very efficient to allocate certain camps to certain livestock herds and to rotate between the different camps.

The challenge is however, to allocate certain areas within an unfenced communally utilised grazing area for utilisation by certain livestock herds during certain times of the year. Issues making it very difficult or preventing it from happening at this stage, are poor water distribution, free roaming of livestock in all directions from a central waterpoint, lack of participation and willingness amongst farmers to co-operate in grouping livestock herds together and identifying certain areas to be rested in order to allow for recovery during the rainy season. However, one of the most serious reasons preventing farmers from taking active responsibility of the natural resources is the lack of ownership or at least some kind of exclusive user rights of a community over a piece of grazing. This prevents farmers from deciding how best to utilise “their” area and whether they would like to allow others coming into the area or not. It is the responsibility of the community to identify and demarcate (not necessarily fence) their traditional grazing areas during normal years as well as during periods of feed scarcities. Within these demarcated areas, an inventory of available infrastructure like fences, waterpoints, roads, etc. need to be done as a next step. Information regarding the vegetation such as rangeland condition, different veld types and current grazing capacity need to be collected.

On the basis of this information and in collaboration with the local farmers, a zoning of the area should be made in order to divide the area into possible grazing zones that do not need to be fenced off, but only identified and made known to all the farmers in that area. For this purpose either “live fences” or existing boundaries like dry river beds, mountain ranges, roads, etc. could be used. On the basis of mutual consent and backstopping from professionals, some areas need to be rested while animals are grouped together and allocated to graze only in other areas at certain times of the year. Grouping together does not necessarily mean that one herd is formed, but that several livestock owners agree to send their individual herds jointly to one grazing area.

4.3.3.3 Strategies of livestock movement

Taking into account the huge variation in rainfall in arid and semi-arid areas of southern Africa (Co-efficient of variation exceeding 33%)(Ellis, 1994), it should be kept in mind that the availability of fodder for animal consumption is closely correlated to it. This will result in temporary fodder deficiencies despite proper range
management systems being implemented. Examples of such fodder deficiencies related to low rainfall are currently evident in the eastern areas of Namibia and even some of the commercial farmers in that area are forced to find alternative fodder for their animals elsewhere. This led to several commercial farmers being forced to find fodder in the western regions of Namibia which received very good rains during 1995. It is also known that several hundred livestock from the eastern communal areas (Okakarara) had to move to areas in the Erongo region in search for fodder.

This occasional movement of animals in search for patches or areas where better grazing is available, should not be seen as an abnormal activity related to poor range management, but should be seen as a normal phenomenon and an integral part of livestock farming in highly dynamic environments. The movement of animals in response to spatial and temporal variation in resource availability is perhaps the most classic of all tracking strategies (Swallow, 1994).

The challenge is to find ways and means how such movement of animals can be organised and institutionalised in order to allow the communal farmer to benefit most out of it. One way might be to support local community based organisations (CBO’s) like the community management community in the SARDEP programme, to develop and operate an information network regarding the availability of fodder in a larger area e.g. a constituency or even in another region. Through this network the CBO can collect information on rainfall patterns, availability of fodder, where it is and at what price, for how many livestock and for how long it will be available. This information can then be made available on a regular basis at a central point in order to inform other communities about it. Pre-requisites needed in order for this network to be operational, will include the willingness and capacity of local CBO’s to perform this duty against a commission; proper professional backstopping from the side of research and extension to prevent over exploitation of certain areas as well as the right of local communities to use income derived from renting out their areas for own development purposes. Proper supportive services like veterinary permits, trekking routes and, if distances are very far, even support in transportation of animals should be considered very important.

4.3.3.4 The use of well adapted indigenous livestock together with improved animal husbandry practises

By farming with well adapted indigenous zebu type livestock, mortality rates can be considerably reduced during droughts and recovery rates can even be increased dramatically after droughts. Indigenous zebu cattle have energy sparing mechanisms that act as an adaptation to undernutrition and water deprivation (Finch & King, 1979; King, 1993; Nicholson, 1987). Trials showed that increasing the walking distance and decreasing the watering frequency, as might happen in a period of drought, did not result in any significant loss of weight in African zebu (Finch & King, 1979).

Results of work done with Borana cattle in Ethiopia showed that reduction in milk supply to the calf (through droughts or human consumption) did not affect the longer term target weight of calves, despite reducing calf growth rates in the short term (Coppock, 1992). Recovery following the drought is equally rapid. When food is available again there is a rapid response in metabolic rate levels and, with increase in nutrition levels, conception rates greatly increased amongst mature female zebus.

It is thus very clear that indigenous animals are physiologically adapted to mobility and flexible responses to uncertain fodder and water availability. Due to reductions in fasting metabolism, more animals can be sustained on a given amount of available fodder during periods of drought than would be possible if there was no physiological tracking of the environment. Forage needs during droughts can be reduced with as much as 30% through shifts in metabolic rates (Scoones, 1994).

Healthy animals are best able to track environmental fluctuations. Animals with high parasite loads are less resilient to stress. Veterinary interventions and support in general and specifically during drought periods are seen to be of utmost importance in order to increase the tracking ability of herds. These support efforts and interventions should be complemented by indigenous knowledge of veterinary care.

The introduction of animal husbandry practises like early weaning of sucklings and mating seasons that will allow young to be born during times of sufficient grazing, should be highly prioritised by livestock managers, farmers and researchers. It is well known that the springtime (August to November) is the time of the year in Namibia when the lowest fodder availability occurs. It is very common to find female animals with big calves/lambs still suckling during this period which places extra stress on these animals usually already in poor condition.

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4.3.3.5 Feed supplementation

A common problem with research in fodder crops is that researchers have tried to provide equilibrium solutions to highly variable non-equilibrium environments. Reseeding with legumes or planting of fodder trees appeared to provide some promise of boosting productivity in more humid agro-ecosystems, but such technologies have rarely proved viable in drier situations, especially when repeated droughts or intense grazing have wiped out vulnerable grass and legume species or killed trees (Bayer & Waters-Bayer, 1994).

The identification of strategic “key resources” that sustain animals in times of fodder shortage, should be done on the basis of studying how livestock herds use fodder landscapes during periods of droughts. These areas usually have a more stable production of fodder due to specific characteristics like better soils, more soil nutrients and higher moisture contents. These “key resources” should be the focus for fodder improvement. The introduction of fodder species that are well adapted to that environment and severe grazing, reseeding by using seeds of species already existing in those areas and by introducing proper fodder management practices to enhance livestock production in normal years and survival feeding in bad years (Barton, 1993) are recommended. Strategic movement of animals to such sites should be considered.

Simple practices like cutting grass in road reserves and specifically cleared areas during years of normal rainfall, should also be considered. Other possibilities are the reeds in the Fish River Canyon and even garden residues. This fodder can easily be stored for several years and can be used during periods of food scarcity. This fodder is usually very handy to feed sick animals, breeding stock outside the mating season and even fattening of livestock before marketing, or any other purpose.

Depending on the livestock species, browse may also act as an important key resource. The availability of coppiced trees and shrubs in dryland areas is often critical to the nutrition of livestock in times of drought. Tree pods in particular may be an important protein supplement that increase appetite and ensure maintenance of animals during periods of stress (Coppock & Reed, 1992; Oba, 1993). It is important not to see all trees and shrubs, especially in the savanna areas, as part of the “bush encroachment” problem, but rather to try and adapt the livestock breeds to the available browse fodder sources. Scientists in Namibia however, are also aware of the limitations in this regard.

The enhancement of agro-pastoral linkages and the promotion of integrated mixed farming systems are seen as other ways of reducing fodder variability in dynamic environments. Despite the fact that the majority of pastoral areas, especially in the central, eastern, western and southern areas of Namibia, are not very suited for any kind of crop production, doubts also exist whether such mixed farming systems will significantly contribute towards reducing risks in fodder availability and eventually animal output. Where mixed farming systems are possible, especially in the northern and north eastern parts of the country, considerable contributions towards reducing the risks of fodder production can be made. It is however doubtful whether the tendency to settle farming systems as a result of population pressure and the promotion of mixed farming practices as opposed to a more transhumant way of livestock farming will be desirable on the long run. The solution should rather be sought in a system where crop residues are used by livestock and that the majority of the livestock are still being moved to the cattlepost areas away from the larger settlements.

Farmers should also have access to concentrates (mineral/protein/energy licks) as a feed supplementation. Feed supplementation should not be seen as necessary only during periods of food shortages, but rather as a normal strategy to enhance animal production. Current incentives to support farmers with licks during drought periods while the actual problem is a deficiency in fodder, should be reconsidered.

4.3.3.6 Resettlement of large communal farmers to title deed areas

The number of people living in the communal areas will probably double in less than twenty years. Without major changes in the political system, the disparity in the distribution of land will further increase from a current 1 million people on 40 % of the land area to about 2 million people on the same area of land in twenty years (KEK, 1994). This is done under the assumption that the migration to the urban areas is subjected to the same rate of increase.

This means an extreme population growth in the communal areas. Therefore, besides the question of how the human carrying capacity of the communal areas in terms of population can be increased through better land use management, improved livestock production and alternative income generation, additional strategies in demographics and land distribution need to be examined. One such strategy can be to resettle large
communal farmers to title deed areas in order to reduce the pressure of livestock in the communal areas.

This can only be done with proper support from government in terms of incentives and access to “soft” loans. The current system being run by the Namibia Agricultural Bank is problematic because farmers find it very difficult to repay loans. Ways and means to make it easier for farmers to meet the loan conditions are currently being addressed.

The major objective of this element is to reduce the number of livestock in the communal areas. These communal farmers will have to move with all their livestock from the communal areas to the newly acquired farm and prevented from returning to the former rangelands in bad times. Mechanisms to control this will determine the success or failure of such an activity.

Another way of reducing the number of people and thus livestock in the communal areas, is the policy of government to acquire commercial land for the resettlement of neglected citizens. It is however doubtful whether, under current conditions and availability of funds, such an activity will make a significant impact in the short term.

4.3.3.7 Livestock marketing as a way of tracking

The success of livestock farming in the arid and semi-arid areas of the world, and especially in Namibia, is very dependent on the ability of the farmer to determine the current grazing capacity (fodder availability) at the end of the rainy season and to match the livestock feed demand to it. This should be done on an annual basis at the end of each rainy season because rainfall variability is high and thus fodder availability will also fluctuate widely on an annual basis. There is an urgent need for an easy but accurate method of estimating or calculating fodder availability by the farmers themselves.

Should the livestock fodder demand exceed the fodder availability at any time, opportunities for rapid destocking through efficient marketing channels should be accessible to farmers as one way to get rid of excess animals. Another way might be to move them to areas where sufficient fodder is still available. This strategy has already been discussed in more detail earlier on in this chapter.

The ability of pastoralists to restock after droughts should also be enhanced. This includes also alternative investment opportunities where money derived from animal sales during droughts can be invested in such a way that it is easily available to buy livestock after the drought. Mobile banking services to remote areas will contribute a great deal towards achieving this objective.

Problems encountered with livestock marketing in the communal pastoral areas of Namibia include lack of quarantine facilities, poor competition between buyers, lower prices due to higher risks of animal diseases and long distances from urban markets, insufficient marketing infrastructure such as auction pens and also lack of knowledge and understanding amongst livestock farmers regarding prices and free market economics. Namibia, being an exporter of red meat, is in an advantageous position as far as marketing infrastructure such as abattoirs and external markets are concerned. The private sector is also well organised in livestock marketing. The challenge, however, is to increase the access of marketing facilities and to secure improved prices to the average communal livestock farmer in Namibia.

4.3.3.8 Alternative income generating activities

The task of farmers in the communal areas of Namibia is currently to sustain a decent living in a growing population to ensure subsistence for their families (SARDEP, 1994). It is becoming more and more difficult to base it purely on income derived from animal production. According to communal farmers in the southern, eastern and northern communal areas, a household currently needs at least 150 small stock or 50 large stock in order to meet the basic demands of an average family. Large numbers of households in communal areas don’t have any livestock at all, and a large number of households have animal numbers well below these subsistence levels.

This further contributes towards the impoverishment of local communities. In order to survive and be able to achieve their task of sustaining their families in a decent way, the introduction of alternative income generating activities need to be considered. Other possibilities are the processing of animal by-products e.g. leather tanning, cheese making, soap making and also the utilisation of resources locally available like charcoal production, crushing stones for the building sector, collecting minerals, etc. Problems like the identification of

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economically viable enterprises and sufficient technical and financial support need to be addressed. One of the biggest problems in this regard is the small local market and low purchasing power of local people. An involvement of relevant private organisations and non governmental organisations is seen as a pre-requisite for success.

4.3.3.9 Frame conditions

In communal areas, sedentarisation (settling down of formerly nomadic farmers) is an on-going process that can not be reversed. Transhumance and semi-nomadism will decrease in future, urbanisation in the communal areas will continue and migration to urban workplaces will increase.

The expansion of the modern state in the communal areas, e.g. through the creation of formal structures in spheres of life, that formerly have been regulated by customary laws and rules or through substituting traditional leaders by councillors and governors, is contributing to this process of sedentarisation.

This expansion creates a decentralisation problem for government. The state has to expand or at least to redistribute its services without having additional resources available to cover the higher costs.

Decentralisation is more than the deconcentration of governmental services to a regional level. In order to be effective, decentralisation has to include devolution of power, i.e. transfer of ownership and decision making competence on the internal use of resources and profits, and finally a change in management style.

With regard to the use of rangeland in the communal areas, that is entirely state owned, the land tenure issue is a critical element, having a big impact but also carrying great risks. In some cases land tenure systems do function, even in the absence of exclusive user rights or land titles. Therefore it is important to check for each individual case, what elements of the existing land tenure system are working and where improvements or changes are indicated.

Subsidies to livestock production in communal areas and those remaining in commercial areas, should be phased out over a five year period, and in the meantime, be directed towards areas which are not degraded. The Drought Aid Scheme (fodder/transport/grazing) should be overhauled to promote long term coping strategies through increased expenditure on land reform and/or destocking and restocking strategies.

The Communal Land Bill should be promulgated as soon a possible to provide for exclusive, secure tenure which is comprehensive and allows for mobility on rangeland. Government should declare an immediate moratorium on new fencing in the communal areas. All "illegal" fences should be removed, while those erected with the approval of a traditional authority should only be approved by Land Boards if adequate common property land is available.

The Commercial Land Act should also be implemented as soon as possible so that commercial farmers are clear on what will happen to their farms.

4.3.3.10 Alternatives for capital accumulation

Incentives for the provision and development of alternative capital accumulation in the communal areas, will provide opportunities to livestock farmers to invest their money form livestock sales in alternative enterprises. This will support and underpin the whole strategy of rapid destocking during droughts and restocking after droughts. In the absence of alternatives for capital accumulation needed, amongst other things, for old age and social security, nobody can expect the farmer to reduce livestock numbers since livestock is, most of the time, the only method of investment available.

4.3.3.11 Local investment packages

This point is closely related to the previous one. Emphasis will have to be put on the identification, development and testing of appropriate strategies for local investment. The role of banking services in the communal areas, especially during auctions, should not be underestimated.
4.3.3.12 Institution building on communal land

There is an obvious gap between the traditional authorities on communal land, who are no longer able to assume full management responsibility, and the recently created administrative bodies, that are not yet able to take over as far as control of, and access to the management of the natural resources concerned. Existing community based organisations (e.g. farmers associations, development organisations, etc.) need to be strengthened and supported in order to take up the responsibility of managing the resources in a sustainable manner and to the benefit of the whole community. The current system of representation alone is not enough.

Empowerment of local institution can best be done through training in technical and organisational and management topics as well as exposure to other areas and organisations in order to broaden the foundation for the people.

4.3.4 Arable Land Management

4.3.4.1 New Staple Crop Cultivars

Namibia's primary food crops are pearl millet, maize, cowpeas and sorghum. Variety choice for maize and brewery sorghums is plentiful from regional commercials sources. For food sorghums, pearl millet and cowpeas there is, however, not much cultivar choice available to small farmers. Except for Okashana-1 and -2, farmers growing food sorghums, pearl millet and cowpeas have to rely on their local landrace varieties.

Farmers have used a great variety of local cultivars as part of their strategy of coping with uncertainty in rainfall and the varying potential of their soils. The major limitation of the farmers' local landrace varieties is that they are predominantly late maturing and this increases the risk of total crop failure in the event of a short rainy season. Over the last few seasons there has been a significant loss of the diversity of plant materials: millets, sorghums, groundnuts, cowpeas, bambara nuts and curcurbitaceae. There also appears to be an absolute shortage of seeds and access to stocks at the beginning of the season and later, if the first planting fails.

Researchers and seed producers have realised that farmers require seeds that are well adapted to drought, are early maturing, lodging resistant and that store well. Also, as modern varieties do not have all these characteristics, so it is important that local land races are preserved and multiplied where appropriate.

4.3.4.2 Crop diversification

In order to increase system diversity as a means of securing livelihoods and mitigating the impact of drought on farm productivity, the search for new crops is continuing.

The government has established a Cotton Task Team to promote cotton production. The aim is to increase hectarage under cotton to around 15,000 nationally, which will lead to production levels sufficient to justify the establishment of a gininery in the country. One of the major requirements for expanded production is the availability of credit for producers.

Another crop that is showing promise is Oriental tobacco. Economic yield levels of marketable leaf were harvested last season with less than 50 mm of rain following the transplanting of seedlings into wet soil. Supplementary irrigated Oriental tobacco at the Sesfontein, Khwarib, Warmquelle project have returned gross per hectare incomes five times higher than maize using one fifth of the water required for optimum growth. The high labour demand of this crop also gives it great potential in job creation.
Sunflower varieties suited to arid conditions are available and are being grown on a small scale in many areas of northern Namibia. Attempts to grow the crop commercially on a small scale have not proved successful. In Caprivi Region farmer organisations are attempting to grow and process sunflower oil in a combined and collective operation in the hope that it may prove to be profitable. Otherwise, sunflower offers hope for subsistence growers, as its oil has a preferred taste and is easier to extract than traditional cucurbits oil seed sources.

There is thought to be considerable scope for increasing production of legumes such as cowpeas, bambara nut, and groundnuts. These crops are important for maintaining soil fertility in addition to their being a source of green vegetables, grain, and animal fodder. It is hoped that new varieties will be released soon, and that traditional varieties, which have been lost to many communities during recent drought years, can be multiplied and distributed.

Finally, irrigated horticultural production is believed to offer some hope where farmers have access to surface water sources in the Kavango and Caprivi Regions. Small scale production is increasing. Constraints include lack of access to inputs, poorly developed marketing channels, and the relatively small range of crops that will thrive in Namibia’s climate on a year round basis.

4.3.4.3 The increased use of draught animal power for cultivation

The increased use of draught animal power for cultivation should benefit sustainability by enabling farmers to cultivate more timely than either by hired tractor, which they may have to wait long periods for, or by hand, which is slow. However, dispossession of draught animals and equipment due to poverty, and the poor condition of draught animals are the end of the dry season, when they are needed for ploughing, are major constraints. Efforts are underway to counteract these constraints. The use of a small ripper for dry cultivation is also being promoted. Recent developments include new approaches to conservation tillage methods.

One of the major factors limiting areas that can be cropped, as well as yields generally is the problem of weeds, and the cost of traditional methods of weeding, that is ploughing or discing to destroy initial weed growth, and, after crop emergence, hoeing. The extension service is currently promoting two interrow cultivators (from Zimbabwe and Senegal). Uptake in the north central Regions has been extensive and rapid.

4.3.4.4 Soil fertility management

Agroforestry

With the prospect that only a very small proportion of farmers will take the risk of purchasing fertiliser, it will be necessary to investigate which species can be used for the improvement and maintenance of soil fertility - as this may be one of the few affordable means for the majority of the farmers to improve their soil quality. The introduction of alley cropping using *Leucaena leucocephala* has started; this system enhances soil fertility, whilst providing protection against wind damage and soil erosion, as well as browse, fuelwood and building material. *Faidherbia albida* may have the required potential, as may *Sesbania sesban*, for the improvement of fallows. Research is also on-going into the seasonal availability and management of browse species, and into the advisability in view of factors such as the harbouring of grain eating birds, of leaving a certain number of trees of some species on land cleared for cultivation by tractor or oxen.

Manure and crop residues

Without the reincorporation of organic matter continuous cropping on Namibia’s sandy soil leads to a rapid loss of organic matter, lowering of the cation exchange capacity, lowering of the soil’s moisture retention capacity, and the destruction of soil structure. As noted in Part 3 of this report, manure is only used to any extent in the north central Regions, but hardly at all in Kavango and Caprivi. The main constraints for not using manure are lack of animals and lack of labour and transport to carry and spread manure. Possible options to overcome these constraints include the use of mobile kraals, the addition
of weeds (before flowering) and other organic matter into kraals, the improved siting of kraals, and the removal of the sand layer above the hard solonetz layer in kraals.

**Inorganic fertilisers**

On-farm trials of low level applications of phosphorus and nitrogen (e.g. 10 kg of P and 20 kg of N per hectare) in recent seasons, have shown yield increases of up to 300% as compared to control yields. The application of phosphorus alone has also been shown to increase yields significantly, and, given its universal shortage in sandy soil and its residual effects, is probably the safest bet for economically sustainable viability.

Under the erratic rainfall conditions prevailing, the risk of crop loss and hence loss of investment in fertiliser means that only the richer farmers, who also pursue good farming practice generally, will be able to afford to risk using fertilisers. In addition fertiliser placement adds considerably to the labour demands of cultivation. The Government’s current strategy is to promote fertiliser use by selling it at greatly subsidised prices in the hope that this will encourage farmer to evaluate its benefits for themselves. Regrettably, appropriate fertiliser formulations have yet to be made available under the Government’s scheme which negates much of its promotional objective.

**Inter-cropping and rotations**

Surveys have found that 45% of mahangu fields in northern Namibia were regularly intercropped, while 34% were occasionally intercropped. Nearly all intercropping involves cowpeas, with bambara nut and groundnut also featuring in specific areas. However, legume to mahangu ratios are generally estimated to be low; optimum ratios for increasing and sustaining mahangu productivity need to be determined.

On the other, crop rotation is estimated to be practised on only 5% of pearl millet land. The main constrain is the lack of alternate crops suited to the growing conditions. As much as 95% of arable land in the north central Regions has been estimated to be sown to mahangu, and slightly less in the Kavango Region where more sorghum and maize is grown. Alternate crops need to be actively promoted if rotation is to be a useful strategy for managing soil fertility.

### 4.3.4.5 Small-scale irrigation

The focus of small-scale irrigation should be on irrigation from perennial rivers in the Kavango and Caprivi Regions and the proper use of natural springs in other localities. Reliance on ground water or dams for irrigation puts additional strain on limited water resources which are normally stressed at drought times anyway.

Past practice in irrigation schemes has contributed to a belief that these require high technology and large-scale capital inputs. Irrigation has therefore taken one of two very different forms, either large-scale capital projects or hand watering with buckets. Intermediate-scale irrigation has now been tested in the Kavango Region. These pilots range from small petrol or diesel pump systems to small hand pump operations using locally-produced bush pumps or rower pumps. The main conclusion from the tests are that small-scale irrigation is viable, but that individually managed schemes work, whereas collective schemes don’t.

### 4.3.4.6 Medium and large-scale irrigation

As already discussed in chapter 2.5.2.2 of this report, irrigation is considered an important means of intensification of agricultural production. For this reason, the government is actively developing irrigation schemes. Namibia currently has some 7,500 hectares under small, medium and large-scale irrigation schemes, the large majority under large-scale irrigation. Expansion is being considered in many areas, notably beside the Orange river and Okavango river and in the Caprivi region.

On the basis of estimated gross water requirements for irrigation in different parts of the country and total water source availability for irrigation (according to present or current agreements for the use of common
waters), and assuming the availability of soils suitable for irrigation is not a limiting factor, it is estimated that the Cunene river could irrigate about 7,900 hectares, the lower Orange river about 15,200 hectares, while the rest of the country as supplied by existing and proposed dams on ephemeral rivers and groundwater supplies could irrigate about 2,400 hectares (Hardap, Naute, Stampriet, Sesfontein, Brukcaros). These figures assume an overall irrigation efficiency of 60 per cent. With efficiencies of 50 to 80 per cent the total potential would range between 21,000 and 34,000 hectares. In addition, it may be expected that agreements will be reached with neighbouring countries to enable irrigation from the Zambezi river, and from the Kavango river.

Forecasts of the total irrigable area vary according to the design parameters adopted. Recent estimates by Windhoek Consulting Engineers for the Water Management Review put the figure at more than 70,000 hectares.

4.3.5 Freshwater fisheries

Fisheries in the perennial rivers of northeastern Namibia appear to be declining for a number of reasons including the breakdown of traditional fishing practices, changes in the use of fishing equipment, reduced floods, and the degradation of riparian flood plains used seasonally by some fish species due to overgrazing and deforestation (Hay, 1995). More research is needed to understand the ecology of these fish species and to be able to make recommendations for sustainable resource management. Regular monitoring of fish stocks is also needed. Such management efforts will require joint efforts with Angola, Zimbabwe and Botswana with regard to Namibia’s northern boarder rivers. Likewise, the oshana fisheries in the north-central regions depends to a large degree on parent stocks in Angola.

A brief review of developments since independence reveals neglect of the field of freshwater fisheries development, particularly in terms of production issues. Freshwater fisheries remains in the deep shadow of marine fisheries. While a policy has been adopted and legislation is nearing completion, there has been no parallel development of institutions to promote freshwater fisheries. There is a danger that policy-making efforts to date may not be implemented.

The government has acknowledged that:

"The latent potential for aquaculture to increase fish availability in Namibian rural communities has not been fully appreciated because of:

- lack of capacity and low awareness of aquaculture potential;
- concern about inadequate and irregular freshwater supplies;
- a focus on stock assessment in inland waters, and
- the predominant importance of the Namibian marine fisheries industry." (RoN 1996)

The active sustainable management of most of Namibia’s freshwater fisheries seems a long way off. Hay (Hay, 1995) recommends the following measures, on both sides of the Okavango:

- restrictions on the use of non-traditional gear, including specifications of the allowable size of gill-nets;
- control over the number and length of nets;
- banning of drag nets, fish poisons and explosives, and any other gear that could span more than half the width of the river;
- control of livestock grazing on the banks of the river;
- the reduction of fishing effort during periods of low flow but increased effort in the peak flood season when the are excess fish in the form of juveniles;
- the proclamation of closed areas.
While some of these aspects are being prescribed in the forthcoming legislation and question of enforcement is an entirely different matter, except in areas where communities can be persuaded there is some incremental benefit to be had by themselves assisting in enforcement.

4.3.6 Land use planning

No local level land use planning exists in Namibia at present. In the absence of local level land use planning, land users do their best land management practices under the circumstance. This is despite available local. At local level is where land use planning is critical for resource management and best use of available resource. In the Namibian conditions of aridity and ecological variability, land use planning should focus on local setting ecologically socially and economically. For this reason, the role of local level land use planning is to enhance local competence promote local knowledge and decentralise education and training.

The activities towards Land use planning in Namibian have started but the situation is in infancy the mapping of the country in Agro-ecological zones as mentioned before is a start of such activities where zones of similar ecological conditions are mapped and can be quantified. The Agro-ecological zones provide the planners and decision makers with the bases on which to formulate development objectives for various regions according to the ecological condition prevailing at that particular region.

Complementary to the agro-ecological zones is the land evaluation process land use planning which starts with the collection of information from the various thematic surveys (soil water ...) to match the different land utilisation types with their specific requirements. These are confronted with the land characteristics of the different land units. Out of this confrontation the suitability of the land for alternative uses can be assessed. In this assessment the way in which various uses influence each other has also to be taken into account. Some uses may support each other while some uses exclude each other. The result of this land evaluation can be expressed as alternative combinations of land uses for a particular area.

Information and current land use pattern data are need by planners and decision makers. Because, when they combine it with the development objectives that are formulated, they will know what still has to be done to achieve those objectives and what other information is required in order to develop and implement plans. According to these information requirements the various surveys have to be carried out; for example population utilising the land resources.
PART 5. INDICATORS FOR MONITORING THE STATE OF THE ENVIRONMENT FOR AGRICULTURE AND LAND RESOURCES

5.1 Introduction

This part of the report presents some preliminary definitions of indicators for monitoring the state of the environment in relation to Namibia’s agricultural and land resources. The intention is to present these to the report’s readership as the first step towards one of the pre-requisites for effective SoER indicators, namely, the building of a broad consensus or acceptance by society, and particularly by decision makers.

In future, the State of the Environment Reporting project, under the Directorate of Environmental Affairs in the Ministry of Environment and Tourism, intends to develop a broad-based set of indicators covering the fullest possible range of concerns in terms of environmental monitoring. The intention is to effect monitoring and reporting through a range of responsible institutions, which will thereafter be collated in a central database and reporting system managed by the Directorate. Ultimately, it is hoped that reporting on indicators will reach a wide Namibian audience of decision makers in relation to environmental concerns, at the governmental, NGO, private sector, and individual levels. One reporting mechanism is expected to be an annual State of the Environment Report which it is expected will be presented to the National Assembly by the Minister of Environment and Tourism in terms of forthcoming environmental legislation.

First, it is important to be clear about the rationale for the whole exercise:

To ensure the sustainability of development efforts, societies need to monitor environmental change and, on the basis of an understanding of environmental processes and causal relationships, reform those of its activities which impact negatively on sustainability and reinforce those which impact positively.

State of the Environment Indicators aim to increase public awareness of critical changes. They are a means of making often complex issues accessible to decision makers on both an individual and societal level. As such they depend on valid monitoring data, accepted analysis of causal relationships, and imaginative ways of translating these into easily understood messages.

The aim of the government’s State of Environment Reporting (SoER) initiative, therefore, is to support sustainable and responsive policy and strategy formulation, and implementation by:

♦ defining indicators for monitoring environmental sustainability of agriculture and land resources utilisation;
♦ providing baseline data against which several indicators of sustainable resource utilisation can be monitored over time; and
♦ communicating findings to various stakeholders, so as to ensure that this monitoring takes place and informs the national development process.

It is sometimes said that decision makers are given too much data and not enough information. Indicators are an attempt to bridge the gap.

Indicators which represent clearly and relatively simply the status of complex processes are valuable as an efficient means of focussing data collection and analysis resources. They are also useful for communicating of findings to a wide audience.
To define State of the Environment indicators the project has defined an overall framework. This is useful (1) to ensure that issues are covered systematically, and (2) to ensure comparability cross-sectorally and internationally. The framework adopted for identifying indicators is the same as that adopted for the entire narrative report: the pressure-state response model. Likewise, the framework adopted for considering the issue of responses, specifically, is the technologies-institutions-policy and regulatory framework model for sustainable agriculture and land use. These have been discussed in Part 1 of this report.
<table>
<thead>
<tr>
<th>Issue</th>
<th>Indicator</th>
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| Agriculture and land resources-general | **Pressure**  
- Contribution of primary agricultural production to annual GDP (indicator of reliance on primary agricultural production and movement towards diversification).  
- Contribution of agricultural and forestry sectors to total foreign exchange earnings (indicator of importance of agriculture sector to the overall economy).  
- Self-sufficiency Ratio - Ratio of annual food production (excluding marine fisheries) to food imports (indicator of degree to which policy of national food security is applying in practice [and season's rainfall]).  
- Contribution of agricultural production to main sources of income among Namibian households (Namibia Household Income and Expenditure Survey)  
- Rural population growth rate compared to urban population growth rate (indication of increase in numbers dependent or partly dependent on agriculture for their livelihoods, and over movement away from dependence on agriculture.  
- Labour involved in agriculture, and specifically labour force and wages paid to workers on privately owned farms (increased number/incomes indicates health of sector).  
- Population growth rate x % of very poor (annual income below N$ x) who are assumed to be highly dependent on exploitation of natural resources and whose vulnerability to risk means they must operate with a short-term view. (Assumes that the very poor rural population have no choice other than to over-exploit natural resources, and that only when their numbers decrease will these resources be secured). (Other key indicators of "poverty" here could include educational levels, the oppression of women (measurability?), and rates of infant mortality, under nutrition and malnutrition - could these together form a complex indicator - ref. Socio-economic indicators)  
- Percentage of population "depending on agriculture for their livelihoods" - the magic "70%" figure.  
- Harvesting of veld and forest products and hunting of wild animals and fish as sources of food and income.  
| Response                     | Effectiveness of policies and programmes to overcome rural poverty. (Pol./Reg.)  
- Percentage of government's annual budget allocated to agricultural research (including veterinary and forestry research) (% budget allocated to extension services?) (Where > 60% of the economically active population are engaged in agricultural production FAO recommends 3% and 1-2% of agricultural GDP should be allocated to agricultural research and extension respectively - check figures) (Org.).  
- Government budget allocation to research and extension per farmer (Org.)  
- Percentage of research and extension budgets allocated to programme and operational costs vs. remuneration costs (FAO recommends 35-40% : 65-60%) (Org.)  
- Percentage of international development aid devoted to agriculture (Org.)  
- Some indicator of response to the issues of gender in agriculture.  
- Number and types of Namibian tertiary level agricultural and forestry graduates finding employment in related fields in first three years after graduation (indicates entry of skilled personnel into employment in the sector). (Inst.) |
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<tr>
<td><strong>Pressure</strong></td>
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<tr>
<td>- Extent (land area) of private tenure, exclusive communal tenure, open-access and communal tenure arrangements (Indicator of likelihood of adoption ecologically sound management practices - assuming causal relationship between security of tenure and land management).</td>
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<td>- Nature (qualitative) and extent (land area) of resettlement of farmers on range land (Assessment of technologies, organisations and enabling environment for resettlement schemes indicates likelihood of environmentally sound farming practice).</td>
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<td>- Bank interest rates on farm loan repayments (assuming a relationship between high interest rates and need for farmers to maximise incomes by increasing stocking rates (thus risking overgrazing).</td>
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<td>- Ratio of per LSU availability of grazing (assessed carrying capacity x area) in relation to livestock numbers (indicator of grazing pressure).</td>
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<td>- Ratio of used to unused range land (indicator of availability of emergency grazing subject to water point development).</td>
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<td>- Extent of multi-species production (indicator of mix of grazers and browsers - assumed better range management practice).</td>
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<td>- Range yields (How to factor out rainfall)</td>
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<tr>
<td>- Fodder shortage in dry season (sales of supplementary fodder) in relation to livestock numbers (How to factor out rainfall)</td>
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<td>- Livestock numbers in relation to annual marketing (high numbers and low marketing indicator of increasing numbers)</td>
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<tr>
<td>- Land use in relation to erosion hazard</td>
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<tr>
<td>- Drought (annual rainfall in lowest 7 percentile of mean annual rainfall)</td>
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<tr>
<td><strong>Status</strong> (all measured by monitoring of network of “managed” and control plots)</td>
</tr>
<tr>
<td>- Estimated grazing condition.</td>
</tr>
<tr>
<td>- Rates of recovery of plant cover after drought.</td>
</tr>
<tr>
<td>- Extent and degree of bush encroachment/dieback.</td>
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<tr>
<td>- Extent and degrees of denudation/recovery.</td>
</tr>
<tr>
<td>- Grass sward composition and trends (annual and perennials/unpalatable and palatable species)</td>
</tr>
<tr>
<td>- Occurrence of soil fertility/range status indicator plants (e.g. poisonous plants and invasive alien species)</td>
</tr>
<tr>
<td>- Soil nutrient levels and organic matter content (soil lab. surveys (long term data needs to be analysed))</td>
</tr>
<tr>
<td>- Extent and severity of physically eroded land/soils (bare, trampled, capped etc.) (Siltation of dams and rivers)</td>
</tr>
<tr>
<td>Issue</td>
</tr>
<tr>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Sustainable Range Management (cont.)</td>
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<tr>
<td>Issue</td>
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<tr>
<td>----------------------------</td>
</tr>
<tr>
<td>Sustainable Forest Management</td>
</tr>
</tbody>
</table>
### Sustainable Wetlands Management

**Pressure**

- Nature and extent of exclusive tenure, communal tenure and open access tenure arrangements (indicator of likelihood of adoption environmentally sound management practices - assuming causal relationship between security of tenure and land management).
- Cultivation on wetlands soils and watershed soils with high erosion hazard without soil conservation measures
- Number and capacity of dams per strategic watershed.

**Status**

- Distribution of migratory bird populations as indicators of habitat change (Southern African Bird Atlas Project).
- Wetland vegetation inventory (Tree Atlas Project)
- Rates of aquifer recharge

**Response**

- Effective implementation of land reform legislation to promote wetlands tenurial security (Pol./Reg.)

### Maintenance of agriculturally useful species biodiversity

**Pressure**

- Livestock cross-breeding programmes
- Replacement of traditional crop varieties with new improved varieties and new exotic crops
- Loss of habitats

**State**

**Response**

- In-situ and ex-situ gene conservation measures: livestock breeders associations, gene banks, botanic collections (Tech.).
<table>
<thead>
<tr>
<th>Issue</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sustainable Rainfed Arable Land Management</strong></td>
<td><strong>Pressure</strong></td>
</tr>
<tr>
<td>- Nature and extent of exclusive tenure, communal tenure and open access tenure arrangements (indicator of likelihood of adoption environmentally sound management practices - assuming causal relationship between security of tenure and land management).</td>
<td></td>
</tr>
<tr>
<td>- Agro-environmental population density - the number of persons involved in agriculture per million kilocalories of production potential estimated at the intermediate technology level (indicator of pressure on the land and of non-viability of achieving food self-sufficiency, and of need for livelihood diversification out of food crop agriculture in rural and urban areas).</td>
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<tr>
<td>- Rural livelihood diversification (Household income and expenditure surveys (CSO) and Farm Management Surveys (MAWRD).</td>
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<tr>
<td>- Rural-urban migration (rural-urban population growth rates).</td>
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<tr>
<td>- Land use in relation to erosion hazard (indicator of risk erosion risk from crop farming).</td>
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<tr>
<td>- Ratio of cultivated to cultivable land (indicator of availability of addition arable land in future).</td>
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<tr>
<td>- Use (annual sales) of chemical pesticides (indicator of risk of soil and water pollution).</td>
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<tr>
<td>- Use of inappropriate mechanical tillage practices on vulnerable soils (number of working tractors with disc harrows x average area cultivated) (indicator of risk of damage to soils).</td>
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</tr>
<tr>
<td><strong>Status</strong> (all measured by monitoring of network of “managed” and control plots)</td>
<td></td>
</tr>
<tr>
<td>- Soil nutrient levels and organic matter content (soil fertility surveys).</td>
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<tr>
<td>- Extent and severity of physically eroded soils (gullying, sheet and wind erosion, hard pans, plough lines, pulverisation, salinisation) arable land.</td>
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<tr>
<td>- Ratio of actual to estimated (modelled) potential crop yields.</td>
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<tr>
<td>- Abandonment of eroded, formerly cultivated land.</td>
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<tr>
<td>- Occurrence of soil fertility indicator plants (e.g. Striga sp.).</td>
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<tr>
<td>- Accumulation of chemical pesticides and residues in soils and water (measured by microbial activity).</td>
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<tr>
<td><strong>Response</strong></td>
<td></td>
</tr>
<tr>
<td>- Adoption of appropriate low tillage cultivation technologies (Tech.) (Implement sales).</td>
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</tr>
<tr>
<td>- Adoption of appropriate fertilisation technologies (manure, crop residues, incorporation, inorganic fertilisers, fallowing, agro-forestry) (Tech.).</td>
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<tr>
<td>- Adoption of practices to reintegrate of organic matter content in soils (biomass entering the soil) (Tech.).</td>
<td></td>
</tr>
<tr>
<td>- Adoption of tree/fence barriers (agro-forestry) in relation to wind erosion hazard (Tech.) (The above 4 indicators measured by adoption surveys as part of the National Extension Service’s MIS).</td>
<td></td>
</tr>
<tr>
<td>- Implementation of land reform legislation to promote arable land tenure security (Pol./Reg.)</td>
<td></td>
</tr>
<tr>
<td>- Ratio of Agricultural Extension Technicians in the field to farmers, and ratio of members of Farmer Extension Development Groups to farmers (Org.) (National Extension Service’s MIS).</td>
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<tr>
<td>- Membership of farmer self-help organisations/associations (Org.) (Annual Reports of the NNFU, NAU, Registrar of Co-operatives, the National Extension Service).</td>
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</tr>
<tr>
<td>- Implementation of regulations governing the sale and use of chemical pesticides and the adoption of Integrated Pest Management practices (Pol./Reg.) (Annual Report of the Division of Law Enforcement - MAWRD).</td>
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</tr>
<tr>
<td>Issue</td>
<td>Indicator</td>
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<tr>
<td>-------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Sustainable Irrigated Arable Land Management</td>
<td><strong>Pressure</strong></td>
</tr>
<tr>
<td></td>
<td>- Excessive use of irrigation waters leading to mechanical and biological soil erosion, waterlogging, salinisation (flood and sprinkler)</td>
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<td></td>
<td>- Poor maintenance of drainage structures (preventing leaching of salts)</td>
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<td></td>
<td>- Use of chemical pesticides</td>
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<td></td>
<td>- Use of inorganic fertiliser (eutrophication of downstream waters)</td>
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<tr>
<td></td>
<td>- Alternative demands for irrigation (discussion of economics of irrigation schemes considering competing demands for water)</td>
</tr>
<tr>
<td></td>
<td><strong>Status</strong></td>
</tr>
<tr>
<td></td>
<td>- Crop yields</td>
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<td></td>
<td>- Soil salinity levels</td>
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<tr>
<td></td>
<td>- Soil erosion</td>
</tr>
<tr>
<td></td>
<td>- Siltation of irrigation structures</td>
</tr>
<tr>
<td></td>
<td>- Accumulation of chemical pesticides and residues in soils and water (measured by microbial activity)</td>
</tr>
<tr>
<td></td>
<td>- Accumulation of inorganic fertilisers and residues in soils and water (measured by microbial activity)</td>
</tr>
<tr>
<td></td>
<td><strong>Response</strong></td>
</tr>
<tr>
<td></td>
<td>- Development of irrigation schemes and expansion of the land area under irrigation (Tech.).</td>
</tr>
<tr>
<td></td>
<td>- Development of irrigation management structures which give responsibility for scheme infrastructure management to irrigation users (Org.).</td>
</tr>
<tr>
<td></td>
<td>- Implementation of water pricing policies and supportive assistance which encourage farmers to switch from low value to high value crop production and from the employment of wasteful and damaging flood irrigation and inefficient sprinkler irrigation systems to efficient sprinkler and drip methods (Pol./Reg.).</td>
</tr>
<tr>
<td></td>
<td>- Irrigation water use efficiency: area of irrigated land subject to flood irrigation as compared to sprinkler or drip irrigation systems (Tech.).</td>
</tr>
<tr>
<td></td>
<td>- Implementation of regulations governing the sale and use of chemical pesticides and the adoption of Integrated Pest Management practices (Pol./Reg.).</td>
</tr>
</tbody>
</table>
5.3 Indicator workshop conclusions

The project’s indicators workshop revealed a lack of viable indicators because of the lack of data and monitoring systems. It was agreed that to be practically useful to the SoER project, indicators should only be selected if existing data sets and monitoring systems were already in place, or if there was a reasonable chance of such systems being developed in the foreseeable future.

In several instances, possible indicators of the general state of agriculture and land use in Namibia were rejected by the Workshop because they were regarded as of little relevance to “the environment”. While these indicators were seen to be relevant to the “agriculture sector” or the “land use situation”, their relevance to the biophysical environment was in doubt. In other words, these may be relevant as indicators of, for example, the “state of the agriculture sector”, and as such would be reported on to the National Assembly by the Minister of Agriculture, but not of the more specific “state of the environment”.

The workshop identified the following 18 potential indicators to be further considered.

1. The total number of people depending directly on agriculture.
2. The existence of a conducive policy framework (comprising a pre-defined basket of desirable policies and strategies).
3. GRN budget allocated to renewable natural research and extension, budget allocation to operational costs, aid budget for renewable natural resources, presented as per capita efforts, i.e. per rural household, and as a composite indicator.
4. Changes in land use from livestock to game /tourism.
5. “Rangeland Condition Indicator” which would be a composite including
   -Rangeland condition index (derived from annual assessment of species, cover, composition, and vigour in selected sample plots)
   -Soil condition index (soil sample assessment from the same sample plots)
   -Bush (utilisable and non-utilisable) density index (again derived from annual assessment of sample plots)
6. “Conducive policy and legislative framework”. A composite including (1) increase of individual and community rangeland user rights, and (2) number of communities which have adopted improved rangeland management practices.
7. Relationship between plant and animal biomass (on a seasonal basis) and the amount and distribution of annual rainfall. Data derived from NOAA satellite images and ground truthing.
8. A composite indicator including: (1) the average rangeland area per livestock owning household per region increase/ decrease (communal areas), and (2) the minimum rangeland required to sustain commercial economic viability (commercial areas).
9. A composite indicator for “management practices” including (1) diversification in/outside rangeland use, and (2) choice and use of markets.
11. Development of Irrigation, economic costs and benefits of irrigation, and financial costs to the government and irrigation management systems (a complex indicator aiming to summarise the state and sustainability of irrigation in the country).
12. Forest cover changes, % Area.
13. Timber stock changes.


16. Percentage of land proclaimed as State and Community-protected forest % area of wetlands
    protected vis a vis area defined as wetlands.

17. % of RAMSAR sites which have a management plan being implemented.

18. On-going monitoring of threatened & vulnerable plant and animal populations.

5.4 Suggested indicators

Ultimately, after further close analysis in relation to the criteria adopted for defining indicators, the SoER
team have focussed on the following indicators.

1. Security of land tenure

2. Rangeland condition index

3. Sustainable irrigation development

4. Forest and crop area change

5. Maintenance of the hydrological function of wetlands

6. % GDP spent on agriculture and land resources research, extension and training

7. Population changes/movement
INDICATOR 1: SECURITY OF TENURE

**Table**

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Security of tenure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>Security of tenure can be said to exist when an individual perceives that he or she has rights to a piece of land on a continuous basis, free from imposition or interference from outside sources, as well as the ability to reap the benefits of labour and capital invested in that land, either in use or upon transfer to another holder.</td>
</tr>
<tr>
<td><strong>Measurement</strong></td>
<td>The proportion of Namibia's land area on which individuals and communities using land resources have secure tenure rights</td>
</tr>
</tbody>
</table>

**Significance of the indicator**

PURPOSE: This indicator provides a proxy for incentives or disincentives to make medium- to long-term investment in natural resources enhancement or preservation.

**RELEVANCE:**

This Indicator applies at the level of natural resources users. It indicates the extent to which the users of land based resources feel secure in the use rights which they enjoy. By implication, it will be a proxy for the extent to which resource users have property rights over the resources they use, either at the individual, household or community level. It is assumed that under tenure insecurity individuals and households are less likely to make medium- to long term investments, as the likelihood to enjoy the benefits of such investments is compromised. Conversely, assuming that viable technologies, access to appropriate inputs and extension advice, household labour and financial resources are available, tenure security is likely to contribute significantly to more sustainable land use practices.

**LINKAGES TO OTHER INDICATORS**

This Indicator is linked to the availability of extension services to farmers, the human poverty index and the human development index.

**UNDERLYING VARIABLES AND DEFINITIONS:**

This indicator will require the qualitative assessment of perceptions of security of rights under different types of tenureal system. These will include private registration of freehold tenure, various forms of customary tenure of communal land, registered and unregistered Permission to Occupy (PTO), registered conservancy, registered community forest, and rights granted under forthcoming legislation governing communal land.

**MEASUREMENT OF THE INDICATOR:**

Data to measure this indicator will have to be obtained through regular surveys in different regions of the country. It is not easy to devise an objective scale or index of tenure security, as it is not directly observable or measurable. However, different options have been used elsewhere to obtain reasonable results. Measurement and updating of this indicator should be the responsibility of the Directorate of Lands (MLRR), with inputs from the Directorate of Environmental Affairs (MET), the Directorate of Forestry (MET).

**LIMITATIONS OF THE INDICATOR:**

The limitations of this indicator stem from the fact that while tenure security is a necessary condition for land based resource enhancement, it is not a sufficient condition. On the one hand, security of tenure must be accompanied with support services to enable farmers to implement resource enhancing programmes or raise agricultural productivity. On the other hand, farmers may prefer to invest possible surpluses in leisure activities, off-farm opportunities.
State of the Environment Report on Agriculture and Land Resources

Narrative section

A. PAST PERFORMANCE

The National Land Policy White Paper approved in April 1998 states that government 'will accord full and equal security and protection to all legally held land rights, regardless of the form of tenure, the income, the gender or race of the rights holder. It proposes to achieve this in what is referred to as a 'unitary land system', which will provide 'equal status and validity before the law' to the full range of tenure. Customary land allocations will be secured by the issuing of 'a certificate of right' which is 'secure, inheritable by immediate family and not limited in time'. However, this certificate will not be mortgageable or transferable outside the limits of consanguinity'.

Although the White Paper alludes to a strategy to promote group tenure, the Communal Land Reform Bill does not seem to provide for the extension of property rights to communities over the land they utilise. It does, however, introduce several measures which, on the face of it, seem to protect the land rights of communal farmers to some extent.

B. INTERPRETATION

Currently, farmers in the communal areas enjoy different levels of tenure security. This does not only differ between region, but within farming systems. Communal farmers in the mixed farming areas of the north-central, north-eastern and eastern regions as a rule enjoy lifelong use rights to the arable land which is allocated to them by a traditional authority. The same applies to residential rights in all communal areas.

However, these customary rights are not always backed by an institutional framework capable to administer and enforce them in an equitable and sustainable manner. In addition, these use rights are not protected under any statutory legislation.

With regard to communal pastures the situation is slightly different. While customary rules and regulations on land tenure and natural resource management in general still exist in most communal areas, the institutional framework in many is no longer capable of enforcing these. The result is thus that in practice many communal pastures are characterised by an open access regime.

At the same time, however, several donor supported programmes such as SARDEP, NOLIPDEP and NAPCOD are involved in mobilising rural communities to become more active in sustainable resource management. This is accompanied by technical support to develop capacity at the community level to manage community resources. In the case of conservancies, government has already extended limited property rights to natural resources to rural communities. The forthcoming Forests Bill aims to extend community rights to resources in gazetted community forests.

Lastly, the Communal Land Reform Bill aims to revise mechanisms for granting all land resource user rights, including customary grants and PTOs.

This indicator will enable decision makers to monitor the extent to which more secure use and transfer rights to land are being acquired by communities.

C. DATA REQUIREMENTS

Data on tenure security at present is rather sketchy. NOLIDEP has generated very useful information on land tenure and animal husbandry practices in the northern communal areas, including northern Kunene Region. However, regular surveys in all regions will have to update the information. In order to facilitate this, criteria will have to developed and accepted.

Essentially, surveys will have to obtain information on farmers' perceptions of four characteristics associated with tenure security:

1. The number or breadth of land rights: this refers to all legally held rights in land and includes use rights, rights of transfer and rights to exclude.

2. Duration of land rights: as the wording suggests, this refers to the length of time that the rights identified in 1. are legally valid. This can be tied to seasons, years etc.
3. Assurance refers to the certainty with which rights are held over time. It should be noted here that rights and duration are seldom absolutely absent or present. Instead, rights are normally held with varying degrees of certainty at different points in time and depending on specific resources.

4. Mode of acquisition of land rights: this refers to whether access to land has been inherited, bought or obtained through renting. The mode of acquisition will have a direct bearing on components 1-3 above.

D. CALCULATION AND FUTURE UPDATING OF THE INDICATOR

There is no need to update data on tenure security every year, since tenure changes are mostly subtle and often slow. The possibility of attaching these questions to agricultural surveys should be investigated.

It should be noted that since this data is essentially of a qualitative nature, it seems reasonable to extrapolate the results of a few surveys to a much larger area, provided that the farming system is more or less the same.

Measurement and updating of this indicator should be the responsibility of the Directorate of Lands (MLRR), with inputs from the Directorate of Environmental Affairs (MET), the Directorate of Forestry (MET), and the Department of Agriculture and Rural Development (MAWRD).
INDICATOR 2: RANGELAND CONDITION INDEX

Table

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Rangeland Condition Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td>The extent to which rangeland condition is improving or degrading</td>
</tr>
<tr>
<td>Measurement</td>
<td>To measure rangeland as a condition score (% or index) in relation to the potential for that area</td>
</tr>
</tbody>
</table>

Significance of the indicator

PURPOSE:
This indicator measures the condition of the rangeland as reflected in the following four processes in the rangeland ecosystem:
- Water cycle (soil surface condition)
- Mineral cycle (micro-organisms in soil)
- Energy flow (vigour, density, composition)
- Community dynamics (composition, ecological status, bush encroachment)

RELEVANCE:
This indicator is most useful at local level. Resource users can easily use this indicator. This should allow due account to be taken of the different management objectives of farmers in different farming systems.

LINKAGES TO OTHER INDICATORS
This indicator is directly linked to farming practices, range management approaches, rainfall, etc.

UNDERLYING VARIABLES AND DEFINITIONS:
This indicator measure the response of the rangeland to the impact of climate and management practices of the resource users. Ideally, it should enable the effects of management practices to be disaggregated from the effects of environmental variability.

MEASUREMENT OF THE INDICATOR:
Some permanent plots in both communal and commercial farming areas are available for annual/biannual monitoring. MAWRD the major source of information. Measurements need to be standardised, compared to control plots representing natural range conditions.

LIMITATIONS OF THE INDICATOR:
Sometimes inability of surveyors to recognize smaller indicators of rangeland degradation. Through practice and experience, this can be overcome.

Agriculture & Land Resources SoER Consortium 222
INDICATOR 3: SUSTAINABLE IRRIGATION DEVELOPMENT

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Sustainable Irrigation Development</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>A composite indicator including, initially, (a) land area used for irrigated crop production (b) irrigated areas used for &quot;low value&quot; versus &quot;high value&quot; crop production (c) an assessment of progress towards the establishment of irrigation scheme management boards giving users responsibility for large scale irrigation scheme infrastructure</td>
</tr>
<tr>
<td><strong>Measurement</strong></td>
<td>Reports of the Agronomic Board of Namibia, the Namibia Early Warning and Food Information System, and the Annual Report of the Division of Agricultural Engineering</td>
</tr>
</tbody>
</table>

**Significance of the indicator**

Irrigation represents a major investment in land for agricultural purposes. However, the expansion of the land area under irrigation indicates per se indicates only the commitment of enormous capital funds to this form of land use. Sustainability on the other hand can be assessed by a number of approaches.

**PURPOSE:**

**RELEVANCE:**

On the one hand, the indicator shows the extent of investment in irrigation infrastructure, which may be considered a significant enhancement of natural resources available for agriculture. In itself measurement of the land areas under irrigation, says nothing about the output of that irrigation, and whether this is economically or environmentally valuable and sustainable. To gain such insights a number of variables each with more or less relevance can be measured.

As a proxy indicator for the complex (both to analyse and interpret) analysis of production cost-benefit and irrigation efficiency, the irrigated land area under what may be characterised as "low value" production (eg. wheat, malaze and lucerne), and compared with the area under other crops, including grapes, dates, cotton, and melons, which may be characterised as "high value" production. This could be interpreted against the calculation of generalised analyses of the financial and water economics for a basket of low and high value crops.

The institution of irrigation management boards will indicate that irrigation users are financially able to manage irrigation infrastructure. It will also indicate the likelihood that farmers are employing good irrigation management practices (because they must pay for the consequences of bad practice). For the future, economic and financial cost benefit analysis will indicate the comparative advantage of using the country's scarce water resources for irrigation as compared to other uses. The adoption by farmers of water conserving irrigation would indicate the degree to which irrigation water is being used efficiently.

**MEASUREMENT OF THE INDICATOR**

Data on land areas under irrigation, crops produced and irrigation methods is being compiled by Windhoek Consulting Engineers for the government's current Water Management Review. This provides data on some 200 irrigation schemes, and should represent baseline data for this indicator. Data can be updated by repeating the process of data gathering carried out by Windhoek Consulting Engineers which involved contacting all scheme managers. This time consuming task should be carried out every three to five years.

Measurement of progress towards the establishment of Irrigation scheme management boards comprising irrigation users will be based on reports of the Division of Agricultural Engineering.

A methodology for conducting a financial and economic cost-benefit analysis of irrigation schemes has been demonstrated in a MAWRD evaluation of the Etunda project (Akwenye et al. 1996). Given the implementation resources and priorities it is unlikely that the Ministry will be in a position to provide the necessary data for this aspect of the Indicator in the foreseeable future.
LIMITATIONS OF THE INDICATOR

Given current availability of data, and measurement systems, it is not practical to include more than the three components proposed. As such, the indicator would say relatively little about sustainability issues. In future, capacity should be elaborated to (a) assess the economic costs and benefits of different irrigation crop models and then relate these to the land areas in which these models pertain, (b) the financial costs (hidden and actual) to the government of irrigation scheme maintenance and management, and (c) the adoption of water-conserving irrigation technology (e.g. relative areas under drip, micro-spray, sprinkler, flood etc.).
A. PAST PERFORMANCE

Given Namibia’s aridity, irrigated crop production has been practiced since soon after the arrival of the first European settlers mainly on a small scale. The main State investment in irrigation was in the Hardap Scheme which became operational in the late 1960's. However, the expansion of irrigation in Namibia has not previously been monitored. Nor has significant attention been paid to issues of sustainability. It is probably the case that the first ever accurate record of land area under irrigation is currently being produced by the government’s Namibia Water Resources Management Review. This lists some 200 different irrigation schemes totally some 7,500 hectares of irrigated land nationally. This study, once finalised, should provide the baseline data for the indicator.

B. INTERPRETATION

This indicator aims to monitor the land area under irrigation, as well as factors influencing the sustainability of irrigation. Initially, due to measurement difficulties, the indicator will only monitor the production of high value as opposed to low value crops as a proxy for an indicator of the cost-benefit and water use efficiency of irrigation, and the development of irrigation scheme management structures, which give responsibility for scheme infrastructure to irrigation users.

- Irrigated area

Irrigation represents the pinnacle of investment in land for agriculture. As such it can been seen as a means of significantly enhancing the status of land resources. Consequently, the expansion of areas under irrigation, the improvement in irrigation management towards the adoption of water-efficient irrigation systems can be seen as important indicators of the State of the Environment.

- Economic and environmental viability

Is irrigation economically sustainable?

Is investment in irrigation a wise use of government’s scarce financial resources? To answer this we must look at the government’s objectives in developing irrigation. An evaluation of the Etunda Project (Akwenye et al. 1995) illustrates some common issues albeit under one specific set of circumstances.

The Etunda Irrigation scheme became operational in 1995/96, when 203 hectares were irrigated, 81 by 27 settlers with 3 hectares each, and the remainder by the Namibia Development Corporation (NDC), as project managers. Currently, the project irrigates a total of 640 hectares of land, of which 290 hectares are occupied by 96 settlers. All 640 hectares are managed by NDC. The Scheme could expand in future to irrigate up to a total of 1,200 hectares.

Considering the financial costs and benefits of the project over a 25 year period (converted to present values at a 10% discount rate), the 1996 evaluation found that the present net value of crop sales of N$ 24.7 million compared to investment costs of N$28.6 million, operating costs of N$ 9.8 million, and crop input costs of N$ 8.7 million (total costs N$47.1 million). However, considering benefits to settlers, produce consumers in the region, and unskilled labourers employed, these groups were N$ 10.4 million better off, while the taxpayer was N$ 29.3 worse off.

This excludes any reckoning of intangible benefits such as improved nutrition and health and some multiplier effects through petty trading in the vicinity of the scheme. Hence, while in straight financial terms the project is a loss maker, in economic terms, in particular considering government’s objective of reducing income inequalities, this is not as clear. At the moment government considers such a means of engineering transfers between the rich and poor acceptable.

More worrying perhaps, in view of the unpredictability of the government’s future financial health, is that the evaluation found that the operating margin (operating costs less project revenues) would become positive in 1998/99 only if no charges were made for bulk water supply to the project. If bulk water
supply was to be charged at the proposed tariff of 8 cents per m\(^3\), revenues will never be sufficient to cover operating costs. NamWater is currently charging 10 cents per m\(^3\) to the Scheme, with a new rate of 14.2 cents per m\(^3\) still under discussion. It should be noted that the evaluation considered only the Scheme’s existing operational and production records. Should a switch to higher value crops occur, the economics would of course change. Likewise, if the irrigation farmers organised themselves to take over the management burden of the Scheme from the government, costs should be reduced and overall efficiencies should increase.

Is irrigation environmentally sustainable?

A variety of environmental problems are experienced in Namibia’s Irrigation schemes. While no figures exist as to the extent of these problems, anecdotal evidence suggests that most are small scale and manageable. They include soil salinity problems in the Hardap and Aussenkehr Schemes, siltation of and reed growth in canals and weed invasion in the Hardap Scheme, and soil compaction and run-off problems at the NDC’s Shadi Kongoro farm (in the Kavango Region). Otherwise, good drainage and or good quality water leave most schemes trouble free. For example, although the Naute Scheme’s soils are saline, water quality and drainage are good so that leaching effectively deals with salinity. Even on small-scale ground water irrigation schemes, it is often found that boreholes with sufficient pressure for irrigation tend to be those with good quality, and vice versa.

By far the most serious problems are those of salinity and siltation and reed growth problems experienced in the Hardap Scheme. This case demonstrates that while most irrigation problems are technically manageable in terms of dealing with proximate causes (e.g. excessive use of water and maintenance of drainage systems), it is essential to address the ultimate causes such as low water costs and lack of user responsibility for irrigation scheme infrastructure, so as to encourage farmers to change their management practices.

Conclusion

Ideally this indicator should report on analysis of production cost-benefit and irrigation efficiency of different irrigation farming systems, and how these are changing over time. Increasing production of high value crops and water conserving irrigation technologies should be reflected in the important objectives of improved cost-benefit of irrigation and greater efficiency in the use of irrigation water. However, we currently do not have the capacity to elaborate and update such analyses. Nor would the interpretation of an indicator based on such analysis be straightforward and hence suited to the targets of the SoER project. Rather a simple proxy measure is proposed. This is a measure of the irrigated land area under what may be characterised as “low value” production, including wheat, maize and lucerne production, compared with the irrigated land area under other crops, including grapes, dates, cotton, and melons, which may be characterised as “high value” production. This could be interpreted against the calculation of generalised analyses of the financial and water economics for a basket of low and high value crops.

- Management systems

Lack of clear responsibility for maintenance of drainage works has lead to the situation where some drainage infrastructure has not been maintained at all, while some has been maintained by the MAWRD though usually on a crisis management basis, and at great cost. Farmers themselves have no incentive to maintain infrastructure or to prevent damage to it in the first place.

Government’s policy is that so called “irrigation boards” should be established to take over ownership and responsibility for irrigation scheme infrastructure. Management agreements would be established for each scheme. A Joint Irrigation Authority between Namibia and South Africa, known as the Noordoewer/Viooldrift Irrigation Board was established 1993. This board only covers irrigation schemes along the Orange River. Legislation on irrigation in Namibia has been in a draft form since 1993. Two main constraints are impeding progress. On the one hand, the government lacks capacity to draft legislation which is in line with existing national and neighbouring country legislation. On the other hand, massive investment is needed to upgrade existing irrigation scheme infra-structure to levels that users could be expected to assume responsibility for. Hence, it is suggested that the monitoring of this part of the indicator should be based on the following milestones:
(i) adoption by government of a plan to establish irrigation boards;
(ii) passage of relevant legislation;
(iii) essential upgrading of irrigation infra-structure so that responsibility for maintenance can reasonably be handed over to irrigation boards;
(iv) establishment of irrigation boards; and
(v) establishment of management agreements between the government and irrigation boards.

C. LIMITATIONS OF THE INDICATOR

Given current availability of data, and measurement systems, it is not practical to include more than those components proposed. As such, the indicator would say relatively little about sustainability issues. In future, capacity should be developed to (a) assess the economic costs and benefits of different irrigation crop models and then relate these to the land areas in which these models pertain, (b) the financial costs to the government of irrigation scheme maintenance and management, and (c) the adoption of water-conserving irrigation technology (e.g. relative areas under drip, micro-spray, sprinkler, flood etc.).

D. CALCULATION AND FUTURE UPDATING OF THE INDICATOR

Data on land areas under irrigation, crops produced and irrigation methods is being complied by Windhoek Consulting Engineers for the government's current Water Management Review. This provides data on some 200 irrigation schemes, and should represent baseline data for this indicator. Data can be updated by repeating the process of data gathering carried out by Windhoek Consulting Engineers which involved contacting all scheme managers. This time consuming task should be carried out every three to five years.

Measurement of progress towards the establishment of irrigation scheme management boards comprising irrigation users will be based on reports of the Division of Agricultural Engineering.

A methodology for conducting a financial and economic cost-benefit analysis of irrigation schemes has been demonstrated in a MAWRD evaluation of the Etunda project (Akwenye et al. 1996). Given the implementation resources and priorities it is unlikely that the Ministry will be in a position to provide the necessary data for this aspect of the indicator in the foreseeable future.

E. MAPS

The Namibia Water Resources Management Review is in the process of producing a map indicating irrigation demand for 1999. The following map indicates the main irrigation areas in terms of numbers of different irrigation schemes in the area.
INDICATOR 4: FOREST AND CROP AREA CHANGE

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Forest and crop area change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td>Changes in absolute and percentage terms in the area of land in the northern communal areas (a) with forest cover, (b) that has been cleared for cultivation, and (c) that is actually cultivated.</td>
</tr>
<tr>
<td>Measurement</td>
<td>(a) &amp; (b) The Forest Mapping Project of the Directorate of Forestry of the Ministry of Environment and Tourism. (c) The Early Warning and Food Information Unit of the Ministry of Agriculture, Water and Rural Development</td>
</tr>
</tbody>
</table>

**Significance of the indicator**

**PURPOSE:**
This indicator looks at changing land use. As such it is an indicator of changing pressures on land resources. It should reveal the changes in areas of forested land, cleared forest land and crop land in the northern communal areas.

**RELEVANCE:**
This indicator will give us an indication of the degree to which
- Forested areas are diminishing
- Cleared land is increasing
- Cultivated land is increasing
- Cleared land is being used for cultivation
- Areas are being reforested

**LINKAGES TO OTHER INDICATORS**
This indicator only deals with the northern communal areas which the Directorate of Forestry's mapping project. In order to give it greater coverage it could be linked with the indicator of rangeland condition.

It is also linked to several other forestry indicators which are discussed in the narrative below narrative which follows (see Section E.).

**UNDERLYING VARIABLES AND DEFINITIONS:**
The indicator adopts the following definitions based on those of the FAO’s Forest Resources Assessment Programme (FAO, 1998).

Forest: Land with tree crown cover of more than 10 per cent and area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 metres at maturity in situ. Closed forest exceeds 40 per cent ground cover, and open forest exceeds 10 per cent and is less than 40 per cent.

Other wooded land: Land with tree crown cover of more than 10 per cent of trees not able to reach a height of 5 m at maturity in situ.

When forest land is used for domestic crop production it becomes arable land, even when trees are an important part of the landscape. There is often significant overlap between rangeland and forest land. All forests outside national parks (other protected areas) are subject to varying intensities of livestock grazing. This section of the report will focus on such land from the point of view of woody biomass, while the previous section will focus on grasses and shrubs.

**MEASUREMENT OF THE INDICATOR**
This indicator is reliant on data which should be contributed by the existing measurement systems. Forest data should be provided by a comparison of base-line data produced by the forest mapping project during 1992-96, with the data to be gathered when the National forest inventory repeats the process as some as yet undetermined date in future.

Data on cultivated areas (but not their location) will be provided annually by the Early Warning and Food Information Unit, derived from pre- and post-harvest crop survey information provided by the National Extension Service, and other sources.

**LIMITATIONS OF THE INDICATOR**
It deals only with the northern mixed farming communal areas.
**A. PAST PERFORMANCE**

The Directorate of Forestry's Forest Mapping Project provides useful baseline data for measuring this indicator. These are shown in the tables below.

**Table 5.1: Change in closed forest area**

<table>
<thead>
<tr>
<th>Region</th>
<th>Total land area</th>
<th>Total closed forest 1992 (000 ha)</th>
<th>% of land area</th>
<th>Total closed forest Yr 2 (000 ha)</th>
<th>% of land area</th>
<th>Total change area (Yr 2-1992) (000ha)</th>
<th>Total change %</th>
<th>Annual change %</th>
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### Table 5.2: Change in open forest area

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<th>Region</th>
<th>Total land area</th>
<th>Total open forest 1992 (000 ha)</th>
<th>% of land area</th>
<th>Total open forest Yr 2 (000 ha)</th>
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### Table 5.3: Change in cleared land area

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<th>Total land area</th>
<th>Total cleared land 1992 (000 ha)</th>
<th>% of land area</th>
<th>Total cleared land Yr 2 (000 ha)</th>
<th>% of land area</th>
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<th>Annual change %</th>
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Table 5.4: Change in cultivated land area

<table>
<thead>
<tr>
<th>Region</th>
<th>Total land area</th>
<th>Total cultivated land '93/94* (000 ha)</th>
<th>% of land area</th>
<th>Total cultivated land Yr 2 (000 ha)</th>
<th>% of land area</th>
<th>Total change area (Yr 2-1992) (000ha)</th>
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</table>

(*1992/93 was a drought year. However, this did not greatly affect the area cultivated. In the case of the 4 O Regions figures for the 1994/95 are taken, being the first year that NEWFIS records for these regions started. Again 19994/95 was a drought year, and again this does not seem to have affected the area cultivated.)

B. INTERPRETATION

Changes in forested area will be revealed by the findings of the Directorate of Forestry's forest mapping project. Changes in the area of arable crop land will be based on figures from the Early Warning and Food Information System unit of the MAWRD. The latter records areas harvested only, and therefore reflects, to an extent, rainfall. The indicator will reveal the forested area which has been cleared for cultivation. The difference between the area cleared for cultivation and the area cultivated should indicate the area of land which has been left fallow.

A comparison of base-line data produced by the forest mapping project during 1992-96, with the data to be gathered when the National forest Inventory repeats the process, combined with data from the Early Warning and Food Information Unit, will provide a good deal of information, notably.

- change in area of land with closed forest
- change in area of land with open forest
- change in area of land cleared for cultivation (i.e. cleared forest)
- cultivated area (i.e. the area cultivated)
C. CALCULATION AND FUTURE UPDATING OF THE INDICATOR

To provide comparison with the baseline situation during 1992-96, it will be necessary for the Forest Mapping Project to be repeated at a suitable interval. Given the nature of Namibia’s dryland forest ecology, and the rates at which deforestation for crop production purposes are thought to be taking place, it is advisable to repeat the mapping exercise every ten years. There are currently no specific plans to this effect.

D. MAPS

The Directorate of Forestry implemented a Forest Cover Mapping Project of communal lands north of 20 degrees south. The project covered the entire northern communal areas. It was started in 1992 and completed in 1996. Data was and is being reviewed and refined with ground-truthing on an ad hoc basis as and when the opportunity arises.

The project used 21 LANDSAT satellite images, provided by the Swedish Space Corporation, as the basis for visual tracing areas of different vegetation cover types as determined by different surface area colours depicted on the images. This is followed by ground-truthing in the field, definition of final legends, final interpretation and pre-digitising checks. Data is presented in the form of maps and detailed statistical tables by map sheet and by political Region (GRN. 1995. Area Statistics for Vegetation Maps. Dorthe Holme, Patrick Graz. National Remote Sensing Centre Technical Series NRSC 4. Directorate of Forestry. Ministry of Environment and Tourism. Windhoek.)

As yet no map specifically of cleared forest land or of cultivated land has been produced for Namibia.

E. LINKAGES WITH OTHER FORESTRY INDICATORS

In identifying SoER indicators the ideal situation arises when the needs of the SoER process are met by indicators which have been developed and are indeed being monitored for other purposes. In this regard, there are three existing indicator processes in the field of forestry which merit close attention.

- National Criteria and Indicators for Sustainable Forest Management

The Directorate of Forestry, assisted by the Namibia-Finland Forestry Programme, is aiming to produce a number of criteria and indicators for monitoring sustainable forest management before mid-2000. These will be based on criteria and indicators developed at a number of international fora including the Second Ministerial Conference on Forests in Europe in Helsinki in 1993, a meeting in Montreal for other non-European like-minded countries, a meeting at Tarapoto for Amazon Basin countries, and various meetings at which Namibia’s Directorate of Forestry has been represented, and which have produced a set of criteria and indicators for sustainable forest management in SADC countries within the framework of the dry-zone Africa process as coordinated by the FAO/UNDP.

The criteria for assessing sustainable forest management proposed for review and adaptation to Namibia’s situation are as follows.
Environmental criteria
Development, maintenance and improvement of forest resources, including their contribution to global warming.
Conservation and enhancement of biological diversity in forest ecosystems.
Maintenance and health of forest ecosystems health and vitality.

Management criteria
Maintenance and enhancement of productive functions of forests and other wooded lands.
Maintenance and improvement of environmental and conservation functions of forests and other wooded lands and combating desertification.

Socio-economic criteria
Maintenance and enhancement of socio-economic benefits of forests and other wooded lands.

Legal, institutional and policy criteria
Adequacy and effectiveness of legal, institutional and policies frameworks for sustainable forest management.

At the time of reporting three working groups are reviewing these criteria and the indicators prepared to monitor them. The process should be complete by early in the year 2000.

- Namibian National Biodiversity Task Force Indicators
Under the auspices of the Namibian National Biodiversity Task Force, work is currently underway in a number of specialist working groups to look at systems for monitoring biodiversity in different ecosystems. Different working groups are currently looking at terrestrial bio-monitoring, forest and wetlands biodiversity, with others to follow in due course. Thematic background papers are being prepared for incorporation into the National Biodiversity Strategy by the end 1999, and work has started in defining appropriate criteria and indicators. At the time of reporting it is too early to say what sort of indicators will be defined.

It would seem that there is likely to be some overlap between forest biodiversity indicators and those indicators defined for the first three criteria as noted in the box above. Indeed, while it would appear that the SoER and biodiversity indicator projects could have benefited from better co-ordination at the planning stage, it will be important that the two projects co-operate closely in indicator monitoring and reporting.

- Global Forest Resources Assessment
The Forest Department of the FAO collects and compiles forest information internationally. This information goes into a biannual report entitled State of the World's Forests and a Global Forest Resources Assessment every ten years (the next is due in the year 2000).

Key indicators that the Global Forest Resources Assessment will report on include:
- Area of natural forest cover
- Plant and tree resources
- Volume and biomass of tree resources
- Forest changes

It may be noted that the following information is provided on countries in southern Africa in the State of the World's Forests 1999 (FAO. 1999) (FAO. 1999. State of the World's Forests 1999 Food and Agriculture Organisation of the United Nations. Rome ISBN 92-5-104193-8). Unfortunately, information on what definition of forest this applies to and on how this data was derived is not provided.
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<thead>
<tr>
<th>Country</th>
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<td>-354</td>
<td>-0.5</td>
</tr>
<tr>
<td>Lesotho</td>
<td>3035</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Malawi</td>
<td>9408</td>
<td>3612</td>
<td>3339</td>
<td>-273</td>
<td>-1.6</td>
</tr>
<tr>
<td>Mozambique</td>
<td>78409</td>
<td>17443</td>
<td>16862</td>
<td>-581</td>
<td>-0.7</td>
</tr>
<tr>
<td>South Africa</td>
<td>122104</td>
<td>8574</td>
<td>8499</td>
<td>-75</td>
<td>-0.2</td>
</tr>
<tr>
<td>Swaziland</td>
<td>1720</td>
<td>146</td>
<td>146</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zambia</td>
<td>74339</td>
<td>32720</td>
<td>31398</td>
<td>-264</td>
<td>-0.8</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>38685</td>
<td>8960</td>
<td>8710</td>
<td>-250</td>
<td>-0.6</td>
</tr>
</tbody>
</table>

Having reviewed these indicator processes, the team concludes that none can be considered as completely suitable at present to the SoER project’s needs. Clearly, however, it is imperative that the SoER project should liaise closely in this regard.
### INDICATOR 5: MAINTENANCE OF THE HYDROLOGICAL FUNCTION OF WETLANDS

#### Table

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Maintenance of the hydrological function of wetlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td>Water supply, both in terms of quantity and quality, whether below or above ground, needs to be maintained if the products and services provided by wetlands are to continue to play an important role in agricultural production in Namibia.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Assuming any decline in amount and quality of water supply to wetland systems results in a decline in wetland agricultural production, the indicator can be measured by using hydrological and water quality data currently being collected by DWA.</td>
</tr>
</tbody>
</table>

#### PURPOSE:
In a country as arid as Namibia, wetlands provide the focus of many agricultural practices and as such assume a disproportionate value relative to their size. Over much of the country, rural populations are highly dependent on wetland systems for their continued well-being. Given the assumption that water quantity and quality determine to a large extent the products and services (in terms of agriculture) provided by wetlands, this Indicator would provide a direct measure of a wetland systems ability to continue to supply those goods and services. Any decline in water quantity or quality would be assumed to lead to a decline in goods and services.

#### RELEVANCE:
Wetlands systems in Namibia form the basis of many of the farming systems/activities over much of the country, particularly in the communal areas where the greatest rural population densities are centered on wetland systems (e.g. the Cuvvela system, the Okavango River). These systems are essential to maintaining diverse rural livelihoods as they provide a broad range of goods and services (e.g. livestock grazing, arable soils, construction materials, water). Any loss of agricultural capacity through a decline in wetland functioning would result in a greater risk of insecurity in rural livelihoods.

#### LINKAGES TO OTHER INDICATORS
Not known

#### UNDERLYING VARIABLES AND DEFINITIONS:

- **Wetland**: See narrative account following. Coastal and marine wetlands are excluded and the focus is on the wetlands of the interior of the country.
- **Water quantity**: This would be broadly defined as the amount of water entering any wetland. Data already exist for many systems.
- **Water quality**: This would be broadly defined as the chemical composition of the water entering and/or exiting a system. Data already exist for certain systems.
- **Wetland goods/products**: Goods would include water, construction materials, fodder, fish, etc.
- **Wetland services**: Services would include water retention, groundwater recharge, nutrient transportation and flood attenuation. Wetland goods and services are defined in terms of type, extent and susceptibility to change in water quality and quantity.

#### MEASUREMENT OF THE INDICATOR
Data on water quantity and quality are routinely collected by the Dept. of Water Affairs within selected systems. This includes data on the amount of water within systems and the chemical composition of water within those systems. Pollution data is also collected within certain systems. Few data exist on the nature, extent and value of goods and services provided by wetlands. There is a need to have these data to understand perturbation risk and the implications of any change in the quantity and quality of water entering any wetland system.

#### LIMITATIONS OF THE INDICATOR
The limitations of this indicator are largely associated with a general lack of understanding and data on the nature, extent and value of the goods and services provided by different wetlands systems. This applies equally to goods and services in the broadest sense, as well as more specifically, agriculture. There is a need to quantify and qualify what these are (or may be) such that clear linkages within the framework of the Pressure-State-Response model can be defined. The general lack of data on the value of goods and services and a clear definition of linkages within the systems may result in this indicator being problematic to interpret and difficult to understand.
Narrative

Indicator Name: Maintenance of the hydrological functions of wetlands

Definition: Water supply, both in terms of quantity and quality, whether below or above ground, needs to be maintained if the products and services provided by wetlands are to continue to play an important role in agricultural production in Namibia.

Measurement: Regular monitoring of hydrological and water quality variables such as runoff rates, flood duration and peaks, water table depth and water quality variables would provide the basic data for this indicator in terms of water quantity and quality. Data on the importance/reliance of the different wetland systems on water quantity and quality are lacking (i.e. linkages are poorly understood). Data on goods and services provided by wetlands are also lacking.

Significance of the Indicator

Purpose: In a country as arid as Namibia, wetlands provide the focus of many agricultural practices and as such assume a disproportionate value relative to their size. Over much of the country, rural populations are highly dependent on wetland systems for their continued well being. Given the assumption that water quantity and quality determine to a large extent the products and services (in terms of agriculture) provided by wetlands, this indicator would provide a direct measure of a wetland systems ability to continue to supply those goods and services. Any decline in water quantity or quality would be assumed to lead to a decline in goods and services.

Relevance: Wetlands systems in Namibia form the basis of many of the farming systems/activities over much of the country, particularly in the communal areas where the greatest rural population densities are centred on wetland systems (e.g. the Cuvelai system, the Okavango River and floodplains, the west-flowing ephemeral rivers). These systems are essential to maintaining diverse rural livelihoods as they provide a broad range of goods and services (e.g. livestock grazing, arable soils, construction materials, water). Any loss of agricultural capacity through a decline in wetland functioning would result in a greater risk of insecurity in rural livelihoods.

Linkages to other indicators: Not known.

Underlying variables and definitions: The following definitions apply:

Wetland: those areas of marsh or water, whether natural or artificial, permanent or temporary (ephemeral), with water that is static or flowing, fresh, brackish or saline, including areas of marine water the depth of which at low tide does not exceed 6 metres.

For the purposes of this agricultural indicator coastal and marine wetlands included in this definition are excluded and the focus is on the wetlands (including artificial impoundments) of the interior of the country.

Water quantity: This would be broadly defined as the amount of water entering any wetland system over a given period of time (e.g. per annum). This may be defined in terms of flow rates, flood data, water table levels, etc. Data already exist for many systems.

Water quality: This would be broadly defined as the chemical composition of the water entering and/or exiting a system. Data already exist for certain systems.

Wetland goods/products: At present these are undefined. Goods would include such things as water, construction materials (e.g. thatching grass), livestock grazing, fish, arable soils. These need to be defined in terms of susceptibility to change in water quality and quantity.

Wetland services: At present these are undefined. Services would include such things as water retention, groundwater recharge, fish breeding grounds, nutrient transportation, improvement of water quality and flood attenuation. These need to be defined in terms of susceptibility to change in water quality and quantity.
Measurement of the indicator: Data on water quantity and quality are routinely collected by the Dept. of Water Affairs within selected systems. This includes the duration, timing and intensity of flooding, flow rates, rest water levels (important in alluvial aquifers), rates of water abstraction and the number of dams within each catchment system. Water quality data is also routinely collected and includes data on chemical composition of water (e.g. Total Dissolved Solids TDS, sodium content, fluoride levels etc). Pollution data is also collected within certain systems.

Few data exist on the nature, extent and value of goods and services provided by wetlands. There is a need to have these data to understand perturbation risk and the implications of any change in the quantity and quality of water entering any wetland system. For example, the construction of a dam upstream of a farming system dependent on the current flood regime would be expected to have a negative effect on agricultural production due to flood attenuation or failure.

Limitations of the indicator: The limitations of this indicator are largely associated with a general lack of understanding and data on the nature, extent and value of the goods and services provided by different wetlands systems. This applies equally to goods and services in the broadest sense, as well as more specifically, agriculture. There is a need to quantify and qualify what these are (or may be) such that clear linkages within the framework of the Pressure-State-Response model can be defined.

The lack of understanding and the paucity of data is a result of the strong sectoral definition of functions (roles and responsibilities) within government and other institutions and a failure to understand that wetlands cannot be managed sectorally. For example, water issues are largely dealt with by DWA with little recognition of the implications of any policy or programme on agricultural production, conservation or health within the same wetland system. There is little recognition of cross-sectoral demand for the same goods and services and the importance of wetland ecosystem integrity in the continued supply of goods and services.

The general lack of data on the value of goods and services and a clear definition of linkages within the systems may result in this indicator being problematic to interpret and difficult to understand.
**INDICATOR 6: % GDP SPENT ON AGRICULTURE AND FOREST RESOURCES RESEARCH, EXTENSION AND TRAINING (RET).**

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>GDP spent on agriculture and forest resources research, extension and training (RET).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>% of primary agricultural GDP and total GDP, and of GRN expenditure spent on agricultural and forest resources research, extension and training service provision by the government.</td>
</tr>
<tr>
<td><strong>Measurement</strong></td>
<td>Based on published financial reports and national accounts.</td>
</tr>
</tbody>
</table>

**Significance of the indicator**

**PURPOSE:**
To monitor government expenditure on agricultural and forest resources-related RET, in comparison to other government services and in relation to the sectors contribution to GDP, and international norms.

**RELEVANCE:**
Government's agriculture and forest resources-related RET services are one of societies key means of facilitating its “response” to the changing status of natural resources, as well as in determining the nature of production “pressures” on the natural environment.

The indicator is a quantitative measure of the funding provided by society for RET services in comparison with other services, and in relation to the importance of the sectors contribution to GDP.

**LINKAGES TO OTHER INDICATORS**
The indicator should be compared with the SoER indicator “GDP spent on education”.

It can also be compared to international norms - although direct comparison is not possible because of the unique national importance of the agriculture and forestry sectors in Namibia (see Interpretation, below).

**UNDERLYING VARIABLES AND DEFINITIONS:**

**MEASUREMENT OF THE INDICATOR**
The indicator is measured through a number of data sets which are already being gathered for other purposes (See: Calculation and Future Updating of the Indicator, below).

**LIMITATIONS OF THE INDICATOR**

i. The indicator tells us nothing about the quality of service provision, nothing about the efficiency with which services are provided nor on savings made when some current service provisions move to the private sector. Key qualitative issues are discussed in Part 4 of this report.

ii. Expenditure under the Main Division: Agricultural Training is mainly on agricultural colleges and since 1996/97 also on UNAM's Faculty of Agriculture and Natural Resources. It could be argued that this should be part of the education sector, and that it does not represent direct support to farmers.

iii. Expenditure under Main Division: Extension and Division included in earlier years (e.g. 1992/93) significant expenditure on non-extension items including support for Development Brigades Corporation and Drought Relief.

iv. Total expenditure on RET services excludes Main Divisions: Office of the Minister, Administration, Agricultural Engineering, and Planning, Pricing, Marketing and Co-operatives, some of which, especially Administration directly related to RET service provision.

v. Expenditure figures given are gross. They do not include revenue generated from the sale of services and produce. This is significant for the Main Division: Agricultural Research.

vi. Donor project support is not included. This may be partly justified (a) because it is of limited financial significance and (b) because of its heavy emphasis on high cost expatriate Technical Assistance. However the exclusion of Japanese Gov't assistance via KRII could skew the figures.

vii. Agricultural GDP figures is thought to under-represent production other than grain and livestock, particularly in the communal areas.
### A. PAST PERFORMANCE

#### Table 5.6: RET Indicator Data Set

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Dev. &amp; Extension*</td>
<td>82,758,459</td>
<td>50,512,667</td>
<td>68,290,847</td>
<td>53,221,503</td>
<td>64,298,270</td>
<td>67,654,857</td>
<td>47,091,426</td>
</tr>
<tr>
<td>Agricultural Research*</td>
<td>12,779,282</td>
<td>16,246,284</td>
<td>24,320,189</td>
<td>20,726,259</td>
<td>24,401,340</td>
<td>21,177,606</td>
<td>21,484,913</td>
</tr>
<tr>
<td>Agricultural Training*</td>
<td>3,810,354</td>
<td>8,684,782</td>
<td>9,990,254</td>
<td>11,577,746</td>
<td>19,211,790</td>
<td>28,544,007</td>
<td>41,615,636</td>
</tr>
<tr>
<td>Veterinary Services*</td>
<td>24,319,325</td>
<td>23,154,253</td>
<td>22,678,068</td>
<td>26,720,712</td>
<td>32,609,760</td>
<td>33,588,281</td>
<td>28,829,700</td>
</tr>
<tr>
<td>Forestry*</td>
<td>2,199,162</td>
<td>4,059,121</td>
<td>7,872,710</td>
<td>10,382,076</td>
<td>10,391,090</td>
<td>10,391,090</td>
<td>11,183,000</td>
</tr>
<tr>
<td>Total Recurrent RET**</td>
<td>125,866,582</td>
<td>102,657,117</td>
<td>133,152,068</td>
<td>122,628,926</td>
<td>150,912,250</td>
<td>144,694,850</td>
<td>144,694,850</td>
</tr>
<tr>
<td>Total DARD Capital**</td>
<td>30,322,763</td>
<td>24,102,653</td>
<td>41,178,666</td>
<td>53,212,834</td>
<td>24,102,653</td>
<td>24,102,653</td>
<td>24,102,653</td>
</tr>
<tr>
<td>Total Recurrent RET + DARD Capital</td>
<td>156,189,345</td>
<td>126,759,770</td>
<td>174,330,734</td>
<td>175,841,760</td>
<td>247,413,918</td>
<td>247,413,918</td>
<td>247,413,918</td>
</tr>
<tr>
<td>Total GRN Budget</td>
<td>3,423,127,922</td>
<td>3,386,258,053</td>
<td>3,738,441,561</td>
<td>4,379,913,007</td>
<td>5,325,049,983</td>
<td>(238,837,000)</td>
<td>(5,207,073,000)</td>
</tr>
<tr>
<td>Total Primary Agricultural GDP</td>
<td>458,000,000 (1993)</td>
<td>869,000,000 (1994)</td>
<td>900,000,000 (1995)</td>
<td>1,029,000,000 (1996)</td>
<td>972,000,000 (1997)</td>
<td>1,344,000,000 (1998)</td>
<td>(1,344,000,000 (1998)</td>
</tr>
<tr>
<td>Total GDP</td>
<td>8,630,000,000 (1993)</td>
<td>10,641,000,000 (1994)</td>
<td>11,778,000,000 (1995)</td>
<td>13,537,000,000 (1996)</td>
<td>14,987,000,000 (1997)</td>
<td>16,917,000,000 (1998)</td>
<td>(16,917,000,000 (1998)</td>
</tr>
</tbody>
</table>
Table 5.7: RET Indicators Data Set - RET Recurrent Expenditure Spent on Personnel

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Personnel: 27,332,951 (43%)</td>
<td>Personnel: 27,987,596 (41%)</td>
<td>Personnel: 29,029,493 (62%)</td>
</tr>
<tr>
<td>Agricultural Dev. &amp;</td>
<td>64,298,270</td>
<td>67,654,857</td>
<td>47,091,426</td>
</tr>
<tr>
<td>Extension *</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural Research*</td>
<td>24,401,340</td>
<td>21,177,606</td>
<td>21,484,913</td>
</tr>
<tr>
<td>Personnel: 14,219,549</td>
<td></td>
<td>Personnel: 11,740,066 (55%)</td>
<td>Personnel: 13,677,128 (64%)</td>
</tr>
<tr>
<td>(58%)</td>
<td></td>
<td>(55%)</td>
<td></td>
</tr>
<tr>
<td>Agricultural Training*</td>
<td>19,211,790</td>
<td>28,544,007</td>
<td>41,615,063</td>
</tr>
<tr>
<td>Personel: 3,630,528</td>
<td></td>
<td>Personel: 6,540,927 (23%)</td>
<td>Personel: 12,091,426 (29%)</td>
</tr>
<tr>
<td>(19%)</td>
<td></td>
<td>(23%)</td>
<td></td>
</tr>
<tr>
<td>Veterinary Services*</td>
<td>32,609,760</td>
<td>33,588,281</td>
<td>28,828,700</td>
</tr>
<tr>
<td>Personel: 19,297,728</td>
<td></td>
<td>Personel: 20,022,368 (60%)</td>
<td>Personel: 21,290,804 (74%)</td>
</tr>
<tr>
<td>(59%)</td>
<td></td>
<td>(60%)</td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td>140,521,160</td>
<td>150,964,751</td>
<td>139,020,102</td>
</tr>
<tr>
<td>Personel: 64,480,756</td>
<td></td>
<td>Personel: 66,290,957 (44%)</td>
<td>Personel: 76,088,851 (55%)</td>
</tr>
<tr>
<td>(46%)</td>
<td></td>
<td>(44%)</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.8: RET Indicators

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>% Expenditure of Agric. &amp; Vet. RET spent on Personnel (excl. Dor. of Forestry)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>46</td>
<td>44</td>
<td>55</td>
</tr>
<tr>
<td>Expenditure on Agric. Extension as % of Primary Agric. GDP</td>
<td>18***</td>
<td>5.8</td>
<td>7.6</td>
<td>5.2</td>
<td>6.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expenditure on Agric. Research as % of Primary Agric. GDP</td>
<td>2.8</td>
<td>1.8</td>
<td>2.7</td>
<td>2.0</td>
<td>2.5</td>
<td>Average in previous 5 years: 2.4</td>
<td></td>
</tr>
<tr>
<td>Total Expenditure** on Agric. &amp; For. RET as % of Primary Agric. GDP</td>
<td>34</td>
<td>15</td>
<td>19</td>
<td>17</td>
<td>25</td>
<td>Average in previous 5 years: 22</td>
<td></td>
</tr>
<tr>
<td>Total Expenditure** on Agric. &amp; For. RET as % of Total GRN Expenditure</td>
<td>4.5</td>
<td>3.7</td>
<td>4.6</td>
<td>4.0</td>
<td>4.6</td>
<td>Average in previous 5 years: 4.3</td>
<td></td>
</tr>
<tr>
<td>Total Expenditure** on Agric. &amp; For. RET as % of Total GDP</td>
<td>1.8</td>
<td>1.2</td>
<td>1.4</td>
<td>1.3</td>
<td>1.7</td>
<td>Average in previous 5 years: 1.5</td>
<td></td>
</tr>
</tbody>
</table>

* Actual recurrent expenditure (authorised appropriation in brackets).
** Total DARD capital expenditure is (a) mainly spent on RET-related projects, and (b) includes significant recurrent expenditure under the guise of capital expenditure. Therefore, total expenditure on RET includes both recurrent expenditure of those Directorates and Divisions noted and total DARD capital expenditure. (From 1994/95, Directorate of Forestry Capital expenditure is not included.)
*** 1992/93 Main Division Extension and Development expenditure included support for the Development Brigades Corporation, Drought Relief, and other non-extension activities.
B. INTERPRETATION

Expenditure on Agric. Research and Agricultural Extension as % of Primary Agric. GDP:

The levels of support for public sector national agricultural research and agricultural extension are often expressed in relation to the contribution of agriculture to the gross domestic product (AgGDP). They are sometimes referred to as the "agricultural research intensity (ARI) ratio" and ("agricultural extension intensity (AEI) ratio"). Namibia's figures appear to compare well with international norms. Some examples of ARIs are as follows:

- Sub-Saharan Africa during 1981-85 averaged 0.49% (Pardy et al. 1991).
- SADC countries averaged 1.02% (ISNAR, 1993).
- Developed countries averaged 3% + (ISNAR, 1993)
- Botswana 4.7% (ISNAR, 1993)
- South Africa rose from 1.2% in 1961 to 2.6% in 1991 (Beynon et al. 1998)
- Nigeria dropped from 0.81% in 1981 to 0.19% in 1991 (Beynon et al. 1998)
- Cape Verde more than 6% (Beynon et al. 1998)

AEI patterns are shown in the following tables (Swanson et al. 1989):

Table: 5.9 Extension Expenditures as a Percent of AgGDP Mean Levels for 1980, 1985 and 1988

<table>
<thead>
<tr>
<th></th>
<th>Africa %</th>
<th>Asia/ Pacific%</th>
<th>Europe %</th>
<th>Latin America %</th>
<th>North America %</th>
<th>Near East %</th>
<th>World-wide %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>1.17</td>
<td>0.48</td>
<td>0.44</td>
<td>1.22</td>
<td>0.39</td>
<td>n/a</td>
<td>0.96</td>
</tr>
<tr>
<td>1985</td>
<td>0.86</td>
<td>0.68</td>
<td>0.47</td>
<td>0.90</td>
<td>0.41</td>
<td>0.96</td>
<td>0.87</td>
</tr>
<tr>
<td>1988</td>
<td>0.98</td>
<td>0.56</td>
<td>n/a</td>
<td>1.40</td>
<td>n/a</td>
<td>1.00</td>
<td>0.88</td>
</tr>
<tr>
<td>Average</td>
<td>1.04</td>
<td>0.57</td>
<td>0.46</td>
<td>1.17</td>
<td>0.40</td>
<td>0.98</td>
<td>0.90</td>
</tr>
<tr>
<td>N=</td>
<td>20</td>
<td>13</td>
<td>3</td>
<td>13</td>
<td>1</td>
<td>7</td>
<td>57</td>
</tr>
</tbody>
</table>

Table: 5.10 Extension Expenditures as a Percent of AgGDP, Mean Levels for 1980, 1985 and 1988 Categorised by Per Capital Income Levels

<table>
<thead>
<tr>
<th></th>
<th>Low income %</th>
<th>Lower middle %</th>
<th>Upper middle %</th>
<th>High income %</th>
<th>World-wide %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>1.00</td>
<td>1.19</td>
<td>0.71</td>
<td>0.42</td>
<td>0.96</td>
</tr>
<tr>
<td>1985</td>
<td>0.73</td>
<td>1.19</td>
<td>0.85</td>
<td>0.42</td>
<td>0.87</td>
</tr>
<tr>
<td>1988</td>
<td>0.78</td>
<td>0.93</td>
<td>0.48</td>
<td>n/a</td>
<td>0.88</td>
</tr>
<tr>
<td>Average</td>
<td>0.84</td>
<td>1.10</td>
<td>0.68</td>
<td>0.42</td>
<td>0.90</td>
</tr>
<tr>
<td>N=</td>
<td>19</td>
<td>16</td>
<td>7</td>
<td>4</td>
<td>46</td>
</tr>
</tbody>
</table>

1 Using 1988 extension expenditure data and 1987 AgGDP data for each country. The data represent the simple mean of 57 countries sampled without allowing for size of country difference.

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Several factors need to be considered in assessing these comparisons.

(i) Developing countries' expenditures are determined by budgetary constraints rather than as planned. It may be noted that developed countries support higher levels of investment in agricultural research through industry taxes. An interesting point of comparison is Botswana where high levels of research investment are supported by mining income.

(ii) It is also notable that small countries normally maintain higher levels of support than large countries - due to the economies of scale that are attained by the latter. As a rule of thumb Swanson suggests that small countries may need to invest 1.5-2.0% to maintain a minimal research capacity that can adapt externally developed technology for local conditions. (Swanson et al. 1989)

(iii) Another important issues, particularly for Namibia, is the urgency of the research and extension services in response to both social and technical reasons, which may predicate short-term high rates of support (ISNAR. 1993).

Total Expenditure on Agric. & For. RET as % of Primary Agric. GDP

Instead on concentrating exclusively on one aspect of public sector farmer service provision this indicator combines expenditure on the key agricultural support services. It reveals high levels of investment in relation to AgGDP. It might be of interest to take this exercise a step further and include all agricultural sector support services (e.g. all DARD expenditure, agricultural credit expenditure, marketing support, drought relief and so forth). High levels of public sector expenditure in relation to Ag GDP partly reflect the structure of Namibia's economy which is notoriously State dominated.

Total Expenditure on Agric. & For. RET as % of Total GDP

This indicator recognises that the importance of the agriculture and forestry sectors is not simply reflected in their contribution to AgGDP. In Namibia, these sectors have important social and environmental implications which increases their importance in national terms. Equally, agricultural and forestry RET services impact on all the government's major development objectives (economic and employment growth, and reduction in income inequalities and poverty), and have linkages with many other sectors, such as human resources development (education) and health and nutrition. As such one would expect it to receive a greater share of the government budget, and % of GDP, than Ag GDP would predict.

Total Expenditure on Agric. & For. RET as % of Total GRN Expenditure

Given the above, and that expenditure ratios in relation to AgGDP and total GDP in good part reflect the degree of State dominance of Namibia's economy, it is of interest to consider the ratio of public sector expenditure on RET services in comparison with other public sector services.

C. CALCULATION AND FUTURE UPDATING OF THE INDICATOR

Sectoral expenditure data:
The Finance Division of the Directorate of General Services of the Ministry of Agriculture, Water and Rural Development has, in recent years, produced its financial report within six months of the preceding financial year. This provides information on appropriations and expenditure for all the Main Divisions noted above excepting that for the Directorate of Forestry, which is provided by the Ministry of Environment and Tourism.

Total GRN expenditure data:
Total GRN expenditure data is provided in the reports of the Office of the Auditor General. These are normally produced about two years after the end of the financial year in question.
Total agricultural GDP and total GDP:
Total agricultural GDP and total GDP data is provided in the National Accounts published by the Central Bureau of Statistics of the National Planning Commission, as well as the annual Agricultural Statistics Bulletin produced by the Directorate of Planning of the Ministry of Agriculture, Water and Rural Development.

D. MAPS

It would be technically possible to map government expenditure on RET services on a regional basis, but it would be a complex exercise because of the highly centralised nature of much of RET service organisation and management currently.

In addition, it would be impossible, given the data available, to disaggregate primary agricultural GDP, total GDP, and total GRN expenditure on a regional basis.

What would be possible, and of significance, would be the assessment of certain RET service data (for instance, agricultural and forest resources research and extension service expenditure, and related GRN staff) in relation numbers of farming households on a regional basis.
INDICATOR 7: POPULATION CHANGES / MOVEMENT

<table>
<thead>
<tr>
<th>INDICATOR NAME</th>
<th>Population Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEFINITION</td>
<td>The density of the population divided by the surface area.</td>
</tr>
<tr>
<td>MEASUREMENT</td>
<td>Measured through a combination of population density, percentage of the Population dependant on agriculture and the percentage of people using firewood for cooking. Overall, this measure is relative to the general carrying capacity of the land (relative to aridity index).</td>
</tr>
</tbody>
</table>

Significance of the Indicator

PURPOSE: This indicator measures the spatial concentration of the human population. It also measures the extent to which the population is dependant on natural Resources. It can be used as partial indicator of human requirements and activities in an area.

RELEVANCE: The indicator is most useful at Enumeration area level. Agenda 21 makes specific reference to population density in relation to desertification. However, in Namibia the high levels of variance in rainfall and aridity has a major influence on the ability of natural Resources to support its population sustainably. The level to which people are dependant on natural resources also has an influence on the number of people an area can support.

LINKAGES TO OTHER INDICATORS: The indicator has close linkages with other variables particularly the population growth rate, net migration rate, life expectancy at birth, total fertility rate and human settlement. Higher population densities generally mean increased reliance on natural resources, as well as environmental impacts such as human and solid waste disposal and emissions to air and water. Areas with high population densities tend to rely on the resources of less populated hinterlands, and thereby increase the risk of exceeding regional carrying capacities for stock and sink resources. With sub-national data, Relationships to ecosystems, urban issues and arable land for example can be addressed at a more local level.

UNDERLYING VARIABLES AND DEFINITIONS

The indicator consist of a combination of four Variables namely population density, % of the Population dependant on agriculture, % of the Population using firewood for cooking, and an aridity index.

The percentage of the population dependant on subsistence agriculture is calculated as the number of people in the area who derive their livelihood from agricultural activities. Expressed as a percentage of the total Population in the area. The percentage of the Population using firewood for cooking is calculated in the same way.

Aridity is measured as the growing period which is the period when precipitation exceeds half the potential evapotranspiration.

LIMITATIONS OF THE INDICATOR

The high levels of climatic variability can cause Distortions and seasonal actuals may need to be incorporated in the benchmark values. Data needs to be disaggregated as much as possible to represent the smallest possible Geographic area.

<table>
<thead>
<tr>
<th>MEASUREMENT OF THE INDICATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>The indicator should be used as a GIS query as follows:</td>
</tr>
<tr>
<td><strong>High Pressure</strong></td>
</tr>
<tr>
<td>GP = class 1 and 2</td>
</tr>
<tr>
<td>PD &gt; 15/km²</td>
</tr>
<tr>
<td>AD &gt; 60%</td>
</tr>
<tr>
<td>FW &gt; 80%</td>
</tr>
<tr>
<td>GP = class 3 and 5</td>
</tr>
<tr>
<td>PD &gt; 7/Km²</td>
</tr>
<tr>
<td>AD &gt; 50%</td>
</tr>
<tr>
<td>FW &gt; 80%</td>
</tr>
<tr>
<td>GP = class 4</td>
</tr>
<tr>
<td>PD &gt; 3/Km²</td>
</tr>
<tr>
<td>AD &gt; 40%</td>
</tr>
<tr>
<td>FW &gt; 70%</td>
</tr>
<tr>
<td>GP = classes 6 - 11</td>
</tr>
<tr>
<td>PD &gt; 1/Km²</td>
</tr>
<tr>
<td>AD &gt; 30%</td>
</tr>
<tr>
<td>FW &gt; 60%</td>
</tr>
</tbody>
</table>

PD = Population Density  GP = Growing Period  AD = Dependency on Agriculture  FW = firewood use
The indicator on population pressure which follows next, has been taken from the SOER on the Socio-Economic Environment in Namibia. (Urban Dynamics Africa, Trend Line 1999; indicator 3.2.15). As can be seen from its summary table, this indicator consists of a number of variables:

- Population density
- % population dependent on agriculture
- % population using firewood for cooking
- an aridity index

It is evident that population pressure has a direct impact on agriculture and on land use. This is particularly so around urban areas, along the ephemeral rivers and in the Cuvelai.
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