

## **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.

## 5.2 Process for Defining Indicators

The SoER Agriculture and Land Resources team adopted the following procedures for identifying indicators.

1. It reviewed the indicators identified by the three SoER reports already complete under the project (see chapter 1.1). This revealed no systematic approach to the identification of criteria for identifying indicators. This is likely to make the compilation of a set of indicators for the greater State of the Environment Reporting project more difficult. On the other hand it gives different sectoral reporting initiatives, such as this one, the opportunity to define its own criteria according to the perceived needs of the sector.
2. In view of the need for a broad-based consensus amongst stakeholders in support of indicators, the project sought to involve a range of experts and stakeholders in indicator formulation. This was achieved by:
  - (i) intensive discussion of indicator issues by the 11 person team of experts which prepared the State of the Environment Report on Agriculture and Land Resources;
  - (ii) inputs from a project Task Force whose mandate was to direct the report preparation process;
  - (iii) on-going discussions with interested parties during the report preparation period;
  - (iv) two project workshops: one specifically to discuss indicators, and a second to review the draft final report, which included the indicators proposed.

### Criteria for defining Indicators

Initially, the following criteria were adopted for considering potential indicators.

1. Degree of **relevance** (e.g. indicative value in terms of representativeness, geographical coverage and responsiveness to change) to the main issues which determine the state of the environment.
2. **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.
3. **Utility** of the indicator for decision makers in terms of it being understandable and its relevance agreeable to users.

These criteria were used to consider an initial list of possible indicators drawn up by the SoER team in a workshop convened on 13 September and attended by 45 participants. The initial list of indicators is presented on the following pages. It should be noted that response indicators were classified in terms of the conditions required for sustainable agriculture and land use, as per the conceptual framework adopted, as policies and regulatory framework” (Pol./Reg.), “technologies” (Tech.), or “organisational” (Org.).

A full report on the workshop is available on request.

Issue	Indicator
<p>Agriculture and land resources-general</p>	<p><b>Pressure</b></p> <ul style="list-style-type: none"> <li>- Contribution of primary agricultural production to annual GDP (indicator of reliance on primary agricultural production and movement towards diversification).</li> <li>- Contribution of agricultural and forestry sectors to total foreign exchange earnings (indicator of importance of agriculture sector to the overall economy).</li> <li>- 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]).</li> <li>- Contribution of agricultural production to main sources of income among Namibian households (Namibia Household Income and Expenditure Survey)</li> <li>- 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.</li> <li>- Labour involved in agriculture, and specifically labour force and wages paid to workers on privately owned farms (increased number/incomes indicates health of sector).</li> <li>- 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)</li> <li>- Percentage of population "depending on agriculture for their livelihoods" - the magic "70%" figure.</li> <li>- Harvesting of veld and forest products and hunting of wild animals and fish as sources of food and income.</li> </ul> <p><b>Response</b></p> <ul style="list-style-type: none"> <li>- Effectiveness of policies and programmes to overcome rural poverty. (Pol./Reg.)</li> <li>- Percentage of government's annual budget allocated to agricultural research (including veterinary and forestry research) (% budget allocated to extension services?) (Where &gt; 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.).</li> <li>- Government budget allocation to research and extension per farmer (Org.)</li> <li>- Percentage of research and extension budgets allocated to programme and operational costs vs. remuneration costs (FAO recommends 35-40% : 65-60%) (Org.)</li> <li>- Percentage of international development aid devoted to agriculture (Org.)</li> <li>- Some indicator of response to the issues of gender in agriculture.</li> <li>- 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.)</li> </ul>

Issue	Indicators
Sustainable Range Management	<p><b>Pressure</b></p> <ul style="list-style-type: none"> <li>- 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).</li> <li>- 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).</li> <li>- 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).</li> <li>- Ratio of per LSU availability of grazing (assessed carrying capacity x area) in relation to livestock numbers (indicator of grazing pressure).</li> <li>- Ratio of used to unused range land (indicator of availability of emergency grazing subject to water point development).</li> <li>- Extent of multi-species production (indicator of mix of grazers and browsers - assumed better range management practice).</li> <li>- Range yields (? How to factor out rainfall)</li> <li>- Fodder shortage in dry season (sales of supplementary fodder) in relation to livestock numbers (? How to factor out rainfall)</li> <li>- Livestock numbers in relation to annual marketing (high numbers and low marketing indicator of increasing numbers)</li> <li>- Land use in relation to erosion hazard</li> <li>- Drought (annual rainfall in lowest 7 percentile of mean annual rainfall)</li> </ul> <p><b>Status</b> (all measured by monitoring of network of "managed" and control plots)</p> <ul style="list-style-type: none"> <li>- Estimated grazing condition.</li> <li>- Rates of recovery of plant cover after drought.</li> <li>- Extent and degree of bush encroachment/dieback.</li> <li>- Extent and degrees of denudation/recovery.</li> <li>- Grass sward composition and trends (annual and perennials/unpalatable and palatable species)</li> <li>- Occurrence of soil fertility/range status indicator plants (e.g. poisonous plants and invasive alien species)</li> <li>- Soil nutrient levels and organic matter content (soil lab. surveys (long term data needs to be analysed)</li> <li>- Extent and severity of physically eroded land/soils (bare, trampled, capped etc.) (Siltation of dams and rivers)</li> </ul>

Issue	Indicators
Sustainable Range Management (cont.)	<p>Response</p> <ul style="list-style-type: none"> <li>- Effective implementation of land reform legislation to promote land tenure security. (Pol./Reg.)</li> <li>- Effective implementation of the Soil Conservation Act and National Drought Policy and Strategy (Pol./Reg.)</li> <li>- Democratic credentials of Land Boards under new land legislation (Pol./Reg.)</li> <li>- Inclusion of rangelands in CBNRM activities and Conservancies(Org.)</li> <li>- Adoption of flexible livestock management practices (marketing, movement etc.) (by particular target groups including resettled farmers) (Tech.)</li> <li>- Ratio of Agricultural Extension Technicians in the field to farmers, and ratio of members of Farmer Extension Development Groups to farmers (belonging to particular target groups including resettled farmers) (Org.)</li> <li>- Membership of farmer self-help organisations/associations (Org.) (Quarterly and Annual Directorate of Extension Services Reports from the Research and Extension MIS)</li> </ul>

Issue	Indicators
Sustainable Forest Management	<p><b>Pressure</b></p> <ul style="list-style-type: none"> <li>- 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 forest management).</li> <li>- Ratio of wood and other forest product harvests and estimated regrowth (Indicator of resource depletion caused by over-exploitation)</li> <li>- Cost of wood and forest products in selected markets as an index of local shortages (Local market surveys)</li> <li>- Issuing of forest utilisation permits and incidence of illegal cutting in protected areas (culprit apprehension reports)</li> <li>- Incidence and timing of forest fires in strategic forest areas. (Area subject to burning as a ratio of acceptable norms for a particular area)</li> </ul> <p><b>Status</b></p> <ul style="list-style-type: none"> <li>- Changes in tree inventory (Forest Inventory Studies and Tree Atlas Project)</li> <li>- Changes in forested area cover (Comparative analysis of aerial photos and satellite imagery)</li> <li>- Declines in forest products/timber stocks</li> <li>- Distribution of mobile bird populations as indicators of habitat change (Southern African Bird Atlas Project).</li> </ul> <p><b>Response</b></p> <ul style="list-style-type: none"> <li>- Effective implementation of land reform legislation to promote forest land and tree tenurial security (Pol./Reg.)</li> <li>- Proclamation of state forests etc. (Pol./Reg.)</li> <li>- Inclusion of forests and forest products in CBNRM activities (Pol./Reg.)</li> <li>- Enhanced community participation in forest protection and management (Org.)</li> <li>- Increased adoption of agro-forestry practices (Tech.)</li> <li>- Ratio of Forestry Extension staff in the field to farmers (Org.)</li> <li>- Membership of forest users self-help organisations/associations (Org.)</li> </ul>

Issue	Indicators
Sustainable Wetlands Management	<p><b>Pressure</b></p> <ul style="list-style-type: none"> <li>- 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).</li> <li>- Cultivation on wetlands soils and watershed soils with high erosion hazard without soil conservation measures</li> <li>- Number and capacity of dams per strategic watershed.</li> </ul> <p><b>Status</b></p> <ul style="list-style-type: none"> <li>- Distribution of migratory bird populations as indicators of habitat change (Southern African Bird Atlas Project).</li> <li>- Wetland vegetation inventory (Tree Atlas Project)</li> <li>- Rates of aquifer recharge</li> </ul> <p><b>Response</b></p> <ul style="list-style-type: none"> <li>- Effective implementation of land reform legislation to promote wetlands tenurial security (Pol./Reg.)</li> </ul>

Issue	Indicators
Maintenance of agriculturally useful species biodiversity	<p><b>Pressure</b></p> <ul style="list-style-type: none"> <li>- Livestock cross-breeding programmes</li> <li>- Replacement of traditional crop varieties with new improved varieties and new exotic crops</li> <li>- Loss of habitats</li> </ul> <p><b>State</b></p> <p><b>Response</b></p> <ul style="list-style-type: none"> <li>- In-situ and ex-situ gene conservation measures: livestock breeders associations, gene banks, botanic collections (Tech.).</li> </ul>

Issue	Indicator
Sustainable Rainfed Arable Land Management	<p><b>Pressure</b></p> <ul style="list-style-type: none"> <li>- 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).</li> <li>- 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)</li> <li>- Rural livelihood diversification (Household income and expenditure surveys (CSO) and Farm Management Surveys (MAWRD)).</li> <li>- Rural-urban migration (rural-urban population growth rates).</li> <li>- Land use in relation to erosion hazard (indicator of risk erosion risk from crop farming).</li> <li>- Ratio of cultivated to cultivable land (indicator of availability of addition arable land in future).</li> <li>- Use(annual sales) of chemical pesticides (indicator of risk of soil and water pollution).</li> <li>- 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).</li> </ul> <p><b>Status</b> (all measured by monitoring of network of "managed" and control plots)</p> <ul style="list-style-type: none"> <li>- Soil nutrient levels and organic matter content (soil fertility surveys).</li> <li>- Extent and severity of physically eroded soils (gullyng, sheet and wind erosion, hard pans, plough lines, pulverisation, salinisation) arable land.</li> <li>- Ratio of actual to estimated (modelled) potential crop yields.</li> <li>- Abandonment of eroded, formerly cultivated land.</li> <li>- Occurrence of soil fertility indicator plants (e.g. <i>Striga sp.</i>).</li> <li>- Accumulation of chemical pesticides and residues in soils and water (measured by microbial activity).</li> </ul> <p><b>Response</b></p> <ul style="list-style-type: none"> <li>- Adoption of appropriate low tillage cultivation technologies (Tech.) (Implement sales).</li> <li>- Adoption of appropriate fertilisation technologies (manure, crop residues, incorporation, inorganic fertilisers, fallowing, agro-forestry) (Tech.).</li> <li>- Adoption of practices to reintegrate of organic matter content in soils (biomass entering the soil) (Tech.).</li> <li>- 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).</li> <li>- Implementation of land reform legislation to promote arable land tenure security (Pol./Reg.)</li> <li>- 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).</li> <li>- Membership of farmer self-help organisations/associations (Org.) (Annual Reports of the NNFU, NAU, Registrar of Co-operatives, the National Extension Service).</li> <li>- 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).</li> </ul>

Issue	Indicator
Sustainable Irrigated Arable Land Management	<p><b>Pressure</b></p> <ul style="list-style-type: none"> <li>- Excessive use of irrigation waters leading to mechanical and biological soil erosion, waterlogging, salinisation (flood and sprinkler)</li> <li>- Poor maintenance of drainage structures (preventing leaching of salts)</li> <li>- Use of chemical pesticides</li> <li>- Use of inorganic fertiliser (eutrophication of downstream waters)</li> <li>- Alternative demands for irrigation (discussion of economics of irrigation schemes considering competing demands for water)</li> </ul> <p><b>Status</b></p> <ul style="list-style-type: none"> <li>- Crop yields</li> <li>- Soil salinity levels</li> <li>- Soil erosion</li> <li>- Siltation of irrigation structures</li> <li>- Accumulation of chemical pesticides and residues in soils and water (measured by microbial activity)</li> <li>- Accumulation of inorganic fertilisers and residues in soils and water (measured by microbial activity)</li> </ul> <p><b>Response</b></p> <ul style="list-style-type: none"> <li>- Development of irrigation schemes and expansion of the land area under irrigation (Tech.).</li> <li>- Development of irrigation management structures which give responsibility for scheme infrastructure management to irrigation users (Org.).</li> <li>- 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.).</li> <li>- Irrigation water use efficiency: area of irrigated land subject to flood irrigation as compared to sprinkler or drip irrigation systems (Tech.).</li> <li>- Implementation of regulations governing the sale and use of chemical pesticides and the adoption of Integrated Pest Management practices (Pol./Reg.).</li> </ul>

### 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 NOAH 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.
10. Farmer: extension worker ratios and membership of farmer organisations (indicating strength of institutional responses).
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.

14. Forest fire: incidence, timing, area.
15. Population changes / movement.
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**

<b>Indicator Name</b>	<b>Security of tenure</b>	
<b>Definition</b>	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.	
<b>Measurement</b>	The proportion of Namibia's land area on which individuals and communities using land resources have secure tenure rights	
<b>Significance of the indicator</b>		
<b>PURPOSE:</b> This indicator provides a proxy for incentives or disincentives to make medium- to long-term investment in natural resources enhancement or preservation.		
<b>RELEVANCE:</b>	<b>LINKAGES TO OTHER INDICATORS</b>	
<p>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.</p> <p>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.</p>	<p>This indicator is linked to the availability of extension services to farmers, the human poverty index and the human development index.</p>	
<b>UNDERLYING VARIABLES AND DEFINITIONS:</b>	<b>MEASUREMENT OF THE INDICATOR:</b>	
<p>This indicator will require the qualitative assessment of perceptions of security of rights under different types of tenurial 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.</p>	<p>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).</p>	
<b>LIMITATIONS OF THE INDICATOR:</b>		
<p>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</p>		

## 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. NOLIPDEP 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 be 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 question 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**

<b>Indicator Name</b>	<b>Rangeland Condition Index</b>	
<b>Definition</b>	The extent to which rangeland condition is improving or degrading	
<b>Measurement</b>	To measure rangeland as a condition score (% or index) in relation to the potential for that area	
<b>Significance of the indicator</b>		
<b>PURPOSE:</b>		
<p>This indicator measures the condition of the rangeland as reflected in the following four processes in the rangeland ecosystem:</p> <ul style="list-style-type: none"> <li>• Water cycle (soil surface condition)</li> <li>• Mineral cycle (micro-organisms in soil)</li> <li>• Energy flow (vigour, density, composition)</li> <li>• Community dynamics (composition, ecological status, bush encroachment)</li> </ul>		
<b>RELEVANCE:</b>	<b>LINKAGES TO OTHER INDICATORS</b>	
<p>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.</p>	<p>This indicator is directly linked to farming practices, range management approaches, rainfall, etc.</p>	
<b>UNDERLYING VARIABLES AND DEFINITIONS:</b>	<b>MEASUREMENT OF THE INDICATOR:</b>	
<p>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.</p>	<p>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.</p>	
<b>LIMITATIONS OF THE INDICATOR:</b>		
<p>Sometimes inability of surveyors to recognize smaller indicators of rangeland degradation. Through practice and experience, this can be overcome.</p>		

**INDICATOR 3: SUSTAINABLE IRRIGATION DEVELOPMENT**

**Table**

<b>Indicator Name</b>	<b>Sustainable Irrigation Development</b>	
<b>Definition</b>	A composite indicator including, initially, (a) land area used for irrigated crop production (b) irrigated areas used for "low value" versus "high value" crop production (c) an assessment of progress towards the establishment of irrigation scheme management boards giving users responsibility for large scale irrigation scheme infrastructure	
<b>Measurement</b>	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	
<b>Significance of the indicator</b>		
<b>PURPOSE:</b> Irrigation represents a major investment in land for agricultural purposes. However, the expansion of the land area under irrigation indicates <i>per se</i> 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.		
<b>RELEVANCE:</b>	<b>MEASUREMENT OF THE INDICATOR</b>	
<p>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.</p> <p>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, maize 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.</p> <p>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.</p>	<p>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.</p> <p>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.</p> <p>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 <i>et al.</i> 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.</p>	

**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.).

## Narrative

### 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 totaling 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 be 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.* 1996) 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\$ 28.3 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<sup>3</sup>, revenues will never be sufficient to cover

operating costs. NamWater is currently charging 10 cents per m<sup>3</sup> to the Scheme, with a new rate of 14.2 cents per m<sup>3</sup> 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 Shadikongoro 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 led 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 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.

### **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**

<b>Indicator Name</b>	<b>Forest and crop area change</b>	
<b>Definition</b>	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.	
<b>Measurement</b>	(a) & (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	
<b>Significance of the indicator</b>		
<b>PURPOSE:</b>		
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.		
<b>RELEVANCE:</b>	<b>LINKAGES TO OTHER INDICATORS</b>	
This indicator will give us an indication of the degree to which <ul style="list-style-type: none"> <li><input type="checkbox"/> Forested areas are diminishing</li> <li><input type="checkbox"/> Cleared land is increasing</li> <li><input type="checkbox"/> Cultivated land is increasing</li> <li><input type="checkbox"/> Cleared land is being used for cultivation</li> <li><input type="checkbox"/> Areas are being reforested</li> </ul>	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.).
<b>UNDERLYING VARIABLES AND DEFINITIONS:</b>	<b>MEASUREMENT OF THE INDICATOR</b>	
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 <i>in situ</i> . 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 <i>in situ</i> . 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 of grasses and shrubs.	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.	
<b>LIMITATIONS OF THE INDICATOR</b>		
It deals only with the northern mixed farming communal areas.		

**Narrative**

**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

Region	Total land area	Total <b>closed forest</b> 1992 (000 ha)	% of land area	Total <b>closed forest</b> Yr 2 (000 ha)	% of land area	Total change area (Yr 2-1992) (000ha)	Total change %	Annual change %
Kunene	5657	361	6.4					
Omusati	1390	3	0.2					
Oshana	511	0	0					
Oshana	511	0	0					
Oshikoto	2658	276	10.4					
Kavango	4291	1727	40.2					
Caprivi	1984	821	41.4					
Grootfontein	2497	136	5.4					
Tsumkwe	1833	339	18.5					
TOTAL	21888	3965	18.1					

Table 5.2: Change in **open forest** area

Region	Total land area	Total <b>open forest</b> 1992 (000 ha)	% of land area	Total <b>open forest</b> Yr 2 (000 ha)	% of land area	Total change area (Yr 2-1992) (000ha)	Total change %	Annual change %
Kunene	5657	32	0.6					
Omusati	1390	0	0					
Oshana	511	0	0					
Ohangwena	1067	156	14.6					
Oshikoto	2658	175	6.6					
Kavango	4291	1045	24.4					
Caprivi	1984	502	25.3					
Grootfontein	2497	100	4					
Tsumkwe	1833	262	14.3					
TOTAL	21888	2272	10.4					

Table 5.3: Change in **cleared land** area

Region	Total land area	Total <b>cleared land</b> 1992 (000 ha)	% of land area	Total <b>cleared land</b> Yr 2 (000 ha)	% of land area	Total change area (Yr 2-1992) (000ha)	Total change %	Annual change %
Kunene	5657							
Omusati	1390							
Oshana	511							
Ohangwena	1067							
Oshikoto	2658							
Kavango	4291	194.7	4.5					
Caprivi	1984							
Grootfontein	2497							
Tsumkwe	1833							
TOTAL	21888							

Table 5.4: Change in **cultivated land** area

Region	Total land area	Total <b>cultivated land</b> '93/94* (000 ha)	% of land area	Total <b>cultivated land</b> Yr 2 (000 ha)	% of land area	Total change area (Yr 2-1992) (000ha)	Total change %	Annual change %
Kunene	5657	n/a	-					
Omusati	1390	90	6.5					
Oshana	511	35	6.8					
Oshana	1067	85	8					
Oshikoto	2658	65	2.4					
Kavango	4291	17.5	0.4					
Caprivi	1984	26	1.3					
Grootfontein	2497	14	0.6					
Tsumkwe	1833	n/a	-					
TOTAL	21888	332.5	1.5					

(\*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 1994/95 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 of 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.

**Table 5.5: State of Forests in Southern Africa**

Country	Land area ('000)	Total forest 1990	Total forest 1995		Total change 1990-1995 ('000)	Annual change rate %
			Area ('000)	% land area		
Namibia	82329	12584	12374	15	-210	-0.3
Angola	124670	23385	22200	17.8	-1185	-1
Botswana	56673	14271	13917	24.6	-354	-0.5
Lesotho	3035	6	6	0.2	0	0
Malawi	9408	3612	3339	35.5	-273	-1.6
Mozambique	78409	17443	16862	21.5	-581	-0.7
South Africa	122104	8574	8499	7	-75	-0.2
Swaziland	1720	146	146	8.5	0	0
Zambia	74339	32720	31398	42.2	-264	-0.8
Zimbabwe	38685	8960	8710	22.5	-250	-0.6

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.