National Forest Inventory - Background and methodology

1. INTRODUCTION

Deforestation and forest degradation are often monitored in national programmes, as information on changes in forest resources is needed for political decisions and the planning of forest management regimes for rehabilitation purposes. Regional and national level (broad) information on forest resources is needed for policy making and strategic planning. Local level (more detailed) information on the quantities and location of forest resources is the backbone of proper forest management planning.

Up until 1994, information on Namibian forest resources, both on local, regional and at national level, was very limited to not existing. The quantity (total wood volume in m^3, or total woody biomass in metric tonnes) and the quality (species distribution and species diversification as well as the proportion of timber, poles, construction wood and fuel wood) were poorly known.

The National Forest Inventory Project (NFI) was started in August 1995 to fill this information gap. Although the project was called National Forest Inventory, the inventory was meant to cover only communal lands in the northern parts of the country. The original aim of the project was to collect forest resource information on regional level. However, as the inventory work on regional level has proceeded, a need for more detailed data has arisen. Hence, the project started to carry out both regional inventories, according to its original aim and more detailed higher intensity inventories in areas where there was a need for more detailed information, e.g. State Forests and Proposed Community Forest Reserves.

From, 2001 when DoF enacted the Forest Act no. 12 of October 2001, that advocate for the devolution of management and user-right of forest resources and the empowerment of communities to manage their own resources, the momentum shifted toward a more participatory approach of forest management. Consequently, more proposed community forests came up and it became evident that the NFI team will also carry out more community forest inventories. With this type of inventories, people in the community should tell how they use the forest resources today and how would they like use these resources in the future. Some of the common objectives are to harvest poles and collect fuel-wood for domestic use. A traditional inventory approach reveals enough information to allow planning for these objectives.

The main objectives of the National Forest Inventory can be summarised as:

- To produce forest resource data on northern Namibia for strategic planning (regional inventories)
- To produce resource data for operational management planning on selected forest areas
- To ensure that the resource data are appropriate and in a user friendly format.

2. INVENTORY DESIGN

Annual work planning of inventories

The basis for carrying out inventories of expected quality and efficiency is laid in the annual work planning session of the Directorate of Forestry. The resources for the inventories are limited; therefore it is extremely important to make a realistic plan keeping in mind the limits. At least the following restricting factors are to be taken into account when work planning is done:

- Number of inventory staff available
- Number of cars and ATVs available
- Budget for inventories (both of GRN, DED and any other donor)
- Holiday season
- Time needed for data input, database queries and report writing
- Time needed for training courses
- Weather conditions (heavy rain, extreme heat)

It seems that the need for inventories for communities and conservancies is increasing by the year. Depending on the size of the inventory areas and the sampling method to be applied, the current NFI-team (6 members) can carry out 5 to 6 separate inventories annually. It is very risky to plan for any more inventories than that. Whatever is the number of inventories in the work plan, the plan must be checked against the restricting factors listed above. If too many inventories have been planned, it may lead to carrying out them with low accuracy, which will then not satisfy the customers (the people using the information).

The measurements

The NFI is collecting a comprehensive set of data. The focus is on trees, but data is also collected on shrubs, grasses and herbs. Furthermore, the areas surrounding the measurement plots are described (stand description). Woody vegetation with dbh $\leq$ 5cm is classified as trees. If the dbh is < 5cm the woody vegetation is classified as shrubs. Diameter measurements are taken at dbh (diameter at breast height = 1.3m).

For trees the following data are collected:

- Species, phenology, crown class
- Size data, dbh, height, crown height, canopy diameter
- Timber quality data, quality class, saw log length
- Damage, length of deformed base, cause of damage, degree of damage.

For shrubs the following data are collected:

- Species
- Size data, height and crown diameter.

For grasses and herbs the coverage and general height is recorded. There is no species identification for grasses and herbs.

The area surrounding the sample plots is described (stand description) in terms of:

- The environment: land type, geology, mean height of woody vegetation, soil texture and soil colour
- Land utilisation: permanent or shifting cultivation, grazing, harvesting of fuel and timber, ownership including occurrence of fencing on communal land
- Damage: cause of damage on trees and its severity.

There were no volume or biomass functions available for Namibia. Therefore, to develop volume and biomass functions, a number of sample trees of the most common species were felled and measured in each region.

Sampling Design: Regional Inventories

The inventory method used is stratified systematic sampling. The data for trees, shrubs, herbs and grasses are measured using circular sample plots.

The plots are located in clusters with 2 or 3 plots per cluster. The plots in a cluster are located in north-south direction, normally with a distance of 100m between them. The data for shrubs, herbs and grasses are collected in the first sample plot of each cluster. Tree data is collected in all sample plots.

For the data collection on trees the radius of the circular sample plot is determined based on the size of the trees, the bigger the dbh (diameter breast height) the longer the radius. Data on shrubs, grasses and herbs are collected in two subplots.

If the area to inventory is large, it is divided into quarter-degree squares and a number of the squares are selected for sampling.

The principal for locating the clusters are the following:

- To locate the clusters according to the demand from the stratification sampling technique
- To locate the clusters in lines, with a certain number of clusters in one line and a certain distance between the clusters in the line (cluster distance)
- To locate the lines parallel with a certain distance from each other (line distance). Normally, this principal is applied in such a way, that two or more lines are located parallel to each other.

The clusters are plotted on Vegetation maps using Mapinfo to obtain coordinates. The coordinates and GPS are used to locate the clusters for the measurement in the terrain. All sample plots in each cluster are registered as permanent sample plots. Since coordinates are has taken from each cluster and they (clusters) are marked with an aluminium pole in the terrain, they can be re-located and re-measured.

In the regional inventory each sample plot normally represents 2,000-3,000 ha. E.g. Caprivi Region inventory (area = 1.65 mil ha, 837 plots, Oshikoto Region inventory (area = 1.65 mil ha, 672 plots). The sampling intensity is higher in the inventories on smaller areas with need for more localised information, e.g. Caprivi State Forest.

3. THE INFORMATION PROVIDED BY THE INVENTORIES

The use of the information

The regional inventories:

The regional inventories provide information on the woody resources for the whole region. The information is used for strategic planning at regional level. This inventory does not give site specific (local level) information, and can therefore not be used for operational management planning in, for example, a community forest within a region.

An exception is if an adequate number of clusters in the regional inventory fall into the desired smaller area of interest, e.g. a community forest. In this case the particular clusters represent the smaller area and may be used for operational management planning of the area. Figure 3 gives an example of such a situation. The clusters 326-329 and 332-

336 are within a smaller identified area of interest. Those particular clusters give information which is site specific for that area.

The inventories on selected smaller areas:

There area areas where the Directorate of Forestry has identified a need for more localised information than what the regional inventories can provide. Examples of such areas are Caprivi State Forest and Okongo Community Forest. These areas are smaller than a region, the sized being 15,000 - 150,000 ha. The sampling intensity in these inventories is higher than in the regional inventories, hence the information from these inventories may to a certain extent be used for operational management planning.

The information provided by the inventories

Basically, the same information is produced both by the regional inventories and in the inventories in the selected smaller areas. The difference is in how local (geographically located) the information is. The list of information below is not complete, but is only an example on the information that can be provided by inventories.

Information on the structure of the woody vegetation
- A classification of the area into different vegetation types. The classification used first was the Vegetation Structural Types by Edwards (1983), but now the Vegetation Atlas of Mendelsohn et al (2003) is used. This classification is based on the tree and shrub height and the tree, shrub and grass cover.
- Species composition and dominant species
- Species diversity, using various indexes; Simpson's Dominance Index, Shannon's Diversity Index, Macintosh etc
- Habitat diversity index using various indexes, Simpson, Shannon.

Information on forest and trees
- Number of trees, per species, totally and per hectare
- Volumes, totally, per species and per hectare
- Biomass, totally and per species for the most common species
- Height of trees, totally and per species
- Quality of the trees and damages, i.e. possibilities for economic utilisation in the form of volume (m^3), log length etc
- The phenology, i.e. ratio of trees having leaves, fruit or flowers
- The canopy cover of trees
- Specific data on woodlands of interest. E.g. Baikea woodlands in Caprivi Region.

Information on shrubs

- Number of shrubs, per species, totally and per hectare
- The height of the shrubs
- The cover of the shrub layer
- Regeneration of tree species, both in number and height. The shrub layer includes all woody vegetation with dbh < 5cm , therefore it includes also the regeneration of tree species.

Information on grass and herbs

The cover of grass and herbs.

Description of the environment

- The occurrence of different land types, and soils
- The extent and purposes of land utilisation
- The extent and causes of damages on the woody vegetation

4. INFORMATION AVAILABLE AT THE MOMENT AND SCHEDULE FOR THE REMAINING INVENTORIES

The regional inventories

For the following regions reports on the woody resources are available at the Directorate of Forestry in Windhoek:

- Caprivi Region
- Omusati Region
- Oshana Region
- Tsumkwe, Okakarara, in Otjozondjupa Region
- Otjinene, in Omahake Region

For the following regions fieldwork is completed, and the reports on the woody resources shall be available by December 2007:

- Oshikoto Region

The inventories on selected smaller areas

Reports on the woody resources for the following areas are available in the Directorate of Forestry in Windhoek:

- Ongandjera Proposed Community Forest Reserve (128,200 ha)
- Okongo Community Forest Reserve (55,900 ha)
- Caprivi State Forest (140,000 ha)
- Uukwaludhi Proposed Community Forest Reserve (147,800 ha)

In the following areas fieldwork is completed, and reports on the woody resources shall be available by June 2007:

- Amudhilo Proposed Community Forest Reserve
- Ehangano Proposed Community Forest Reserve
- Okongoro Proposed Community Forest Reserve

Schedule for the remaining inventories for Financial Year 2007/8:

- Okangundumba Proposed Community Forest Reserve
- Ozonahi Proposed Community Forest Reserve