Namibia-Finland Forestry Programme

Community-level Forest Management Component

Integrated Forest Management Planning for the Communal Areas of the *Omusati Region* – Northwest Namibia

Final Report

Part I	Forest Management Planning
Part II	Forest Resources Assessment
Part III	Wood Consumption Survey
Part IV	Evaluation of Community Forest Resources and Wood Consumption

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I wish to express my thanks to all the people I have met during my work in Namibia and in the Omusati Region. In Appendix 1 of this report is a list of the people and organisations I have had the pleasure of co-operating with. It has been interesting engaging in fruitful and rewarding discussions with all these people.

I extend my special thanks to the people I have worked with during this time:

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All the community members in Ontanda Village and especially the Headman Ananias Munete and the members of the Community Forest Inventory Team: Timotheus Iipinge, Amupolo Iipinge and Emmilich Linus, who have shared their vast and profound knowledge of trees and plants with us. Also many thanks to the farmers Leevi Kapolo, Herta Katenda, Tomas Erastus, Jonas Ndundu, Helvi Amundjela, Max Hiskiel and Magano Iipinge for letting us visit their farms and patiently answering our numerous questions.

It has been a most stimulating task to work in the Omusati Region, sharing knowledge about forest resources and their management with the people in the community, and in different organisations. This report has combined knowledge from different sources and may become one of the first steps for the communities to "move from being people with knowledge to people who are in a position to manage [their forest resources]" (Jane Gronow, 1995).

SUMMARY

There is an urgent need to strengthen the communities' rights to manage their forest resources in the Omusati Region as illegal cuttings in communal forests are rapidly increasing. An important part of the strengthening process is to equip the communities with forest management skills and tools. Integrated Forest Management Planning is an effective tool that can be utilised in sustainable long-term management of communal natural resources.

The purpose of the consultancy was to construct a model for Integrated Forest Management Planning (IFMP) at a community level. IFMP combines the management of three of the most important natural resources in the villages: agroforestry, including the whole cropping system, livestock and forest. As models for the Agroforestry Management Plan and Livestock Management Plan were not available at the time of the consultancy it was agreed that the objectives of the consultancy are as follows:

1. To develop a method to be used in the participatory assessment of the village forest resources;
2. To develop a method to be used in the village wood consumption assessment and;
3. To elaborate a model on how these two sets of data, available resources and consumption of resources, can be used in a sustainable forest management planning, at community level. A model for the integration of forest management of the other two as an important means of living, cropping and livestock, will be developed at a later stage.

The first part of this report outlines a model on how **community members can combine the information** obtained from different sources, e.g. village forest resources assessment, village consumption survey, scientific and other studies, when they are in the process of **Forest Management Planning** of their village area.

The **second part** of this report describes the methodology used in the **village forest resources assessment** and the **third part** describes the methodology used in the **village wood consumption survey**.

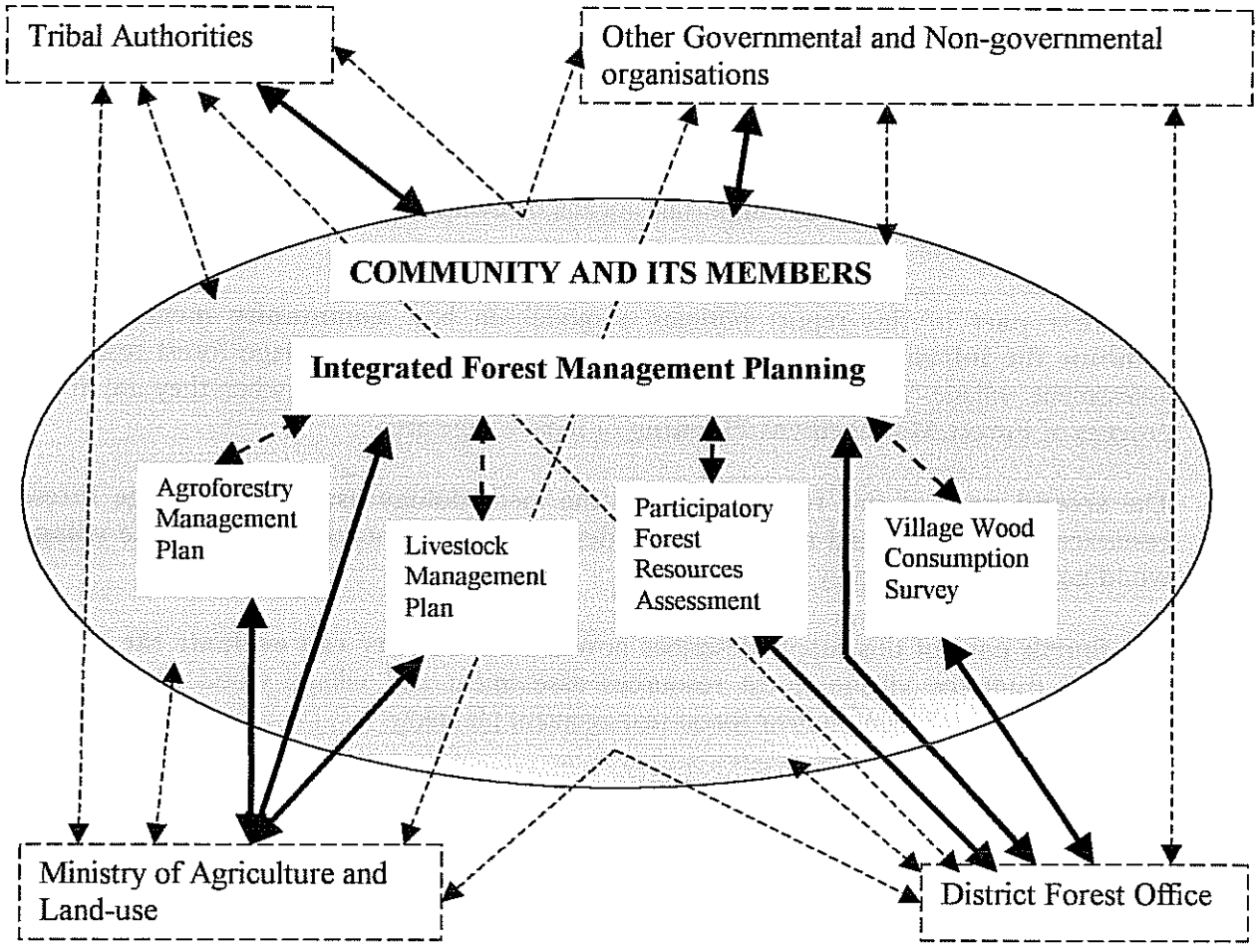
The **fourth part** of this report describes how the **community can evaluate the results** obtained from the village forest resources assessment and village wood consumption assessment and use them in their forest management planning.

The general goal of the Integrated Forest Management Planning (see Figure 1) is that members of the local communities are able to strengthen their rights of use, and at the same time increase the quantities and qualities of their natural resources, i.e. soil, water and vegetation. This means that they need to apply sustainable management of their natural resources, i.e., drain should not exceed growth of these resources.

The existing knowledge about the use and management of natural resources in local communities can be combined with outsiders' knowledge and technical skills. This

combination can be adapted and applied by the local communities in their Integrated Forest Management Planning. Outsiders' learn local skills and knowledge and at the same time transfer their own technical skills and knowledge to local communities. This is a two-way action supported by both the local communities and by different organisations involved in management of natural resources, e.g. District Forestry Office, Tribal Authorities, Ministry of Agriculture and Land-use and other governmental and non-governmental organisations.

Figure 1. Integrated Forest Management Planning at community level



The IMFP is based on the material obtained from the **village forest resources assessment**, which produces two types of information: a **village-map** showing **where** the forest resources are and **forest resources data** showing **how large** the resources are. When this information is collected some special aspects must be considered:

a. **Village map:** community members must be able to identify different areas in order to be orientated by conspicuous features on the village map, e.g. wells, schools, cuca shops etc.

b. **Forest resource data** must give relevant information for the community members, e.g. quantities and qualities of potential forest products at specific sites of their village area, that are possible to identify on the village map.

An appropriate system for the assessment of village forest resources has been developed in one of the pilot communities, Ontanda Village in Ukwaluudhi Tribal Area. Ontanda village has a total area of 6500 ha, which includes a forest area of 2200 ha and a settlement area of 4300 ha. Privately allocated areas, i.e. farms occupying approximately half of the settlement area, and the remainder belonging Common Property (CPR) land. The village area was divided according to these three types of land-use: 1) Privately allocated land; 2) CPR land in the settlement area and; 3) forest area, and applicable forest inventory designs were developed to be used in these areas. A method for the Village Forest Resources Assessment is described in the second part of this report.

Sustainable forest management demands that the drain of the forest resources, e.g. amount of cuttings, do not exceed the yield of the resources, i.e. growth of trees. The yield of these forest resources can be estimated by using the available growth figures, although the information about the growth rates of indigenous species is very scarce in Namibia. The drain of forest resources can be estimated by carrying out a Village Wood Consumption Survey as almost all forest products are used locally in farm constructions. A method to be applied in the Village Wood Consumption Survey was designed and tested in Ontanda Village. The method description is included in the third part of this report.

Apart from the forest resources inventory and the wood consumption survey, which were the main outputs of the consultancy, other tasks, like a **survey of the communities' forest management training needs**, were carried out.

Conclusions and recommendations

Integrated Forest Management Planning

Forest management planning includes several aspects, which demand a long-term commitment of the community. As all land in the tribal areas is state-owned it is important to emphasis that the communities are given definite rights on how to manage their area and its natural resources, e.g. water, soil and vegetation.

1. **One of the most urgent tasks is to raise awareness about the importance of sustainable management of village forest resources for present and future members of the community**. Until now customary laws have allowed the local people open access to forest resources in CPR land, which means that people can cut any trees of their own choice for their farm and cattle post constructions. This has resulted in vast areas of CPR land being deteriorated from previous forestland with big trees to present shrubland without any trees. The deforestation process is ongoing and it continuously diminishes village forest resources when new homesteads are being established, old farm constructions repaired, cattle posts built and repaired every year, demanding large amounts of trees to be felled.

   Results from the Village Forest Resources Assessment and Village Wood Consumption Survey can raise awareness of the community members of devastation of village forest resource, which is continuously ongoing. This awareness may eventually change people's attitudes so that village by-laws can be developed, e.g. open access to forest resources may be abandoned and active management of village forest resources encouraged.

2. When the importance of good management of the village forest resources is recognised by the community members, they may become committed and willing to control **their forest resources** which is a precondition for any successful forest management planning.

3. The community should be encouraged to develop their own **village by-laws concerning forest resources and their use in CPR land as a basis of control.**

4. When the community start planning the Integrated Forest Management **different management options should be presented to the community members** who will eventually decide if these approaches can be applied in their village. Forest management can vary in different land-use areas according to the people's perceptions for these areas:

   a. Forest management of CPR land in the village settlement area, which is the nearest common forest resource for the community, needs active participation of the community members, e.g. in thinning and pruning of *mopane* shrubs.

   b. Forest management in the village forest area needs an organised control of the cuttings by e.g. Village Forest Committee and the Village Headman.

   c. Tree and forest management in privately allocated land offers the easiest commitment for the farmers as they benefit directly from it. Therefore advisory service and concrete support from the involved organisations to farmers can be used as an incentive to encourage people to manage forest resources in CPR areas.

5. It is important to complete the Integrated Forest Management Planning procedures in the first pilot community, Ontanda Village, before continuing the surveys in other pilot villages. There may be unexpected problems when different procedures are linked together, i.e. Agroforestry Management Planning, Livestock Management Planning and Forest Resources management Planning, which may affect and change the proposed forest resources assessment designs.

Village Forest Resources Assessment

A Village Forest Resources Assessment system, which is presented in this report, has been developed in one of the pilot communities and it is still a proposal, not a completed system.

1. Computation of the results in the first pilot community, Ontanda Village, is not yet completed. The feedback from the computation system may cause changes to data collection and field form design.

2. The proposed inventory design can be developed further after the community members in Ontanda Village have evaluated the inventory results. The results of this evaluation can cause changes in the inventory design depending on what type of data and information will be relevant for the communities.

3. After the proposed Village Forest Resources Assessment is completed in Ontanda Village, it will be tested in other pilot villages in the Omusati Region. Ecological, demographic and social conditions and access to forest resources vary in the pilot communities and this may cause changes in the proposed forest resources assessment system.

4. The computation system needs to be finalised, which can be done during and/or after the forest resources assessment system is tested in the other communities.

5. It can be an advantage if the data collection for the three management plans, Agroforestry, Livestock and Forestry, can be carried out at the same time, even using the same sites, if possible.

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Part I Forest Management Planning

1. Introduction

Integrated Forest Management Planning combines information from

1 Agroforestry management planning
- including a survey of the existing cropping system

2 Livestock management planning
- including a survey of the existing cattle and grazing system

3 Forest management planning
- including a wood consumption survey and forest a resources assessment

Why Integrated Forest Management Planning?

In the densely populated regions in Northern Namibia cropping, livestock and forest resources are the three most important conditions of subsistence living and income generation. They interact frequently with each other in a positive or a negative way, e.g.:

- Trees in fields and homesteads offer shade and fodder for the cattle, improve soil and indicate water resources

- Woodland is cleared for fields, which diminishes common grazing areas and forest products.

Therefore successful management of village resources demands consideration and integration of these three means of living.

1.1 Characteristics and products to be assessed for the IFMP

1. Soil
   - quality
   - alternative use of land: cropping or forest
   - alternative use of crops
   - included in Agroforestry management planning

2. Water
   - quality and quantity
   - locations of wells, bore holes, seasonal water resources (ponds and rivers)
   - mainly included in Agroforestry and Livestock management planning

3. Vegetation: grass, herbs, shrubs and trees
   - qualities (species, their use) and quantities (coverage)
   - locations
   - mainly included in Livestock management planning

4. Tree and bush vegetation
   - qualities and quantities: species, wood and non-wood products
   - locations
   - mainly included in Forest management planning

1.2 Participation of the community members

Apart from the right to use their natural resources, communities need tools and skills to administer them. Integrated Forest Management Planning is such a tool, which combines local knowledge and outsiders' technical skills. It is a learning process for both partners: community members obtain technical knowledge and skills, and the outsiders, i.e. forestry professionals learn communities' preferences, perceptions and prospects in order to improve their technical applications. Once the communities have obtained the necessary knowledge and skills they will be able to direct the whole process of Integrated Forest Management, including the planning of the forest management, development of village by-laws, control of use of their forest resources and implementation of other necessary forest management activities.

> *"Trees are important for everyone and everything. There is no rain without trees, water does not come and stay in the ground without trees, and crops do not grow. Animals will die without trees. Everyone in this village should understand how important the trees are to us".*
>
> Headman Ananias Munate, Ontando Village, Uukwaluudhi

Community members' participation can generally vary from co-option, where outsiders have the control and local people are the subjects of the control, to collective action where the local people have total control and outsiders are not involved (Carter, 1996). A long-term objective in Integrated Forest Management Planning is to develop the community participation towards collective action. In the short term local participation can vary between consultation, collaboration and co-learning:

1. In consultative participation, opinions of the local people are asked but the outsiders analyse information and decide on a course of action, which is the case in e.g. when the Village Forest Resources Assessment system is developed.

2. Collaboration is applied when the Integrated Forest Management Planning is elaborated, as the priorities of the community members determine the objectives, but outsiders still direct the process.

3. Co-learning is a continuous process where the local people and outsiders share their knowledge and work together to form action plans. This can gradually be applied in other pilot communities when IFMP is developed and tested to be an appropriate system for these communities.

1.3 Components of Integrated Forest Management Planning

Integrated Forest Management Planning at communal level is based on the participation of all stakeholders, but the members of the community and/or their representatives (Community Forestry Committee) should be responsible for the planning and implementation of the plans.

IFMP contains several stages:

1. **Defining the objectives of IFMP** in the concerned community:

   Community members are able to define the objectives of the IFMP after the **presentation of the Integrated Forest Management Planning and its main components**, i.e. Forest Resources Assessment, Agroforestry management Planning and Livestock Management Planning to the members of the community.

2. **Surveys included in IFMP**:

a. Community members and/or their representatives participate in the **planning of the surveys included in IFMP** together with professionals from the respective government and/or other organisations. Planning of surveys includes selection of survey methods and characteristics to be measured and recorded. Customs and compositions of the communities have an impact on the selection of survey method, and community members' perceptions and preferences define the characteristics to be measured. E.g. restricted access to privately allocated areas and dense farming area needs to be considered when the forest inventory is designed. **Participatory planning of a survey** can include Rapid Rural Appraisal during which the local names and priorities of the forest products and sites can be obtained.

Community members are first given thorough information about how different parts of the surveys are carried out in order to avoid confusions and conflicts. Some parts of the forest resources assessment, like planning of the surveys and computation of the results need technical support from professionals as these activities use relatively complicated techniques and procedures and therefore

demand special equipment and skills. Eventually more of these tasks can be given to the communities.

3. **Forest Resources Assessment** follows a certain procedure:

   a. A Village map drawing includes both fieldwork and office work. The final goal is to produce a village map with known places that are easily recognisable by the community members.
   b. Forest resources assessment: preparatory work, e.g. locating sample plots and planning of the fieldwork
   c. Forest resources inventory carried out by the local inventory team
   d. Computation of the results of the forest resources inventory
   e. Evaluation of the results of the forest resources assessment

   A **participatory forest resources assessment** demands a trained inventory team of local farmers of both gender who can work either independently or with a forest professional. Local team members are trained in using measurement equipment and in following the inventory procedures. Farmers in the inventory team assess the potential products that can be obtained from each tree according to their knowledge. They also identify trees by local names. Forest professionals can support the local inventory team by providing transport and regularly controlling the quality of the work, e.g. measurements and inventory procedures.

4. **Village wood consumption survey**:

   A **participatory wood consumption survey** collects information about local wood consumption patterns and quantities. Owners and family members of the surveyed farms are interviewed and also participate in the measurements of the wood products, e.g. poles and firewood.

5. **A combined survey**:

   It is preferable to carry out **all needed resource surveys**, e.g. soil survey and livestock survey **at the same time** and even combined with a forest resources assessment. A combined survey diminishes the time used in fieldwork and increases community members' knowledge about the integrated forest management. The local members of the survey team can easily extend their experience and knowledge to the other members of the community.

6. **Integrated Forest Management Planning:**

   Community members and/or their representatives carry out the planning and they receive support from the professionals of the involved organisations.

The character of the Integrated Forest Management Planning can vary according to the type of **socio-economic activities** in the different land-use sites inside a village:

- in **privately allocated areas** trees are often income generating and better managed. Farmers are generally more interested in managing resources from which they can benefit directly. Therefore it is easy to encourage people to improve tree management in their private land. These improvements can also become incentives to arouse interest in managing forest resources in CPR land, e.g. people benefit directly (getting seeds, plants, advises how to establish home nurseries, etc.) if they actively improve forest resources in CPR land.

- **CPR land in settlement areas** is the closest forest resource for the communities and its management can improve their life considerably, especially in the long term. Awareness of the importance of the CPR areas as sources of forest products must have arisen before any proper management can be expected. The traditional attitude of having open access to all resources in CPR land can be difficult to change towards accepting individual responsibility of these resources. However it can be encouraged in several ways:

  - activating schools to encourage children to practise afforestation and conservation of trees,
  - work with churches and other non-governmental organisations to disseminate information (maybe involve them also in practical afforestation work)
  - using direct incentives to get people interested in active management of forest resources in CPR land.

- Communities regard **village forest areas** as remote but essential for dry season grazing, especially during the years with low rainfall. They are also sources of non-wood and wood forest products. The remoteness of these forest areas and traditional open access to any forest products makes them more difficult to be managed. A preferable management system for members of the community is to actively control cuttings in these areas according to the village by-laws.

Box 1. Consequences of the community not participating in the planning procedure of forest resources assessment

In Ontanda Village the planning of forest resources assessment was not accomplished with community participation. The community members did not get information about why the forest inventory was being carried out and so this caused some minor conflicts in the community. E.g. one group of people claimed that the farmers who worked in the inventory team were "informers". This could have been avoided by arranging a meeting with the community where the people could have been correctly informed. However, during the fieldwork the team members and the forest ranger informed all community members, whom they encountered, about the purpose of the inventory.

PART II Village Forest Resources Assessment

1. Introduction

The main objective of the participatory tree and forest resource assessment is to process information, which is relevant to forest management planning in the rural communities. Village level forest management should be based on sustainability; i.e. annual cuttings of trees should not exceed annual growth of trees. Annual tree growth depends on the present forest resources, which can be estimated by carrying out a village forest resources inventory. Annual cuttings can be investigated by conducting a wood consumption survey. Growth rates of the indigenous tree species are still not known in Owamboland and therefore only rough growth estimates can be used in calculations.

Integrated Forest Management Planning is based on information of the wood consumption and forest resources in the community. Both types of information can be produced combining the knowledge of community members and forest professionals:

1) A **village-map** shows **where** the forest resources are in the village area. Key features on the map, e.g. local roads, schools, churches, cuca shops, wells and some of the farms, help villagers to identify different places in their village. Community members use a village map as a base in Integrated Forest Management Planning.

2) **Village tree and forest resource data** gives relevant information of **how big** the forest resources are, e.g. quantities and qualities of potential products, which can be attributed to a certain part of the village area. Tree and forest resource data must be presented in such a way that community members can use it in their Integrated Forest Management Planning.

Forest management planning is a wide and complex system and it demands clear definitions of the responsibilities of each participant. There is a Human Resources Plan in Appendix 2, which describes a possible distribution of these responsibilities.

2. Village-map

Drawing of a village map is a combination of local knowledge obtained from the community members and by using advanced modern as well as simpler traditional techniques. Linking the modern techniques, i.e. GIS (Geographical Information System) application, GPS (Geographical Positioning System) and satellite images to the traditional methods, i.e. interpretation of aerial photographs, have several benefits both for the communities and other organisations with interests in environmental issues:

1) GIS together with GPS and the interpretation of satellite images, allows local information to be obtained accurately.

2) Interpretation of aerial photographs makes it possible to apply the participatory resource assessment as local farmers can be trained to use the measurement techniques involved.

When the local tree and forest resource data is stored in a GIS database it is easily available both at a regional and national level.

2.1 Village boundaries

Identification of the village boundaries is an essential prerequisite for the Integrated Forest Management Planning. Unclear village boundaries can become a source of serious conflict between neighbouring villages, and increase confusion amongst the villagers participating in IFMP.

2.2 Delimitation of forest management units

The village forest resources assessment collects site-specific data, which is eventually used for forest management planning by the community members. Quantities of forest resources in certain areas and access to these areas vary a lot inside the village and therefore it is appropriate to divide the village area into smaller management units.

The village area was divided into different management units according to how the community members recognised their area. The selected system of management units is based on the different land-use patterns of the village area, which is described in the next paragraph. The alternative system, based on the delineation of land areas according to the existing vegetation, was abandoned because community members would not be able to recognise management units based on a system, which has been developed by outsiders. It would have been possible to construct a delineation system based on the community members' identification of different vegetation types but developing such a system would demand much longer fieldwork periods than the time allowed for consultancy.

The following land-use classification defined by land-use concepts was chosen to be used in forest management planning:

- **Privately allocated areas** where individual living, subsistence and/or income generating activities are practised
- **Common Property (CPR) areas in a settlement or farming area** which are seasonal common grazing areas as well as a close forest product resource, e.g. important for women when collecting firewood
- **Village forest areas** that are important dry season grazing areas, especially in years with little rain, and sources of wood and non-wood forest products

Woodland in village forest areas and woodland in village settlement areas represent two different management units because according to the community members the two areas have different land-use concepts, although both areas belong to Common Property land. Woodland in the village settlement area is close to the homesteads and a common grazing area all year around. Village forest areas are considered remote where the cattle are taken for grazing during the dry season when there is not sufficient food closer to the homesteads. Cattle posts have been built and deep wells dug in the village forest areas, where farmers or their family members stay for longer periods of time when taking care of their cattle.

2.3 Tools used for drawing a village-map

A village map is a combination of local knowledge and more or less advanced techniques, which together produce relevant and usable information for Forest Management Planning. The use of advanced technology speeds up the definition of village boundaries, which would otherwise demand time-consuming field measurements. However advanced technology should be used so that it supports communities' own activities and no information should be handed over for other purposes without consulting the community.

The following tools and techniques are used to produce a village map:

a. Aerial phographs

Aerial photographs with a scale of 1:78500, photographed in 1996, are available in all pilot villages. Aerial photos are used in all phases of forest management planning, e.g. in definition of boundaries, drawing of a village-map and localisation of sample plots. Community members participating in forest inventory fieldwork are able to use aerial photos independently after being trained by forestry professionals.

A Village-map is based on aerial photos and it is drawn with a GIS application, *Archview* computer programme, which is available at the Forestry District Office in the Omusati Region. Aerial photos must be georeferenced before they can be utilised in the *Archview*.

b. Satellite images

Satellite images over the Omusati Region are available at the Northern Namibia Environmental Project in Ongwediva. Satellite images can be used e.g. in identification of farms in these pilot communities.

c. GIS application - Archview computer programme

A GIS application, *Archview* is used for interpretation of aerial photos and satellite images, for map drawing and processing site-specific data. *Archview* is a relatively complicated programme and its use needs special training. It is available at the Forestry District Office in the Omusati Region and some of the foresters are trained in using *Archview.*

b. GPS

Geographical positioning system, GPS, is used to localise village boundaries and positions of key features, e.g. schools, wells, roads, tracks and "cuca shops", which have been identified in the village. The GPS data is transferred to *Archview* and used for map drawing. Also locations of sample plots in forest resources assessment are stored in the GPS and transferred to *Archview* in order to present site-specific data.

GPS is a relatively simple tool and some community members, preferably those who participate in the village forest inventory are able to use it independently after training. GPS equipment is available at the Forestry District Office in the Omusati Region.

Information needed for drawing a village-map

Community members possess essential information, which is needed for drawing a relevant village-map, as they are able to identify boundaries and key features in villages (see Box 2).

1. Identification of the village boundaries

Identification of the village boundaries is carried out in villages by using aerial photos, GPS and the knowledge of community members. The boundaries are tracked with a GPS, tracking data is transferred to the *Archview* and thereafter the programme draws a village map based on an aerial photo.

2. Identification of key features

Key features, i.e. roads, tracks, schools, churches, cuca shops, wells etc. can be continuously identified by members of the community (e.g. the local inventory team) and positioned with a GPS while carrying out other activities in the village area. Positions of key features are included in the *Archview* database and added to the village map.

3. Identification of the settlement (=farming) area

The village settlement (or farming) area is first identified by the community members on the aerial photo and by positioning the newly established farms and the farms closest to the forest area. Thereafter the Archview programme is used to draw the boundaries between the settlement area and the village forestland.

Box 2. Identification of the village boundaries and land use boundaries in Ontanda Village

Boundaries in Ontanda village were identified in several stages and even checked two times because there was some confusion about the correct boundaries. Some of the community members and the Village Headman participated in the identification. The boundary between the settlement areas of the two neighbouring villages was found without any problem, as everyone knew which farm belonged to each of the villages. The boundary, which was in the forest area shared by the two villages, was more difficult to settle but after checking with the Headman the correct place of the boundary was found. The Headman was obviously the only person who knew exactly where the village boundaries were.

Using a GPS was a precondition for drawing the boundaries on the map as it is very difficult to identify physical features and locations, especially in forest areas, by using only aerial photos (scale 1: 78500). There are very few geographically recognisable features to be found in the flat terrain and the local tracks cannot be identified on the relatively large-scale aerial photos, as they are not visible on them.

Picture 1. Ontanda Village-Map with land-use boundaries

3. Participatory forest resources assessment

There are two main objectives in tree and forest resources assessment:

1) to obtain information about trees and woodlands that is relevant to the community and can be used in IFMP (Integrated Forest Management Planning) in their village. This means e.g. recording of how many and what species, types and sizes of trees are growing, which and how large are the potential non-wood and wood products and their quantities and how the trees and wood lands are managed.

2) to localise the collected site-specific information of forest resources on the village map that is used in IMFP.

Participatory Forest Resources Assessment uses the following inventory designs in the three forest management units:

1) A Tree and woodland inventory in **privately allocated areas**

2) A Woodland inventory in **common property (CPR) land in a village settlement (farming) area**

3) A Woodland inventory in **village forest areas**

A forest inventory consists of the preparatory work in the office where all the procedures of the inventory are carefully planned, and of the inventory fieldwork, which starts with the training of the local inventory team.

3.1 Planning the inventory

Participation of community members in the planning of the inventory can gradually increase, starting with their knowledge of local conditions and their preferences concerning land-use and use of resources. Eventually as the skills and knowledge of the community members grows, communities can do their own planning by receiving only technical support from professional foresters.

Forest inventory planning starts when a village-map, with the necessary boundaries (village and land-use area boundaries), is completed. Planning of the inventory is carried out separately in each of the forest management units (land-use area) and their areas can be estimated (see Box 3).

Box 3. Estimation of the sizes of different types of land use areas in Ontanda Village

People in Ontanda village administer an approximate land area of 6500 ha (65 km^2). The largest part of the village is the village settlement area, 4000 ha (40 km^2).

1. Privately allocated farms

The total area of privately allocated land was estimated by using the following equation:

$$A(\text{Total privately allocated land}) = A(\text{average farm}) * \text{number of farms}$$

A(average farm) was estimated by measuring areas of a number of farms with different sizes on the aerial photo based map (Archview).

2. CPS woodland in the village settlement area

The inventory team members assisted in localising the farms which are situated closest to the forest area. A GPS was used to position the farms and the boundary of the settlement area was drawn after these farms. The area of the CPR land in the settlement area, which was needed to calculate the inventory intensity, was estimated using the equation:

$$A(CPR) = A(\text{settlement}) - A\ (\text{Total privately allocated land})$$

3. Village forest area

There are two forest areas, called okuti. The sizes of the two forest areas were easy to establish after the boundary of the settlement area was drawn. Each of the forest areas, approximately 22 km^2 and 2.5 km^2, compose a separate management unit.

3.2 On-farm tree and woodland inventory in privately allocated areas

In On-farm tree and woodland inventory the first step is to select farms to be inventoried. The criteria for the selection of the farms could be its size and location: e.g. one small sized and one large sized farm is selected in a number of different locations of the community (see Box 4). The number of farms to be selected depends on the size of the community and time available for the inventory fieldwork. The fieldwork is designed in a way that all measurements in one farm can be completed in one working day.

Box 4. Selection of the farms participating in On-farm inventory in Ontanda Village

The farms, which participated in the inventory of On-farm tree and woodland resources, were selected by using different methods. The main criteria were the sizes of the farms and their location in the different parts of the village. Some farms were selected by first observing the size of a farm in a particular part of the village and then asking the owner of the potential farm for permission to carry out the inventory on her/his farm. As the time available for the fieldwork was very limited farms owned by members of the inventory team or their relatives were selected.

Finally six farms participated in the inventory: two farms, one small and one large size in each of the three different locations. It was considered to be disrespectful to express opinions about the size of the farm and therefore only different locations were used as a criterion. The selection procedure demanded approximately two days' working time.

The selected farms were numbered and located on the village map both by using aerial photo and by positioning with GPS, and thereafter they were marked on the map by their numbers (see Figure 1.)

1. Inventory design

There are three types of land-use areas inside a farm area: 1) homestead, 2) fields and 3) woodland. In small sized farms woodland is normally scattered in small pieces along the boundaries, but larger farms may have abundant woodland areas allocated to them. On-farm woodland is the primary source of construction material when a farm, its homestead and surrounding fences are established for the first time. Clearing homestead areas and fields provides a large amount of construction wood for farm and fence constructions. After the crops are harvested the on-farm woodland area is mainly used for grazing, especially by small livestock.

Two different methods are used in an On-farm tree and woodland inventory:

1) **An on-farm single tree inventory:**
   All single trees are measured and recorded in homestead areas and fields as the trees in these areas are often actively managed and grown or conserved for special purposes. A single tree inventory will provide information about the species, their quantities, uses and management methods.

2) **An on-farm woodland inventory:**
   Two circular sample plots are located subjectively in representative sites in woodland patches inside the farm area. An on-farm woodland inventory has been designed so that it is independent of the size of woodland. The main objective is to collect

information about existing and potential (=re-growth) resources and what type of management is traditionally carried out on on-farm woodland.

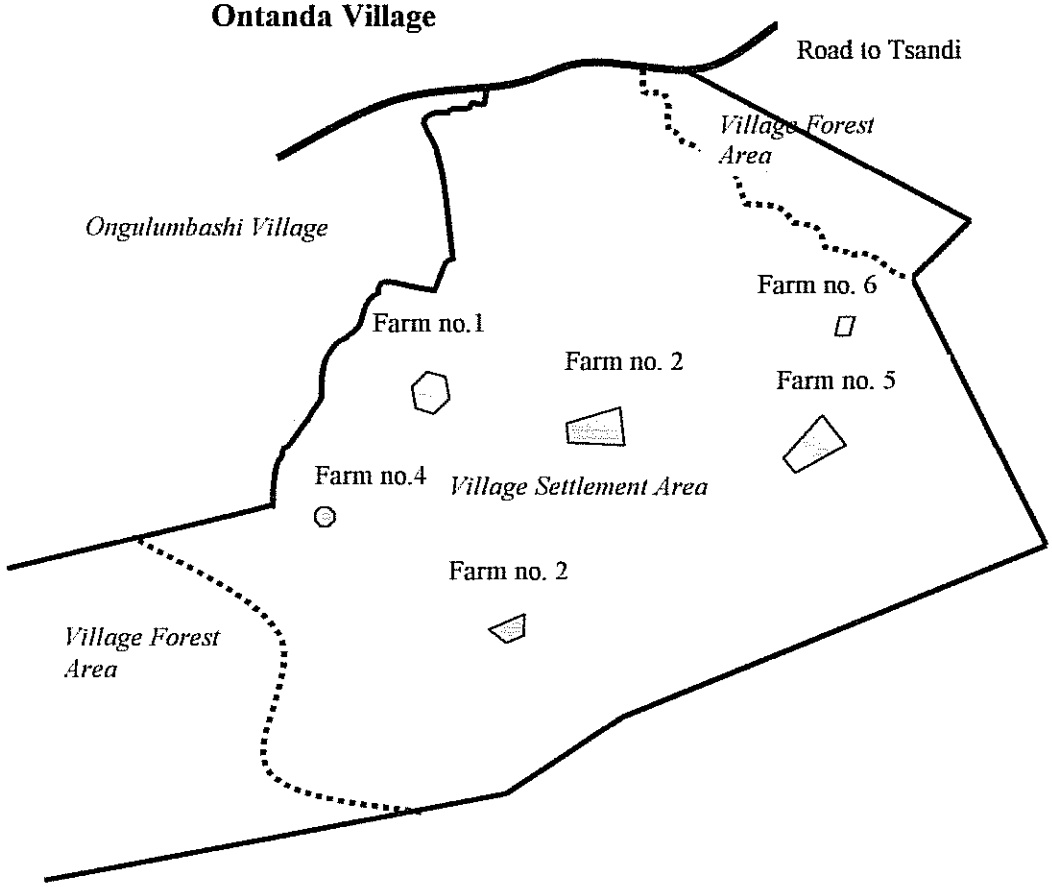
2. Sampling intensity

Sampling intensity is dependant on the time available for the inventory fieldwork. An average of **one day's work** is necessary to complete the inventory in **one farm**. Sampling intensity can be viewed as a percentage of the total number or total area of the selected farms (see Box 5).

Box 5. Sampling intensity in Ontanda Village

The total number of farms is not known exactly but according to the Village Headman there are 184 "old" farms and at present possibly up to a total of 190 farms. The Headman could not give the year from which the number of "old" farms originated. However it was possible to count the approximate number of farms in 1996 as the aerial photo was taken that year. The intensity of the inventory by the number of farms was 3.2 %.

Figure 1. The farms participating in the On-farm forest resources assessment in Ontanda Village



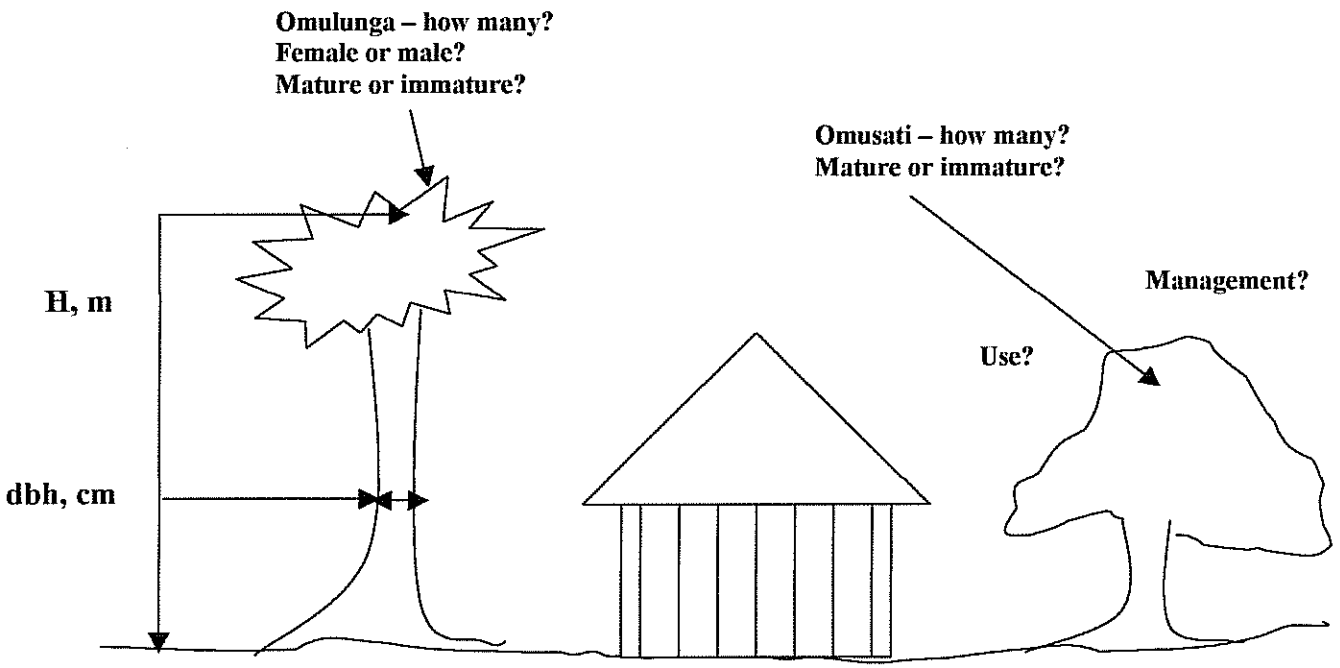
3.3 On-farm single tree inventory

All single trees growing in homesteads and/or field areas are enumerated which means that trees are recorded by species (Figure 2). Sample trees **are selected systematically to present both mature and immature and female and male trees.** Information about local names, use and management of trees is obtained from the owner of the farm or her/his representative.

The following information and characteristics are measured and recorded:

1. Co-ordinates of the farm
2. Owner of the farm
3. Size of the farm
4. Number of specimens of each species
5. Maturity (= producing fruit or male flowers)
6. Sex (if a dioicous species)
7. Uses
8. Management practices
9. Dbh and height for the volume/biomass calculation

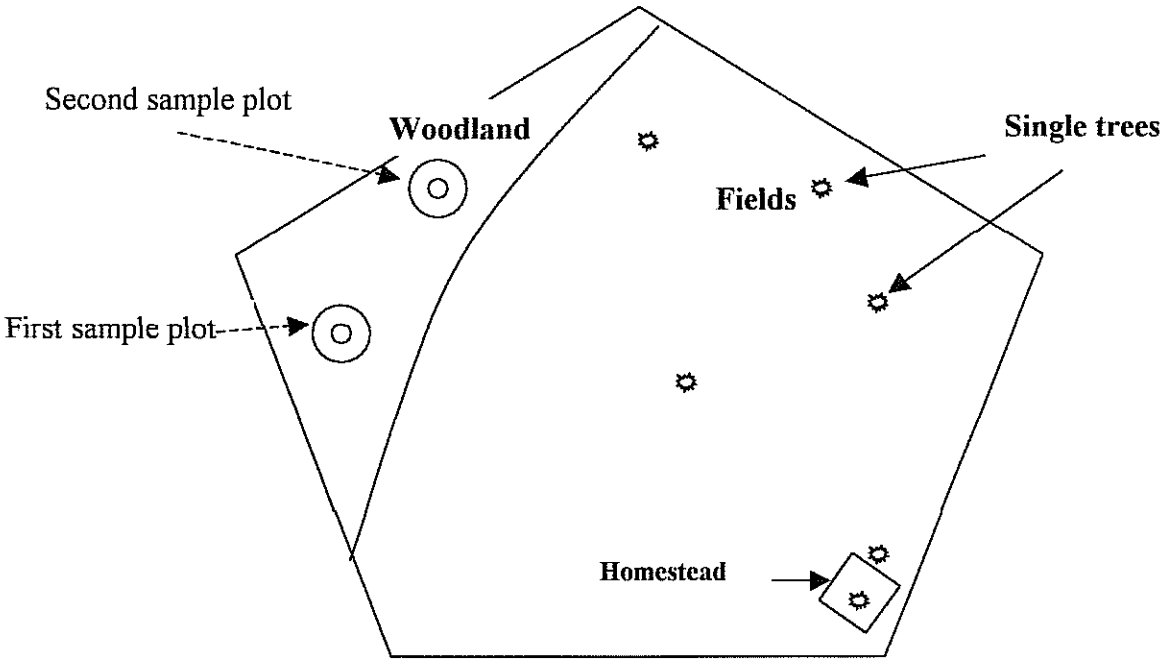
Figure 2. Measurements and recordings in On-farm single tree enumeration



3.4 On-farm woodland inventory

Two circular sample plots were measured in on-farm woodland. Sample plots were located subjectively so that they presented farm woodland areas in a reasonable way (see Figure 3).

Figure 3. Locating sample plots in On-farm woodland inventory



A. Sample plot measurements

The following sample plot measurements were applied in woodland inventories in all land use areas, i.e. in On-farm woodland, in CPR woodland in village settlement areas and in Village Forest Areas.

In each sample plot location two concentric (nested) sample plots were measured (see Figure 4).

a. Tree enumeration sample plot with a radius of 15 m and area of 0.07 ha

The two basic rules are applied in a 15-m sample plot:

1. **All trees with dbh => 5 cm** are enumerated, which means that they are recorded by species. The lower limit, dbh => 5 cm at breast height, was chosen because trees of this size start to produce usable poles.
2. **Sample trees** are selected systematically.

The following characters were measured and/or recorded in a 15-m sample plot:

1. Type of woodland
2. Type of land use
3. Number of specimens of each species
4. Use of the species
5. Management of the species

Sample trees:

6. Dbh and height for biomass/volume computation
7. Height and diameter at the middle of a potential usable pole for volume calculation of potential resources. Local team members assess how many and what types of products are possible to obtain from the sample tree.
8. Local name of the usable pole

b. Regeneration sample plot with a radius of 4 m and area of 0.005 ha

In a 4-meter sample plot the following rules were applied:

1. **All shrubs, bushes and trees with a diameter at breast height < 5 cm and height > 10 cm** were enumerated by species and measured in order to estimate 1) existing products and 2) a potential regrowth
2. **Sample shrub/bush/trees** were selected systematically.

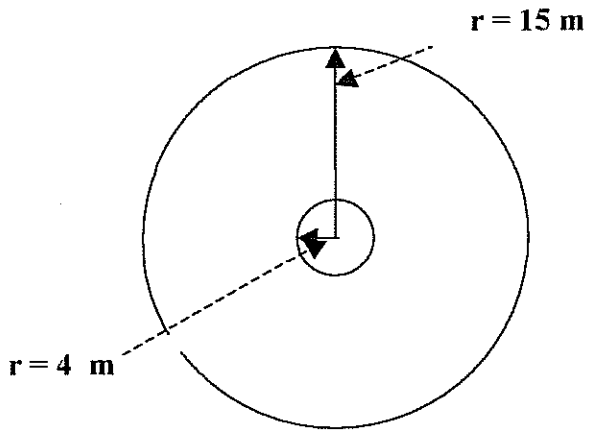
The following characters were measured and/or recorded:

1. Number of specimens of each species:
   One shrub or bush includes all shoots and branches, which have the same origin, e.g. stump, root or branch.
2. Management of the species

Sample shrub/bush/tree:

3. Number of shoots
4. Height of the highest shoot
5. Use of the highest shoot
6. Other uses of the shrub

Figure 4. Two concentric (nested) sample plots



3.5 CPR woodland inventory in the village settlement area

Common Property land (CPR) in a village settlement area is not allocated for private or special use. In the past CPR areas have been used as forest product reserves and as grazing land during the cropping season. Today CPR areas are almost exclusively used for grazing because forest products in them are very scarce. Many of the older villagers have witnessed an enormous change in their environment from the 1970's dense woodlands with large trees and an abundance of wild animals, like elephants and antelopes, to the present low, thin and scattered secondary bush vegetation without any wildlife. Villages have generally very dense settlement and CPR woodland is left only in small patches between the farms.

There is a visible deforestation process, which is on going in the villages. New farms are established each year and village settlement areas are invading village forest areas. CPR lands around new settlement areas are larger compared with older settlement areas. Large trees are still growing in new settlement areas, but their number is rapidly decreasing.

The purpose of the CPR woodland inventory is to find out what the existing forest resources in village settlement areas are. The data collected in the inventory will be eventually used for community based integrated forest management planning. The purpose of forest management planning is to provide sustainable and functional methods in order to increase today's very low woodland resources in CPR land, in the villages.

1. Inventory design

The inventory method used in CPR woodland in the village settlement area is a systematic cluster sampling. Clusters are located systematically in the *Archview* village map where the village settlement area is demarcated.

There are four sample plots in each cluster. Sample plots are first located by measuring the distance with a tape measure and defining the direction to each plot with a compass. A location of each sample plot will also be positioned by a GPS. GPS data is then transferred to the village map in *Archview* .

In their forest management planning, community members will be able to use both site-specific and total information of forest resources in the settlement area. In large villages, in order to obtain more accurate site-specific information, it is advantageous to divide a settlement area into smaller forest management units. However larger number of management units increases the time used for preparatory and fieldwork. More knowledge is needed concerning sizes of management units in the villages. Final recommendations can be done after finishing the IMFP process in all pilot villages.

2. Sampling intensity

The following factors must be considered when sampling intensity is defined (see also Box 6):

1. Time available for the fieldwork is one of the main factors when sampling intensity is decided.

2. Size of the village and its settlement area affects the sampling intensity. In large villages lower intensity must be applied as the sampling must cover the whole settlement area.

3. Sizes of CPR woodland patches are limiting factors in the selection of suitable woodland areas. Very small patches are not suitable, as the area is not large enough to locate a minimum of four sample plots in one cluster.

4. If tree and shrub vegetation varies a lot between different locations in village settlement areas, higher intensity is needed.

Sampling intensity = Sampling area/ Total CPR woodland area,
where Sampling area = the total area of all sample plots.

Box 6. Defining sampling intensity in Ontanda Village

There were 6-7 working days available for CPR woodland inventory fieldwork to be completed in Ontanda Village. The spacing between the sampling units (= clusters) was counted so that the number of sampling units to be located on the map was double the number that was needed, i.e. 12. It was estimated that the location of approximately half of the sample units would be inside the farm areas and thus would be disqualified from CPR land. The spacing was calculated at 1500 m x 1500 m and when all the potential locations, marked with a cross on the map, were checked 4 sample units were directly dismissed and an additional 3 sample units were disqualified after visiting their sites in the terrain. Finally five sample units were measured in the CPR woodland inventory.

3. Preparatory work

Locating sample clusters on the map is done during preparatory work in the office on a grid showing the positions of clusters located on the village-map with *Archview* computer programme. The spacing of the culsters depends on the sampling intensity, i.e. number of clusters, and is calculated before the grid can be located by using an equation:

$a = \sqrt{(A/(n+1))}$ where a = distance between the sample clusters
A = total settlement area
n = number of sampling units (=clusters)

Selection of the route to the cluster on the map is done in the office by using aerial photos and transparent drawing film. Visible physical features (e.g. a road junction, cattle post, a pond or a well) are identified close to the cluster on the aerial photo and used as a fixed point. A route mapping is carried out so that the shortest possible route from the fixed point to the first plot of each cluster is drawn on the transparent drawing film. Distances (calculated in corresponding distances in terrain) and compass direction from the fixed point to the first plot of each cluster are estimated and recorded (see Figure 5 and Table 1). Cluster direction, i.e. direction from the first sample plot to the second sample plot etc. is estimated so that all four sample plots in the cluster (see Chapter 2.3) can be located in the area.

Figure 5. Route from the fixed points (=corners of the farm fences) to clusters no. 1 and 2

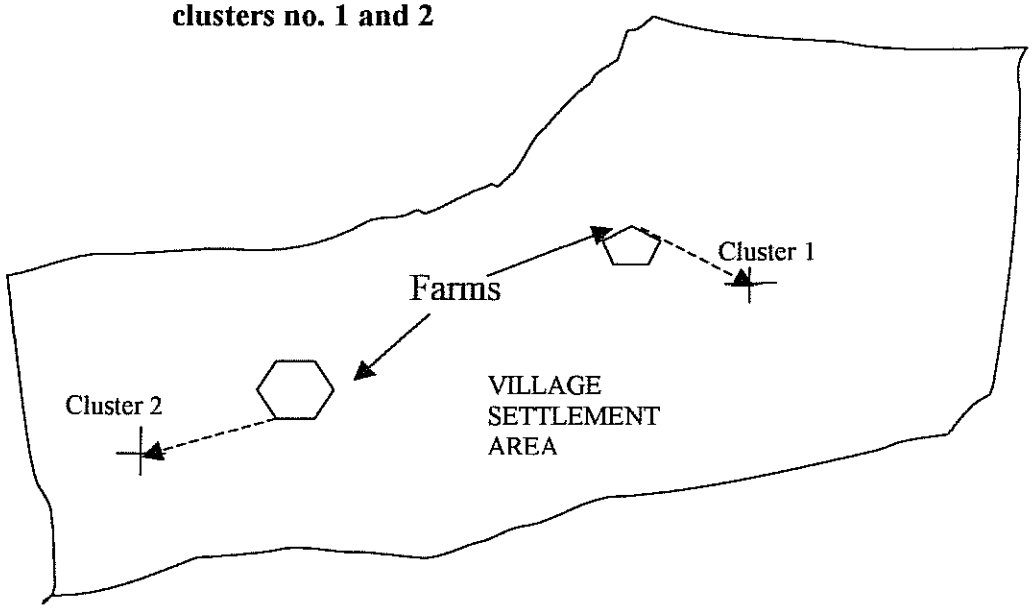


Table 1. Route list with instructions of the route from the fixed points to the clusters

Route list

Ontanda Village, CPR land in the settlement area **Map scale 1: 35 000**

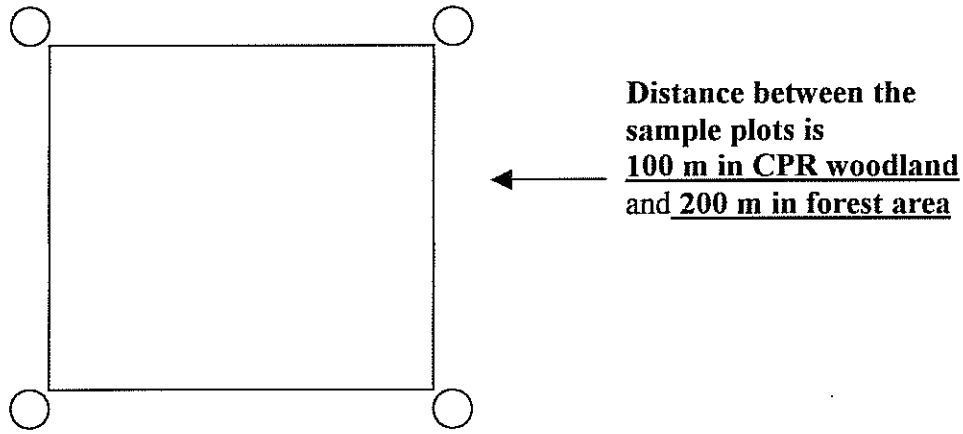
Cluster no.	Distance from the fixed point	Description	Compass direction	Cluster direction [1]
1	350	From the corner of the farm fence	120 °	S-E-N
2	450	From the corner of the farm fence	255 °	W-N-E
...	...	...	...	...

[1] Directions of the sample plot starting from the first sample plot S = South, E = East, N = North and W = West

A **shape of a sample cluster** is a square and it consists of four concentric (nested) sample plots in each of the corners (see Figure 6) A number of sample plots in a cluster can vary depending on the circumstances of the village, e.g. the distances to the clusters and how long it takes to locate a cluster in the terrain. Basically one cluster should be designed so that measuring one cluster = one working day.

In CPR woodland a square-shaped cluster captures information of the trees and bushes in an area of 1 ha in each location. This improves the accuracy of the inventory especially in heterogeneous areas compared with a systematic or random sampling of single sample plots and it also decreases working time.

Figure 6. Sample cluster in CPR woodland and in village forest area



4. Sample plot measurements

The same information and characteristics are measured and recorded in CPR sample plots as in On-farm woodland sample plots (see Chapter 3.2).

4. Village forest area inventory

Village forest areas are used as grazing land during the dry season and there are a number of cattle posts situated in them. Village forest areas are considered remote by the villagers and in the past trees were seldom cut there. Today when resources of construction material are scarce or non-existing in the closer areas, intensive cuttings are found even in the village forest areas.

A village forest area inventory provides data, which is relevant to the members of local communities. The local IFMP will be based on this data.

4.1 Inventory design

An inventory design in village forest areas is basically the same as in CPR land. The only difference is that the distance between the nested sample plots in a cluster is 200 m in the forest area (in CPR land the distance is 100 m). Thereby a sampling cluster represents a larger area, as a village forest area is generally larger compared wit CPR land in a village settlement area. A larger cluster, i.e. representing 4 ha of the village forest area, also captures variations in the vegetation more effectively and at the same time improves precision of the inventory when the working time allowed remains more or less the same.

A number of sample plots in each cluster can be increased, as the fieldwork in a forest area is easier, with less physical hindrances than in CPR land. The working speed may also have improved when the inventory team begins to master their work.

4.2 Sampling intensity

The same factors as in the CPR woodland inventory must be considered when the sampling intensity is defined:

1. Time available for the fieldwork is one of the main factors when the sampling intensity is decided.
2. Size of the village forest area affects the sampling intensity. In large forest areas lower intensity must be applied as the sampling must cover the whole area.
3. Calculation of the sampling intensity:

Sampling intensity = Sampling area/ Village forest area

See also Box 6.

4.3 Locating sampling clusters on the village map

Distance between the sampling clusters (= spacing) is calculated by using the following equation:

$$a = \sqrt{(A/(n+1))}$$

where a = distance between the sample clusters
A = village forest area
n = number of sampling units =clusters)

See also Box 7.

4.4 Selection of the route to the cluster on the map

The same information and instructions are applied in the village forest areas as in CPR land in the village settlement area (see Chapter 2.3). In the forest area fixed points are normally road junctions, wells, ponds and cattle posts.

A transparent film showing the routes and a route list is prepared in the same way as in the CPR woodland inventory (see Figure 7 and Table 2.)

Figure 7. Route from the fixed points (=a road junction and a pond) to clusters no. 1 and 2

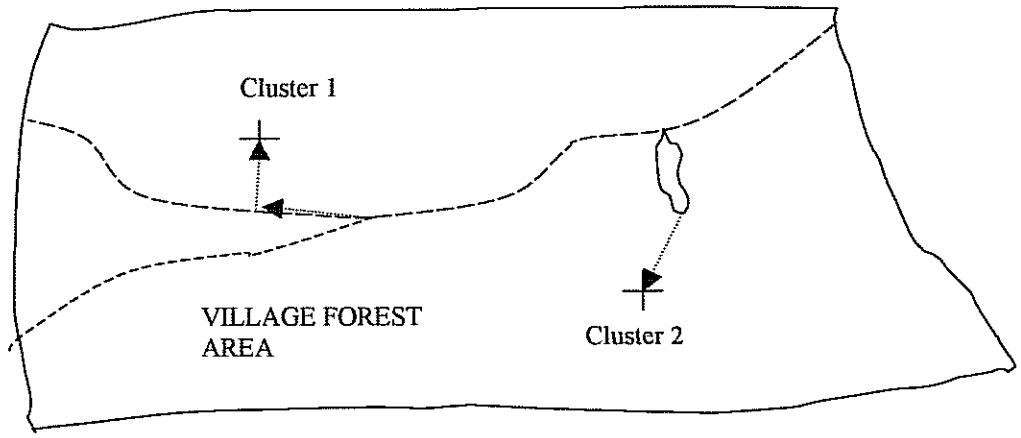


Table 2. Route list with instructions of the route from the fixed points to the clusters

Route list

Ontanda Village, Village Forest Area **Map scale 1: 35 000**

Cluster no.	Distance from the fixed point	Description	Compass direction	Cluster direction [2]
1	1. 650 m 2. 300 m	From the road junction along the road From the road to the first sample plot	- 360 ° = North	 N-E-S
2	400 m	From the tip of the pond	220 °	S-E-N
...	...	...	...	...

[2] Directions of the sample plot starting from the first sample plot S = South, E = East, N = North and W = West

4.5 Locating sample plots in terrain

The same information and instructions are applied in the village forest area as in CPR land in the village settlement area (see Chapter 2.3)

4.6 Sample plot measurements

The same information and characteristics are measured and recorded in sample plots in the village forest area as they are in On-farm woodland sample plots (see Chapter 3.2).

4.7 Training of the local inventory team

An inventory team, consisting of local farmers, carries out the forest inventory in all land-use areas. Participation by the local farmers in the inventory work is essential for several reasons:

- the members of the inventory team are known by the villagers which increases confidence and interest towards IFMP, also when the results are presented;
- the locally known team makes communication easier and;
- the local inventory team makes it possible to continuously collect relevant local knowledge about tree species and their products.

See Box 7.

After the training period the local team can work either independently or under supervision of a forest ranger.

Box 7. Training the farmers to participate in forest inventory in Ontanda Village

In Ontanda Village three farmers were trained to carry out the measurements in the inventory fieldwork. The training period was less than a week as all the farmers had already acquired measurement skills e.g. in their previous experiences in construction work. The forest ranger was a team leader during the whole fieldwork period because the village area was so large that transport was required to reach the farms to be surveyed and locations where the sample plots will be established.

5. Computation of the results

A computation system is part of the village forest assessment and eventually community members should be able to participate in the calculation procedures. However, during the first stage the methodology of the village forest resources assessment must be developed in its entirety before the technical knowledge about the computation system can be transferred to the community members. The computation system that is outlined in this

chapter must be tested in one of the pilot communities and eventually corrected before it is completely adjusted for use by the villagers.

In the village forest resources assessment there are two types of inventory designs and thus two different calculation systems:

1. Single tree inventory in privately allocated areas, i.e. on-farm single tree inventory
2. Subjective or systematic sampling with circular sample plots in woodland areas, i.e. On-farm woodland inventory, CPR woodland inventory and Village forest inventory

Calculation of the results: on-farm single tree inventory

The relevancy of the information obtained from the On-farm single tree inventory is tested when community members evaluate the results of the inventory. Thereafter the inventory designs, e.g. which data should be collected, can be changed if necessary.

The mean values are used to describe the tree characters in the whole community and they are averages of the values calculated for each sampled farm. Thus the general formula to calculate any of the relevant tree characters is

$Cmean = \Sigma ci/n$ where Cmean = mean value of a character C
ci = value of the character C in one selected farm
n = number of selected farms

The following characters describing the quantities and qualities of the trees and bushes growing in privately allocated areas are calculated:

1. Species distribution = number of trees/species
   - Indicates the priorities of the local people in selection of tree species
2. Number of mature/non-mature tree/species
   - Indicates the present yield of different products
3. Number of female/male specimens/ dioecious species
   - Indicates the local knowledge of the production system of different species
4. Sizes of trees/species
   - Mean diameter at breast height/ species
   - Mean height/ species
   - Mean biomass/ species
   - Gives general information for the selection of different management options
5. Use of trees
   - Indicates the importance of the tree species for the local people
   - Gives information of potential income-generating products
6. Management of trees

- Shows the existing local knowledge of the management of trees and shrubs

Calculation of the results in woodland areas

In all woodland areas, i.e. in on-farm woodland, CPR woodland and the village forest area, circular sample plots were used as measurement units. Therefore the formulas for the calculation of different characters are the same as in each type of woodland.

A. Calculation of the results: 15-m circular sample plot

Trees with dbh > 5 cm are measured in this sample plot. A general formula for calculations of different characteristics in each sample plot is

Ci = a* ci where Ci = value of the character C per hectare
a = area of the sample plot
ci = total or mean value of the character c in the sample plot

The values of the following characters are estimated in each sample plot using the actual sample plot area of 0.07 ha.

1. Species distribution = number of trees/species

Ni = ni/0.07 ha where Ni = number of trees/species/ha
ni = number of trees/species/sample plot

Example:
In a sample plot no. C51 (= settlement area; cluster 5; sample plot no.1) the following data is recorded:

ni = number of *Colophospermumm mopane* trees with dbh > 5cm = 6;
Ni = number of *C. mopane* trees/ha = 6/0.07ha = 85.7 trees/ha ~ 86 trees/ha

2. Tree dimensions/species:

In a sample plot no. C51 (= settlement area; cluster 5; sample plot no.1) the following data is recorded:

a. Mean diameter at breast height, cm / species/ sample plot

Mean Dbh = $\sum$ dbhi/ni where dbhi = dbh of each sample tree
ni = number of sample trees

Example:

C. mopane sample tree dbh: 12.3 cm, 6.8 cm
Mean dbh = (12.3 + 6.8) cm/2 = 9.55 cm ~ 9.6 cm

b. Mean height/ species /sample plot

Mean H = $\sum$ hi/ni where hi = height of a sample tree
ni = number of sample trees

Example:

C. mopane sample tree heights: 5.3 cm, 4.8 cm
Mean height = (5.3 + 4.8) cm/2 = 5.05 cm ~ 5.1 cm

c. Mean biomass/species / sample plot

Mean B = $\sum$ Bi/ni where [3]Bi = Biomass of a sample tree
ni = number of sample trees

Example:

C. mopane sample tree biomasses:
0.153 tons, 0.102 tons
Mean biomass = (5.3 + 4.8) cm/2 = 5.05 cm ~ 5.1 cm

d. Numbers and sizes of usable poles/species

The volume of each usable pole obtained from a sample tree is calculated by using a volume equation:

$V = \Pi * r^2 * l$ where r = radius of a cross sectional area in the middle of the pole
l = length of the pole

The values of the following potential resources obtained from sample trees are calculated:

- Number of usable poles of each type/ species (local name of the pole and species)/ha
- Quantity of each type of usable poles/ha
- Total quantity of usable poles of each species/ha

[3] Biomass of each species is calculated by using the biomass equations obtained from National Forest Inventory, see Appendix 5.

Example

In a 15-m sample plot the following sample tree data was collected:

Sample tree no.	Local name (Botanical name)	Whole tree		Usable part of the tree		
		Dbh, cm	Height, m	Height, m	D middle, cm	Local name of the pole
1	Omusati (*Colophospermum mopane)*	5.2	3.8	1.7	5.3	Okatolopola
2	Omukanga (Commiphora sp.)	11.3	5.3	1.6	11.5	Omweelo
3	Omulama (Combretum apiculatum)	6	3.5	1.8	5.3	Oshitolopola

Sample plot results:

Volume of the usable part of the tree:

Omusati $V = \Pi^* (5.3/2 \text{ cm})^2 * 1.7 \text{ m} = 0.0037 \text{ m}^3$

Omukanga $V = \Pi^* (11.5/2 \text{ cm})^2 * 1.6 \text{ m} = 0.0166 \text{ m}^3$

Omulama $V = \Pi^* (5.3/2 \text{ cm})^2 * 1.8 \text{ m} = 0.0040 \text{ m}^3$

Number of usable poles of each type/ species (local name of the pole and species)/ha:

Species	Number of trees/plot	Number of trees /ha
Omusati	3	3/0.07 ha = 42.9 trees/ha~43 trees/ha
Omukanga	3	3/0.07 ha = 42.9 trees/ha~43 trees/ha
Omulama	2	2/0.07 ha = 28.6 trees/ha~29 trees/ha
Total		115 trees/ha

Quantity of each type of usable poles/ha:

Species	Type of pole	No. of trees/ha	Volume of poles/ha
Omusati	Okatopoola	43	43* 0.0037 m^3/ ha = 0.1591 m^3/ ha
Omukanga	Omweelo	43	43 *0.0166 m^3/ ha = 0.7138 m^3/ ha
Omulama	Oshitolopola	29	29* 0.0040 m3/ ha = 0.116 m^3/ ha
Total			0.9889 m^3/ ha

e. Other uses/species

Information of any uses other than for poles is given per each species.

Finally the total values for the whole communities are computed:

1. Privately allocated woodland
   Average values/ha of the different characteristics are calculated. The average values are calculated by using the same formula as in On-farm single tree calculations (see Chapter 4.1).

Total values of each woodland characteristic are calculated only as an average value per hectare. The available aerial photos have too large a scale to be used for interpretation and measurement of woodland/ non-woodland inside farms. An estimation of on-farm woodland areas would demand measurements in terrain, which is a very time-consuming process.

2. CPR woodland and Village Forest Area
   Both total values and average values/ha of each relevant woodland character can be calculated. The formula used in the calculation of the total values is

   Ctot = A* Cmean where Ctot = total value of character C
   A = total woodland area
   Cmean = mean value/ha of character C calculated by using values/ha of character C in each sample plot

Example:

An area of the CPR land in the settlement land is 2000 ha in a village.
A mean number of *Colophospermum mopane* trees is 20 per hectare.
A mean number of *Okatoloopa* poles is 14 per hectare.
There are a total of 40 000 *C. mopane* trees growing in CPR land in the village settlement area and 28 000 *Okatoloopa* poles.

All calculated values are to be seen as indicators rather than representing exact quantities of the forest resources, as the accuracy of the final results is relatively low due to several factors:

1. Only an approximate estimate of the total woodland area, both in the settlement land and in the village forest area was carried out as the exact number and sizes of the farms was not possible to determine during the consultancy.

2. A number of specimens of each species was counted in the sample plots but their dbh was not measured in all the trees, only in the sample trees. This may cause a bias in the mean and total values of each volume-related characteristic in an individual sample plot although the bias in the total values calculated for the whole woodland area may be insignificant.

There are no volume equations available for any of the main species growing in the villages in the Omusati region. Volume functions, developed by using data collected in other regions and/or of other species, were used. This may have caused error in volume calculations as tree shapes of the existing species (e.g. Commiphora sp.) can differ from species with volume functions.

B. Calculations of the results of a 4-m sample plot – regeneration plot

The measured and calculated characteristics of the smaller nested sample plot, with a diameter of 4 m and area of 0.005 ha, indicate the potential re-growth in the area. These sample plots were established in all land-use areas, i.e. in privately allocated land, in CPR land in the settlement area and in village forest areas.

The following characteristics were calculated:

1. Species distribution:
number of shrubs/bushes/trees with dbh < 5 cm / species/ ha was calculated by using the following equation:

$N = \sum ni/a$ where N = number of shrubs/species/ha
ni = number of shrubs/ species in a sample plot
a = area of the sample plot

Example:

Species	No.of shrubs/plot	No. of shrubs/species/ha
Omusati (C. mopane)	21	21/0.005 = 4200
Omulama (Combretum apiculatum)	4	4/0.005 = 800
Total		5000

2. An average height of the shrubs/ species was calculated by using the following equation:

$hj = \sum hi/\sum ni$ where hj = an average height/ species/sample plot j
hi = height of a sample tree i
nj = number of trees/species/sample plot

$Hmean = \sum hj/\sum N$ where Hmean = an average height of a species
hj = an average height of a species/sample plot
N = number of sample plots

3. An average number of shoots of each shrub/specis/ha

4. Use of the shrubs/ species

5. Total amount of usable shrubs (for constructions)

PART III VILLAGE WOOD CONSUMPTION SURVEY

1. Introduction

The second part of the report describes a village wood consumption survey, which was carried out in one of the pilot communities, Ontanda Village, Uukwaluudhi Tribal Area, Omusati Region. It is assumed that the average wood consumption figures computed in this survey can also be used in other pilot communities in the Omusati region. This report consists of both a descriptions of the methodology and a fieldwork manual for further surveys. Local wood consumption surveys may be needed in other regions in Owambo District, as the wood consumption patterns probably differ from those in Omusati Region.

Wood consumption was studied both in privately allocated areas, including all constructions in homesteads and fields and in CPR areas, e.g. constructions in cattle posts. Some information was also collected about firewood consumption, although a single study is not a very appropriate method for that purpose, because of the seasonal variation of the amount and sources of firewood. A long-term study is the only method in which to obtain reliable information of firewood consumption.

There is very little data available concerning wood consumption in homesteads and farms in the Owambo District, and until now there has been no collection of data in any of the communities in the Omusati Region. There is one profound homestead construction study carried out in the Kavango District (Robinson, D. *Usage Surveys as Tool for Community-Based Forest Management*, 1996, University of Oxford, UK) which describes different types and dimensions of poles used in the *Kavango* homestead and farm constructions. Construction types, i.e. huts, shelters, palisade walls and field fences are similar to the *Owambo* constructions but tree species differ, which makes it difficult to compare wood consumption in the Kavango and Owambo districts.

The three objectives in a Village wood consumption survey are:

1. to estimate a total consumption of the construction wood and describe the consumption of firewood . The mean estimates from this village can be used in other pilot communities in the Omusati Region as a wood consumption survey is relatively complicated and time consuming. A total consumption of construction wood also indicates how much wood is needed to establish a new farm.
2. to collect information concerning local names of pole types and species used in different constructions in homesteads and farms. This information helps to select appropriate parameters in a forest resources inventory.
3. to estimate annual consumption of the construction wood by calculating consumption of different types of poles. Annual consumption is compared with the annual yield of trees producing corresponding dimensions (obtained from the forest inventory carried out in the village area). This comparison should give

some indications on how to use the present woodland resources in a more sustainable way.

2. Construction wood consumption

A selection of the methodology depends on the demanded accuracy of the results and the time available. In this survey the accuracy demanded was relatively low as the available time to carry out the survey was limited and the method selected was a two-stage sampling.

Sampling intensity in the village was 1.5 %, i.e. 3 houses out of a total of 190 houses were selected for the study. The criterion of the farms to be included in the study was the farm size, which was assessed after subjective observations during field visits. The three selected farms were classified as

1 large sized farm
1 medium sized farm
1 small sized homestead

First stage of the sampling:

Sample units representing different types of construction in each farm were selected randomly.

Second stage of the sampling:

A systematic sampling was carried out among different types of poles in each sample unit.

The detailed instructions of the sampling and measurement procedures including the field forms are in the Wood consumption survey Field manual.

3. General information

The following general information was collected in each of the selected farms:

1. District
2. Tribal area
3. Village
4. Name of the farmer
5. Number of adults and youth over 15 yr.
6. Number of children under 15 yr.
7. Establishment year and age of the farm
8. Area of the farm (estimated on a map)

4. Sampling units

First stage sampling included a survey of different types of construction on the farms, which were called sampling units (see also Box 7). E.g. the following types of constructions were found:

Homesteads:

1. Huts:
   Round clay brick walls, squared clay brick walls, dense pole walls, supporter walls
2. Roofs:
   Small size and large size
3. Shelters:
   "Living rooms"
   Store "tables"
   Granary shelters
4. Palisade corridors and fences

Fields belonging to the farm:

1. Shelters:
   Visitors rooms
   Store "tables"
2. Cattle pens
3. Fences[4]

An inventory list was recorded showing the number of constructions in each unit, e.g. how many round clay brick huts, large roofs, "table" shelters etc. were found on the farm.

In each group one construction was selected randomly as a sample unit (see Box

4.1 Measurements in the sampling units

Each type of sampling unit (totally six types) represents constructions built with similar poles. The following measurements were done on the sampling units:

Type 1. Hut walls, upright and horizontal poles (round clay brick huts, squared clay brick huts, huts with supporting poles):

- Local name of the pole type

[4] As Ontanga village is densely populated many of the farms share some of their boundaries. A common boundary between two farms belongs to one of them; i.e. the farm owning part of fence, both constructs and repairs it. Therefore only the fences and their parts belonging to the selected farms were measured and parts of the fence belonging to the neighbouring farm were excluded in order to avoid double estimation.

- Number of poles of each type

- **Sample poles of each pole type**

  - Random selection
  - Middle diameter and length
  - description of the use of the pole
  - duration of the pole

Type 2. Low and high palisade wall huts, upright and horizontal poles

- Circumference of the hut
- Local name of the pole type
- Number of poles/ 1 m of wall (horizontal pole starting in 1 m section) in a randomly selected location along the hut wall

- **Sample poles of each pole type**
  - randomly selected pole inside the previously selected 1 m distance of the wall
  - same measurements as in Sampling unit type 1. Sample poles

Type 3. Roofs, small size and large size

Upright poles:

- number of poles in the roof

- **sample poles**

  - same measurements as in type 1. Sample poles

Horizontal poles:

- number of poles in ¼ or 1/6 of the roof

- **sample poles**

  - randomly selected in the same part of the roof
  - same measurements as in type 1. Sample poles

Type 4. Shelters (hut construction, table construction, granary shelters)

- Same measurements as in sampling unit type 1. Sample poles

Type 5. Palisade corridors and fences (homestead, cattle pens)

- Length of the corridor and fence
- Local name of the pole type
- Number of poles/ 1 m of wall (horizontal pole starting in 1 m section) in a randomly selected location along the hut wall

- **<u>Sample poles of each pole type</u>**

  - randomly selected pole inside the previously selected 1 m distance of the wall
  - Same measurements as in sampling unit type 1. Sample poles

Type 6. **Field fences:**

- Length of the fence
- Local name of the pole type
- Large supporting poles:

  - Number of poles/ 10 m of the fence in a randomly selected location along the fence

- Small droppers and horizontal poles

  - Number of poles/ 1 m of fence in the same locations where the large poles were measured

- **<u>Sample poles of each pole type:</u>**

  - randomly selected pole inside the previously selected 10 m and 1 m distance of the fence
  - Same measurements as in sampling unit type 1. Sample poles

Box 8. Selection of sample units in a small-size farm in Ontanda Village

The following list was prepared in the farm:

Type of construction	Number of constructions	Sample unit number
Dense wood wall hut (low palisade wall)	1111 4	1
Granary shelter (large)	1 1	2
Shelters (hut construction)	1111 4	3
Shelters (table construction)	1111 4	4
Kitchen hut (high palisade wall)	11 2	5
Large roofs	11111 11111 1 11	6 and 7
Palisade corridors and fence around the homestead	1	8
Field fences	1	9

One of each type of the constructions was selected as a sampling unit except two of the large roofs.

5. Calculations

5.1 Volume estimation

Volumes of the poles were estimated by using a volume equation:

$V_{pole} = \pi * (dmid/2)^2 * l$ where dmid = middle diameter of a pole
l = length of a pole

Total number of poles/volume of wood consumption on a farm

Total number of poles in a farm is calculated by using the following equation:

$NTOT = Ntot1 + Ntot2$ where NTOT is the total number of poles used in all constructions on a farm and

1) **Ntot1** includes hut walls, upright and horizontal poles (round clay brick huts, squared clay brick huts, huts with supporting poles); roofs, small size and large size, upright poles; shelters (hut construction, table construction, granary shelters).

Ntot1 is calculated by using the following equation:

$Ntot1 = \Sigma(Nj * ni)$ where Nj = number of constructions of each type of sample unit
ni = number of poles of each type in each measured sample unit

Ntot2 includes low and high palisade wall huts, upright and horizontal poles; roofs, small size and large size, horizontal poles; palisade corridors and fences (homestead, cattle pens); field fences.

Ntot2 is calcualted by using the following equation:

$Ntot2 = \Sigma Nj * (ni * L)$ where Nj = number of constructions of each type of sample unit
ni = number of each type of poles in a measurement unit (1 m or 10 m of the wall/fence or ¼ or 1/6 of the roof
L = total length/circumference of the sampling unit

Total volume of the poles used in all constructions of a surveyed farm was estimated similarly to the total number of poles:

VTOT = Vtot1 + Vtot2

Vtot1 $= \Sigma(Nj * ni * vi)$ where Nj = number of constructions of each type of sample unit
ni = number of poles of each type in each measured sample unit
vi = volume of a sample pole

Vtot2 $= \Sigma Nj * (ni * vi * L)$ where Nj = number of constructions of each type of sample unit
ni = number of each type of poles in a measurement unit (1 m or 10 m of the wall/fence or ¼ or 1/6 of the roof
L = total length/circumference of the sampling unit
vi = volume of each type of sample pole

6. Cattle post constructions in CPR areas

Consumption of construction wood in cattle posts was assessed in a same way as wood consumption of palisade huts and fences in farms. Cattle posts are rebuild or moved to some other place every year or every second year, depending on the grazing demands as the cattle is grazing in CPR land in the settlement area during the years with good rains. Normally only part of the fence is build with poles and most part is brushwood.

7. Firewood assessment

Firewood is normally a by-product obtained from the cuttings of other main forest products and its consumption and sources vary seasonally. Firewood consumption depends on the size of the household and on the amount of the resource, i.e. the dry wood in CPR land. Dry wood originates from cuttings of other forest products and therefore collection of firewood does not diminish the live forest resources. However a sustainable management of the existing forest resources in CPR land also increases the amount of firewood. It has a major impact on women's life when the time of firewood collection decreases. The objectives of the firewood consumption survey is 1) to find out where the firewood is collected; 2) how long its collection takes and; 3) what the duration of the collected firewood is.

This is a method description of a firewood survey and only parts of the survey were carried out in a very short period. The " sampling" of the measurement units was occasional and did not follow any statistical method. The information obtained in the survey was only indicative. In order to obtain accurate information of firewood consumption a long-term (minimum one-year) investigation is needed.

Sampling units

Any occasional bundle or load of firewood that is found in the area is included in a firewood survey. Firewood bundles carried by women or loads found in homesteads or in donkey carts are measured.

Measurements

The following characteristics are measured in each bundle or load:

1. Weight of the bundle
2. Number of logs/sticks in a bundle/load
3. Sample log/stick selected randomly in a bundle/load:
   Middle diameter
   Length

Other information

Information of the quality of firewood and duration of the measured bundle/load in the household is also collected.

1. Quality of the wood
   Species used for firewood
   Collected dry or fresh (including shoots, twigs and branches that have been cut fresh but left to dry in the forest).
2. Duration of one bundle in a household
   Number of the household members

6.4 Calculation of the firewood quantities

Some indicative estimation of consumed quantities was done although the most important information in this survey was about the sources of firewood.

Biomass (dry wood weight) **of the bundle** is obtained directly by weighing with a scale.

Weight of a load in a donkey cart is estimated to one ton in the forestry directives.

Volume of a bundle/load is estimated by using the following equation:

$Vtot = ni * vi$ where ni = number of sticks/logs in a bundle/load
vi = volume of a sample stick/log

$vi = \pi * (dmid/2)^2 * l$ where dmid = middle diameter of the stick/log
l = length of the stick/log

Part IV Evaluation of village forest resources and wood consumption

1. Introduction

Forest resources assessment is an important tool in the forest management planning at the community level. Forest resources assessment includes inventory methods and computation system that are producing relevant information for the forest management planning of the local communities. Evaluation of the results by community members is one of the most important steps when the relevancy of the produced information is assessed. In case community members cannot use these results in their forest management planning the whole process, i.e. presentation of the results, computation system and inventory methods must be carefully considered:

1. Were the results presented correctly, e.g. using vocabulary, names and references that are recognisable for the community members?
2. Were the relevant parameters calculated, e.g. quantities and qualities of forest products that are used in the community?
3. Were the relevant variables measured, e.g. dimensions of relevant forest products?

There are tables and figures in Chapter 2 that are processed by using the data collected in the forest resources assessment and wood consumption survey in Ontanda Village, Uukwaluudhi Tribal Area, in the Omusati Region. Some of the results give valuable background information to the organisations that are involved in the natural resources management in the region. The information in the tables is mainly aimed to be introduced in the community. The evaluation of the results by the community members in Ontanda Village is the next stage in the process of developing an appropriate model for the Integrated Forest Management Planning at the community level.

The information in the tables in Chapter 2 cannot be used directly for the presentation in the community. The information needs to be presented using concepts that are recognisable for all the community members. Forestry professionals in the District Forestry Office in the Omusati Region have the knowledge of the local communities needed for the preparation of the provided information for the presentation in the community.

The two main objectives of the village forest resources assessment are:

1. to arouse the awareness among the community members about the condition of the village forest resources and thereby improve their motivation to participate in the planning and implementing of the management of their forest resources.
2. to provide site-specific information about the quantities and qualities of the village forest resources for the forest management planning at the community level.

Forest management planning at the community level should be based on the sustainability, i.e. cuttings in the village area should not exceed growth of trees in the same area. Members of the local communities are dependent on their common forest resources in their village in Common Property land (CPR) in a settlement area and in forest area.

Households are relying on the firewood resources close to the homesteads why it is important to motivate all community members to participate actively in management of common forest resources in the settlement area. Forestland is a resource of building material, as new poles are needed every year in the homesteads to replace the old ones. Both private and common forest resources can become income generating if they are actively managed, e.g. when the forest resources have exceeded a level of sustainability, surplus production can be used for selling firewood and/or construction poles.

Presentation of the forest resources assessment can arouse awareness of how these resources are continuously diminishing and, on the other hand, how they can recover and increase if they are managed.

2. Wood consumption in Ontanda Village

Common forest resources can be compared with the consumption of wood in a village. A wood consumption survey produces information about total and annual wood consumption in villages. The wood consumption survey in Ontanda Village excluded the firewood for two reasons:

1) firewood is normally a by-product, parts of trees, which are left lying on the ground when the main products, i.e. construction poles have been removed and;
2) relevant information about firewood consumption demands a long-term survey, which was not possible to carry out during the consultancy.

Wood consumption survey was carried out in three farms in Ontanda Village and in two cattle posts in the village forest area. The following information was processed by using the data from the wood consumption survey:

- Quantities of poles used in constructions
- Different types of poles used in constructions
- Tree species used in constructions
- Duration of poles

2.1 Wood consumption on farms

Three farms with different sizes were surveyed in Ontanda Village. It was estimated that there are 190 farms, of which 19 farms (10 %) are large sized, 104 (55 %) middle sized and 67 (35%) small sized. A calculation of the total and annual wood consumption in Ontanda Village was based on this estimation.

The surveyed large and medium sized farms belonged to the oldest farms in the village, established in the 1960's and 70's respectively when the forest resources were still

abundant. The surveyed small sized farm was established 1997 and its constructions were not completed because of the lack of construction wood. Interviews with other farmers in Ontanda Village confirmed that there is very little construction wood available close to the village and in the most of the new farms brushwood have been used for fencing of fields.

Table 1. Types of poles, their quantity and dimensions (dmiddle and length) in an average farm in Ontanda Village

Local name of the pole	Description	Number of poles	Dmiddle, cm	Length,m
eehonga	*Supporting long upright poles in roofs*	367	5.0	2.3
iiti	*Smaller not supporting upright poles in walls and palisade corridors*	4687	6.2	1.6
oluuli	*Horizontal long poles in hut walls*	107	2.2	1.9
omainda	*Supporting horizontal or upright poles in walls, shelters and palisade corridors*	2433	12.8	2.2
oongudhi	*Supporting large upright poles in hut walls and palisade corridors*	319	9.6	1.4
opaala	*Supporting poles in field fences*	984	9.3	1.5
uutolopola	*Smaller not supporting poles in field fences*	3250	5.3	1.9
Total/Average		**12145**	**7.2**	**1.8**

Table 2. Species used in different types of poles

Name of the pole		Species	Botanical name
eehonga	*Supporting long upright poles in roofs*	ohama	Terminalia prunioides
iiti	*Smaller not supporting upright poles in walls and palisade corridors*	omusati	Colophospermum mopane
		omatjette	Dichrostachys cinerea
		ohama	Terminalia prunioides
oluuli	*Horizontal long poles in hut walls*	omusati	Colophospermum mopane
		ohama	Terminalia prunioides
omainda	*Supporting horizontal or upright poles in walls, shelters and palisade corridors*	omusati	Colophospermum mopane
		ohama	Terminalia prunioides
oongudhi	*Supporting large upright poles in hut walls and palisade corridors*	omusati	Colophospermum mopane
		ohama	Terminalia prunioides
		omukuku	Combretum imberbe
opaala	*Supporting poles in field fences*	omusati	Colophospermum mopane
		ohama	Terminalia prunioides
		omulama	Combretum apiculatum
uutolopola	*Smaller not supporting poles in field fences*	omusati	Colophospermum mopane
		ohama	Terminalia prunioides
		omulama	Combretum apiculatum

Tables 1 and 2 indicate that *omainda* poles have an important supporting role in constructions and the species used for them is always *omusati, which* is the only species durable enough for that purpose. In an average farm 2433 *omainda* poles are used in walls, corridors and shelters. *Omainda* poles can last from 6 – 30 years depending on the termite infection at homestead. Field fencing is consuming significant quantities of poles of Omusati, *Ohama* and *Omulama* species. These poles can last normally 5 – 10 years before they need to be replaced with new poles.

Table 3. Wood consumption on farms

Farm size	Hut constructions		Palisade fences		Field fences		Total	
	m3	%	m3	%	m3	%	m3	%
Large	16.2	7.9%	121.4	59.1%	67.7	33.0%	205.3	100.0%
Medium	10.6	13.7%	59.9	76.9%	7.4	9.5%	77.9	100.0%
Small	8.3	29.7%	15.8	56.4%	3.9	13.8%	28.0	100.0%
Average	**11.7**	**17.1%**	**65.7**	**64.1%**	**26.3**	**18.8%**	**130.1**	**100.0%**

Table 3 indicates that the largest volume of wood is used in palisade walls and fences in the homesteads and cattle pens. Average volume of construction wood used in hut constructions, including roofs, and field fences are almost the same, but volumes can differ considerably between individual farms.

Table 4. Total consumption of construction wood, m^3, in the village

Farm size	Share of all farms	Number of farms	Total consumption of construction wood, m^3	Total consumption, number of poles
Large	10%	19	3901	521198
Medium	55%	104	8100	1082240
Small	35%	67	1879	251064
Total	**100%**	**190**	**13881**	**1854502**

Average consumption of construction wood/farm	**73.1 m^3**
Average consumption, number of poles/farm	**9761 poles**

The total amount of construction wood in farms in Ontanda village is approximately 13900 m^3 (Table 4). This figure is probably an underestimation as it was not possible to include all wood used in homesteads (e.g. doors and benches were excluded). Total number of poles used in farm constructions in Ontanda Village is 1,85 million. Average construction consumption in a farm was estimated to 73 m^3 and average number of poles used in a farm to 9760. These figures can be compared with the wood consumption volumes in a Kavango farm (Erkkilä, A. and Siiskonen, H. 1992), where the total consumption was 69.5 m^3 and the number of poles consumed was 21 599.

Table 5. Annual consumption of construction wood, total and per species

Farm size	Number of farms	Annual total consumption* m3	Species	Botanical name	Annual consumption %
Small	19	130.7	ohama	Terminalia prunioides	47.1
Medium	104	399.4	omatjette	Dichrostachys cinerea	1.6
Large	67	130.8	omukuku	Combretum imberbe	0.1
			omulama	Combretum apiculatum	3.9
			omusati	Colophospermum mopane	47.3
Total	**190**	**661.0**			100.0

Average 3.5 m^3/farm 0.53% of total annual wood consumption

* Estimation of the annual total wood consumption was based on an assumption that the existing poles are replaced with poles of the same species.

The total annual wood consumption in Ontanda Village (Table 5) was estimated to 661 m^3 of which almost 95 % was composed of two species, *Omusati* and *Ohama*. Annual consumption was predicted by assessing duration of poles of certain species and dimensions. Both total consumption and total annual consumption figures indicate net-consumption of wood as bark and other removed particles of the tree stem were not included in the estimation.

2.2 Wood consumption in cattle posts

Cattle posts in the village forest area are not used in years with good rains and therefore it is difficult to estimate an annual wood consumption. According to the interviewed farmers constructions in cattle posts do not normally last more than one season because of the termites, i.e. they must be rebuild every time the cattle is moved to cattle posts from grazing areas close to homesteads.

Species used to constructions in cattle posts depend totally on the availability, i.e. trees growing close to cattle posts are used as the constructions are temporary. However some times quite large quantities of e.g. *Omusati* are used to build the gates and these, normally quite large poles, are moved to next cattle post site.

Table 6. Number, mean middle diameter, mean length, total and annual consumption of different types of poles in cattle posts

Type of pole	Description of type	Number	Mean middle diameter cm	Mean length m	Total consumptionm3	Annual consumption, m3
Iiti	**Smaller not supporting upright poles in walls and palisade corridors**	670	4.3	2.0	1.658	1.105
Omainda	**Supporting horizontal or upright poles in walls, shelters and palisade corridors**	42	9.4	2.1	0.562	0.204
Oongudhi	**Supporting large upright poles in hut walls and palisade corridors**	408	7.9	1.6	3.963	2.642
Total/cattle post		**1120**			**6.183**	**3.951**
Total (20 cattle posts)		**22393**			**123.7**	**79.0**
Average			**7.2**	**1.9**		

The annual consumption was estimated to half the total consumption as it was assumed that cattle posts are rebuild every second year. Cattle posts are normally fenced with brushwood and only huts and cattle pens have palisade walls.

3. Forest resources in Ontanda Village

Forest resources in Ontanda Village were assessed using different inventory methods in each management unit. The village area was divided in four forest management units: 1. Privately allocated land; 2. Common Property land (CPR) in village settlement area and; 3. Village Forest area. Forest resources of each management unit are presented in chapters 3.2, 3.2 and 3.3 and compared with the consumption figures (Chapter 2). Conclusions and recommendations considering the evaluation of forest resources by the community members are in Chapter 3.4.

3.1 On-farm forest resources

In Ontanda Village six farms were selected for the On-farm forest resources assessment according to their size and location. Two types of inventories were carried out: A) Single tree inventory in homesteads and fields and; B) woodland inventory.

A. Single trees growing on farms

Most single trees growing in homesteads and fields are productive and therefore actively managed. The following information was obtained from the inventory data:

- Single tree species distribution (Mature and immature trees)
- Use of trees
- Management of trees

Table 7. Species distribution of single tree/average farm

Vernacular name	Botanical name n.i. = not identified	Mature trees	Mature trees %	Immature trees	Immature trees %
Omugongo	*Sclerocarya birrea*	5.3	27.1	5.0	10.8
Omusati	*Colophospermum mopane*	5.3	27.1	1.3	2.9
Ongumati	*Euphorbia tirucalli*	5.0	25.4	2.7	5.8
Omunkunzi	*Boscia albitrunca*	0.7	3.4	0.0	0.0
Omushegele	*Berchemia discolor*	0.7	3.4	0.5	1.1
Omulunga	*Hyphaene petersiana*	0.5	2.5	31.3	67.6
Omuye	*Grewia sp.*	0.5	2.5	0.8	1.8
Omudhika	*Securidaca longipedunculata*	0.3	1.7	1.0	2.2
Omupanda	*Lonchocarpus nelsii*	0.3	1.7	0.7	1.4
Enongo	n. i.	0.2	0.8	0.0	0.0
Epapaye	*Carica papaya*	0.2	0.8	0.2	0.4
Ohama	*Terminalia pruinoides*	0.2	0.8	0.2	0.4
Omulama	*Combretum apiculatum*	0.2	0.8	0.0	0.0
Omukuku	*Combretum imberbe*	0.2	0.8	0.2	0.4
Ondungu	*Diospyros mespiliformis*	0.2	0.8	0.0	0.0
Emango	*Mangifera indica*	0.0	0.0	0.2	0.4
Leuceana	*Leuceana leucocephala*	0.0	0.0	0.2	0.4
Okasepati	n. i.	0.0	0.0	0.2	0.4
Omalakasha	n. i.	0.0	0.0	0.3	0.7
Omukwa	*Adansonia digitata*	0.0	0.0	0.2	0.4
Omundayi	*Gardenia spatulifolia?*	0.0	0.0	0.2	0.4
Omwandi	*Diospyros mespiliformis*	0.0	0.0	0.2	0.4
Ongete	*Dicrostarchys cinerea*	0.0	0.0	0.8	1.8
Unknown		0.0	0.0	0.3	0.7
Total		**19.7**	**100.0**	**46.3**	**100.0**
Number of species		**15**		**20**	

In IFMP this information can be used in planning of training need (existing local knowledge), income generating activities and incentives used in management of common forest resources (preferences of local households).

The average number of mature single trees on farms in Ontanda Village was estimated to 20 trees, of which 80 % was composed of three species, *Omugongo, Omusati* and *Ongumati*. *Omugongo* (*Sclerocarya birrea)*, the Marula tree is one of the most useful trees growing in Southern Africa. Almost all parts of the tree are useful: fruit (a source of vitamin C, jelly, cool drink, wine), leaves (fodder), bark (medicine), wood (furniture) and the growing tree itself (shade).

Table 8. Uses and management of single trees, %

Use	Average/farm	Management action	Average/farm
Fodder	27.1	pruning	40.3
Shade	25.9	watering, water conservation	19.9
Fruit	10.1	thinning	14.6
Food ingredients or preparation	8.1	sowing	6.4
Medicine	6.6	manure	6.4
Other uses	5.9	protection	4.7
Drink, wine, gin	5.5	propagation	4.7
Construction	3.6	planting	3.1
Carving	3.3		
Basket	3.0		
Environmental use	0.8		
Total	100.0	Total	100.0

Most single trees growing in homesteads and fields are multipurpose trees. All trees grown or conserved for fodder also serve as shade giving trees. Approximately 26 % of trees are grown particularly for shade. Trees producing fruit, food ingredients and medicines are important for local households. The category "Other uses" composes of products used for glue, decoration, and perfume and dyeing. Some of the products of the single trees are income generating in a very small scale. With improved management these trees could become more significant source of income especially for women.

Approximately 40 % of surveyed single trees were pruned, 20 % watered and 15 % thinned. Extension of new scientific and technical knowledge combined with the local knowledge can improve productivity of trees as well as increase their numbers and variety of species. Some farmers have already experience of growing exotic fruit trees and their knowledge could be extended to other farmers.

B. Forest resources in On-farm woodland

It was estimated that an average farm has approximately 15 % woodland of the whole farm area. An area of an average farm was estimated to 6.5 ha, which means that an average farm has a woodland area of 1.0 ha. There are approximately 190 farms in Ontanda Village.

The diversity of tree species is very low in On-farm woodland as only two species, *Omusati* and *Ohama* were encountered during the survey. Forest resources in privately allocated areas are the primary sources of construction material in farms and often exhausted when the farm is established. Trees growing in farm woodland are not generally managed and only small quantities and trees with small dimensions can be obtained for annual reparation of farm constructions.

Table 9a. Forest resources, trees with dbh> 5 cm, in On-farm woodland

Tree species	Number of trees/ha	Volume m3/ha	MAI m3/ha	Mean dbh, cm	Mean height, m
Omusati	8.7	0.416	0.0137	9.9	4.3
Ohama	9.5	0.453	0.0149	12.9	5.2
All trees	**9.1**	**0.434**	**0.0143**	**11.4**	**4.8**
Total in Ontanda Village	**1727 trees**	**84.7 m^3**	**2.8 m^3**		

There are 9 trees per hectare (with diameters at breast height > 5 cm) growing in woodland of an average farm (Table 9a). Mean dbh is 11.4 cm, mean height 4.8 m and volume is 0.434 m^3/ha. Mean annual increment of trees with dbh>5cm is estimated to =0.0143 m^3/ha, which is 3.3%. This can be compared with the estimated annual growth of 4.9% of *Colophospermum mopane*, which was studied on the Venetia Limpopo Nature Reserve in the northernmost part of South Africa (Cunningham, P.L. 1996).

Annual consumption of construction wood on an average farm in Ontanda Village was estimated to 3.5 m^3, which is eight times more than what are the total forest resources (trees with dbh>5cm) on an average farm. Annual growth of forest resources on an average farm, 0,014 m^3, covers only 4 % of the annual wood consumption.

Table 9b. Construction wood resources on an average farm

Tree species	Number of poles/ha	Mean pole height m	Mean pole middle diameter cm	Pole volume m3/ha	Local name of the pole	Total pole volume m3/ha	Share of all poles %
Omusati	10.4	2.1	11.1	0.180	**Opaala***	0.219648	97.71088
Ohama	19.0	1.8	9.1	0.259	*Okatolopola**	0.005146	2.28912
All trees	**14.5**	**1.9**	**10.1**	**0.225**	**Average**	**0.224793**	**100**
Total in On-farm land in Ontanda Village		**2834 poles**		**43.8 m^3**	**Pole %/tree**		**51.7%**

**Opaala* poles are supporting poles in field fences
**Okatolopola* poles are small non-supporting poles in field fences (= *uutolopola* in Tables 2 and 3)

There is very little construction wood available in On-farm woodland in Ontanda Village (Table 9b). According to the estimation made by the local inventory team there is a potential of approximately 10 larger supporting poles and 19 smaller poles with a total volume of 0.225 m^3 in woodland of an average farm. This can be compared with the annual consumption volume of poles on an average farm, which is 3.5 m^3. The available resources cover only 6.4 % of the annual consumption. Annual growth of pole volume,

0.008 m^3 (3.3 %), covers only 0.2 % of the annual consumption on an average farm in Ontanda Village.

Table 9c. On-farm woodland - shrubs and trees with dbh<5cm

Local name	Botanical name	Average number of shrubs/ha	%
Omusati	Colophospermum mopane	2583	82.0
Ohama	Terminalia prunioides	150	4.8
Oshitulu	Not identified	183	5.8
Omulama	Combretum apiculatum	133	4.2
Oshizimba	Pechuel-Loesche luebnitzae	50	1.6
Omutyuula	Acacia hebeclada	33	1.1
Omukadikuku	Not identified	33	1.1
Omukuku	Combretum imberbe	17	0.5
Omumpwampwalaga	Not identified	17	0.5
Average/farm		**3150**	**100.0**
Number of species		**9**	
Mean height of the highest shoot		**1.2 m**	
Mean number of shoots/shrub		**5.3**	

There are more shrub species (9) on farmland than tree species although 82 % of all shrubs are *Omusati* (*Colophospermum mopane*) (Table 9c). Some of the shrub species never reach tree dimensions, i.e. dbh>5cm, like *Oshizimba*, but they may produce important material for farm constructions. Very few farmers actively manage *Omusati* shrubs (Table 9d). There is a large number of shrubs per hectare and managing them actively (by thinning and pruning) farmers could increase their On-farm forest resources. Thinning residue may be used e.g. for fencing as brushwood, as appropriate poles are scarce near homesteads, or when dried, for daily cooking.

Most of shrubs are too small for any use although trees with dbh 4 -5 cm and with certain height are used for poles (9 %) and for strings (9 %). Many shrubs have special local names indicating their size, which differ from names of larger trees of the same species.

Table 9d. Use and management of shrubs in woodland on an average farm, % of all Shrubs

No management	Pruning	Thinning	Total
94.3	5.7	0.0	100.0

No use	Fencing poles	Mopane strings	Medicine	Total
77.1	8.6	8.6	5.7	100

3.2 Forest resources in CPR land in the village settlement area

The CPR land in the settlement area in Ontanda Village was estimated to 3061 ha, excluding the areas of farms. Forest resources in CPR land are presented site-specific, i.e. referring to a sampling cluster. Coordinates of the clusters were recorded with GPS and the site-specific information of forest resources was addressed to a certain location on the Village Map.

Site-specific information indicates the quantities of total forest resources, their growth and potential forest products, e.g. poles in different areas of the village. The village headman and members of the community know well their village area, and this information improves their knowledge about forest resources in different parts of their village.

Comparison between annual growth of forest resources and annual consumption of wood in communities provides to community members basic information about long-term objectives which can be reached by practising sustainable management of forest resources. E.g. a volume of potential tree products, i. e. poles, can be compared with a total consumption of construction wood on one farm. This describes how many trees are cut down or how large forest area must be cleared of all trees, when a new farm is established in the village.

Table 10. Number of trees per hectare in CPR land in the settlement area

Cluster no.	All trees	Ohama	Omugolo	Omukanga	Omulama	Omusati	Omusepati
		Terminalia pruinoides	T. sericea	Commiphora africana	Combretum apiculatum	C. mopane	Not identifie
2	13	6.3	0.0	0.0	3.6	3.6	0.0
3	43	11.6	0.0	0.9	29.5	0.9	0.5
4	21	12.5	0.0	0.0	4.5	3.6	0.9
5	45	21.4	0.0	14.3	5.4	3.6	0.0
6	31	6.3	3.6	2.7	13.4	5.4	0.0
Average	**31**	**11.6**	**0.7**	**3.6**	**11.3**	**3.4**	**0.3**
%	**100.0**	**37.7**	**2.3**	**11.6**	**36.5**	**11.0**	**0.9**

Total **94343 trees**

There are significant differences in tree numbers/ha between the clusters (Table 10). *Ohama* and *Omulama* are the two dominant species in all clusters. *Omusati*'s share of trees with dbh > 5 cm is relatively small, which first of all depends on its heavy utilisation.

Table 11. Mean diameters of trees with dbh>5 cm in CPR land in the settlement area

Cluster no.	All trees	Ohama Terminalia pruinoides	Omugolo Terminalia sericea	Omukanga Commiphora africana	Omulama Combretum appiculatum	Omusati Colophospermum mopane	Omusepati n.i.
2	9.8	6.6	0.0	0.0	6.3	16.7	0.0
3	10.2	10.6	0.0	13.3	5.7	11.4	0.0
4	11.1	14.1	0.0	0.0	5.0	18.4	7.0
5	7.7	8.3	0.0	9.9	5.3	7.5	0.0
6	6.8	7.9	5.6	5.3	5.3	9.8	0.0
Average	**9.1**	**9.5**	**5.6**	**9.5**	**5.5**	**12.7**	**7.0**

Mean diameters vary between the clusters and *Omusati* trees having the highest mean diameters almost in every cluster although they are not many in numbers (Table 11). This indicates that large *Omusati* trees are conserved, e.g. because they are not usable for constructions.

Table 12. Mean heights of trees with dbh>5 cm in CPR land in the settlement area

Cluster no.	All trees	Ohama Terminalia pruinoides	Omugolo Terminalia sericea	Omukanga Commiphora africana	Omulama Combretum appiculatum	Omusati Colophospermum mopane	Omusepati n.i.
2	4.1	4.2	0.0	0.0	3.5	4.8	0.0
3	4.9	6.0	0.0	4.8	4.0	4.8	0.0
4	4.9	6.2	0.0	0.0	4.3	6.2	3.1
5	4.5	5.0	0.0	3.8	4.3	4.9	0.0
6	3.9	3.8	4.7	3.1	4.0	4.1	0.0
Average	**4.5**	**5.0**	**4.7**	**3.9**	**4.0**	**4.9**	**3.1**

The mean heights vary between the clusters but not so much as the mean diameters do. *Ohama* is generally the highest species, followed by *Omusati* and the other *Terminalia sp. Omugolo (T. sericea).*

Table 13. Volume of trees, m3/ha, with dbh > 5 cm in CPR land in the settlement area

Cluster no.	All trees	Ohama Terminalia pruinoides	Omugolo Terminalia sericea	Omukanga Commiphora africana	Omulama Combretum appiculatum	Omusati Colophospermum mopane	Omusepati n.i.
2	0.261	1.134	0.000	0.000	0.051	0.382	0.000
3	0.199	0.527	0.000	0.005	0.283	0.382	0.000
4	0.345	1.134	0.000	0.000	0.129	0.764	0.044
5	0.481	1.945	0.000	0.024	0.154	0.764	0.000
6	0.268	0.567	0.009	0.169	0.096	0.764	0.000
Average	**0.311**	**1.062**	**0.002**	**0.040**	**0.143**	**0.611**	**0.009**
Total volume	**951.9 m^3**						

Volumes/ha vary significantly between the clusters; in Cluster 3 the tree volume is only 0.199 m^3/ha while in Cluster 5 the tree volume is 0.481 m^3/ha (Table 13). These figures may be compared with the annual consumption of construction wood in one household, which is estimated to 3.5 m^3 (Table 5). This means that in order to obtain the **annual consumption of construction material in one farm it would need a clear-felling of all trees with dbh>5cm in an area of 7 ha.** The comparison is based on figures obtained from Cluster 5 with the highest tree volume in CPR land in the settlement area.

The estimated total annual consumption of construction wood in Ontanda Village, 661 m^3, is only 300 m^3 less than the total volume of trees, 952 m^3, growing in CPR land in the settlement area. This means that in less than two years all trees in the settlement area were felled if the whole annual consumption of construction wood in farms was taken from that area.

Table 14. Mean Annual Increment, MAI, m3/ha of trees with dbh>5 cm in CPR land in the settlement area

Cluster no.	All trees	Ohama	Omugolo	Omukanga	Omulama	Omusati	Omusepati
		Terminalia pruinoides	Terminalia sericea	Commiphora africana	Combretum appiculatum	Colophospermum mopane	n.i.
2	0.011	0.049	0.000	0.000	0.004	0.014	0.000
3	0.009	0.023	0.000	0.000	0.014	0.014	0.000
4	0.014	0.049	0.000	0.000	0.006	0.028	0.002
5	0.020	0.085	0.000	0.001	0.008	0.028	0.000
6	0.015	0.025	0.000	0.034	0.005	0.028	0.000
Average	**0.014**	**0.046**	**0.000**	**0.007**	**0.007**	**0.023**	**0.000**
Total MAI	**42.9 m^3**						

Sustainable use of forest resources means that cuttings should not exceed growth of trees. Information about the growth of tree resources can be used in the long-term forest management planning.

Table 15. Construction wood resources in CPR land in the settlement area

All trees	Number of poles/ha	Mean pole height m	Mean pole middle diameter, cm	Pole volume m3/ha
Ohama	29	1.7	9.7	0.467
Omugolo	7	1.3	5.3	0.006
Omukanga	18	2.1	9.2	0.025
Omulama	24	1.6	5.6	0.096
Omusati	13	1.8	9.0	0.271
Omusepati	0	0.0	0.0	0.000
Average	**15**	**1.4**	**6.5**	**0.144**

Pole percent	**46.3%**
Total pole volume	**441 m^3**
Annual Increase of Pole Volume	**0.006 m^3/ha**
Total Annual Increase of Pole Volume	**20 m^3**

It was estimated that pole percent was 46. 3 %, which means that almost half of the volume of each tree with dbh > 5 cm could be used for farm construction material (Table 15). Sustainable management of forest resources demands that cuttings do not exceed the growth of trees. Therefore the annual demand of construction material in the village was compared with the annual growth of the pole volumes (Table 15).

The total annual increment in pole volume, 20 m^3, in CPR land in the settlement area indicates that less than six farms of the total 190 farms could meet their demand of construction wood if sustainable forest management is practised. It can be expressed in the other way by comparing the annual consumption of wood, 3.5 m3/farm, with the annual growth of pole volume, 0.006 m3/ha. This comparison shows that it would demand a selective collection of poles from 580 ha in CPR land in the village settlement area to meet the need of construction wood in one farm on the basis of the sustainable forest management.

These results could be used to support the development of village by-laws, which could e.g. stop all cuttings in CPR land in the settlement area until the forest resources can be utilised in a sustainable way.

Table 16a. Shrub species distribution in CPR land in the settlement area

Local name	Botanical name	Average number of shrubs/ha	%
Omusati	Colophospermum mopane	2750	77.2
Omulama	Combretum appiculatum	370	10.4
Ohama	Terminalia pruinoides	250	7.0
Oshitulu	n.i.	70	2.0
Okashekaakwaanga	n.i.	50	1.4
Oluwe	n.i.	40	1.1
Omugolo	Terminalia sericea	20	0.6
Omunkunzi	Boscia albitrunca	10	0.3
Total		**3560**	100.0
Number of species	**8**		

Table 16b. Number of shrubs, number of shoots and height of shrubs

Cluster	Average number of shrubs/ha	Mean number of shoots/shrub	Mean height of shrubs
2	2550	5.0	1.3
3	3200	3.4	1.8
4	5300	4.3	1.4
5	5350	6.3	0.9
6	1400	9.8	1.6
All CPR land	**3560**	**5.7**	**1.4**
Total in CPR land	**10,9 million**		

There is an abundance of *Omusati* shrubs in CPR land in the settlement area. However number of shrubs varies between the clusters, from 1400 shrubs/ha (Cluster 6) to 5350 shrubs/ha (Cluster 5). Also mean number of shoots/shrub can vary considerably between the clusters. This data could be used in IFMP, in order to encourage community members to actively manage these shrubs by thinning and pruning.

Table 16c. Use and management of shrubs in CPR land in the settlement area, % of all shrubs

No use	Pole	Mopane strings	Carving	Fodder	Total
82.8	10.9	3.1	1.6	1.6	100.0

No management	Thinnin+pruning	Total
98.4	1.6	100.0

No active management of shrubs is practised in CPR land in Ontanda Village. Most of the shrubs are too small for any use. However it was estimated that 10 % of all shrubs produce small poles for field fencing, which means a total of 1.9 million small poles.

3.3 Forest Resources in the Village Forest Area – *Okuti*

The total surveyed area of the Village Forest Land was 2200 ha. The results of the forest resources assessment in the Village Forest Area, called *Okuti*, are site-specific, i.e. referring to clusters. Community members are able to identify the locations of the clusters on the Village Map. The site-specific results of the inventory can be used for several purposes:

1. When the community members develop village by-laws concerning their natural resources they are able to indicate certain areas with very low forest resources that should be conserved in the long-term planning, until these areas have recovered.
2. Village Forest Committee together with the Village Headman can direct the necessary cuttings selectively according to the resources.
3. Control of the illegal cuttings can be directed to the relevant areas.

Tabel 17. Number of trees, mean dbh, mean heights, volumes and Mean Annual Increment in the Village Forest area

Cluster no.	No. of trees/ha	Dbh	Height	Volume m3/ha	MAI m3/ha	MAI %
1	121	7.9	4.8	3.0	0.103	3.4
2	182	7.7	4.5	4.4	0.152	3.4
3	157	8.4	4.2	2.2	0.144	6.5
4	193	11.1	4.5	3.6	0.190	5.3
5	257	8.3	4.2	3.1	0.206	6.6
6	150	8.4	4.6	3.3	0.130	4.0
7	171	7.7	4.1	3.7	0.138	3.8
8	118	6.9	3.9	2.3	0.085	3.7
9	118	9.2	4.6	2.9	0.116	4.0
10	196	11.5	5.3	1.8	0.137	7.6
Average	**166**	**8.7**	**4.5**	**3.0**	**0.140**	**4.6**
Totals	**366143 trees**			**6669 m^3**	**308 m^3**	**4.6 %**

There are significant differences in numbers of trees/ha between the clusters. The lowest numbers of trees, 118 trees/ha, are in Clusters 7 and 8 and the highest number, 257 trees/ha in Cluster 5. The mean number of trees/ha in the Village Forest Area was estimated to 166.

The largest trees by mean diameter at breast height, 11.5 cm, were in Cluster 10 and the smallest trees with a mean dbh of 6.9 cm were in Cluster 8. The highest trees with a mean height of 5.3 m are in Cluster 10 and lowest ones with a mean height of 3.9 m are in Cluster 8. The mean diameter of all trees was estimated to 8.7 cm and the mean height of all trees to 4.5 m.

The mean volume, m^3/ha, of all trees was estimated to 3 m^3/ha. The highest volume, 4.4 m^3/ha was in Cluster 2 and the lowest one, 1.8 m^3/ha, was in Cluster 10. Mean Annual Increment varied between 0.085 m^3/ha (Cluster 8) and 0.206 m^3/ha (Cluster 5). The mean

MAI was estimated to 0.14 m3/ha. Mai % varied between 3.4 % (Clusters 1 and 2) and 7.6 % (Cluster 10).

Omulama (*Combretum apiculatum)* is the most common species (Table 18) in the Village Forest area (26 % of all trees). *Omulama* and two other species, *Omusati* (*Colophospermum ,mopane)* and *Omukanga* (*Commiphora africana)* were found in all the clusters. *Ohama* (*Terminalia prunoides*) is also one of the four most common species in the Village Forest Area. *Omusati*'s popularity as construction material may have caused its relatively low share of all tree species (16 %).

Table 18. Species distribution in the Village Forest area

CLUSTER NO.	ENONGO	OHAMA	OMUGOLO	OMUKANGA	OMUKUKU	OMULAMA	OMUMBOLONGONDJO	OMUNKUNZI	OMUONDE	OMUPANDA	OMUPOPO	OMUPUWAHEKE	OMUSATI	OMUTSHU	OMUTYUULA	ONGETE	ALL TREES
	n.i.	Terminalia pruinoides	Terminalia sericea	Commiphora africana	Combretum imberbe	Combretum appiculatum	n.i.	Boscia albitrunca	Acacia eriolobа	Lonchocarpus nelsii	Albizia anthelmintica	Combretum collinum	Colophospermum mopane	n.i.	Acacia hebeclada	Dichrostachys cenerea	
1	0.0	33.3	0.0	16.7	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	100.0
2	0.0	37.0	8.7	10.9	0.0	21.7	0.0	0.0	0.0	0.0	4.3	0.0	17.4	0.0	0.0	0.0	100.0
3	6.9	13.7	0.0	29.1	0.0	22.9	0.0	0.0	0.0	0.0	0.0	0.0	27.4	0.0	0.0	0.0	100.0
4	0.0	27.4	9.1	19.4	0.0	15.2	0.0	4.6	4.6	0.0	0.0	0.0	19.8	0.0	0.0	0.0	100.0
5	0.0	0.0	19.0	21.9	0.0	29.6	17.5	0.0	0.0	0.0	0.0	4.4	7.7	0.0	0.0	0.0	100.0
6	0.0	30.5	0.0	20.3	0.0	28.8	0.0	0.0	0.0	5.1	0.0	0.0	5.1	0.0	10.2	0.0	100.0
7	0.0	13.8	0.0	13.8	3.9	51.3	0.0	0.0	0.0	0.0	0.0	0.0	17.1	0.0	0.0	0.0	100.0
8	0.0	22.4	31.3	9.0	0.0	14.9	0.0	0.0	0.0	4.5	0.0	0.0	17.9	0.0	0.0	0.0	100.0
9	0.0	27.0	0.0	15.7	0.0	37.1	0.0	0.0	0.0	0.0	0.0	0.0	20.2	0.0	0.0	0.0	100.0
10	0.0	3.4	0.0	28.7	0.0	18.5	0.0	0.0	0.0	0.0	0.0	6.7	12.4	10.1	3.4	16.9	100.0
Average	**0.5**	**19.4**	**7.4**	**18.6**	**0.5**	**26.4**	**1.9**	**0.5**	**0.5**	**1.0**	**0.5**	**1.5**	**16.0**	**1.5**	**1.5**	**2.4**	**100.0**
Number of trees/ha	**1**	**32**	**12**	**31**	**1**	**44**	**3**	**1**	**1**	**2**	**1**	**2**	**27**	**2**	**2**	**4**	**166**

Table 19. Dimensions, numbers, volumes and growth of the construction wood in the Village Forest area

Vernacular name	Botanical name n.i. = not identified	Mean pole diameter (middle), cm	Pole length m	Number of poles/ha	Volume of poles m3/ha	Total number of poles	Total pole volume m3/ha
Enongo	n.i.	7.8	1.6	1	0.01	1776	13.6
Ohama	*Terminalia pruinoides*	8.8	1.8	31	0.44	68197	965.8
Omugolo	*Terminalia sericea*	7.1	1.6	11	0.12	24508	257.6
Omukanga	*Commiphora africana*	7.1	1.5	25	0.22	56064	489.5
Omukuku	*Combretum imberbe*	5.3	1.7	1	0.00	1776	6.7
Omulama	*Combretum apiculatum*	9.0	1.7	43	0.62	93957	1361.7
Omumbolongondjo	n.i.	8.4	1.0	3	0.02	7104	39.4
Omunkundzi	*Boscia albitrunca*	8.0	1.5	1	0.01	1776	13.4
Omuonde	*Acacia erioloba*	7.8	1.4	1	0.01	1776	11.9
Omupanda	*Lonchocarpus nelsii*	7.9	1.7	2	0.01	3552	29.7
Omupopo	*Albizia anthelmintica*	5.3	2.0	1	0.00	1776	7.8
Omupupwaheke	*Combretum collinum*	8.6	2.1	2	0.03	5328	64.3
Omusati	*Colophospermum mopane*	8.0	1.6	31	0.42	67935	929.4
Omutshu	n.i.	20.6	0.4	2	0.03	5328	71.0
Omutyuula	*Acacia hebeclada*	3.0	1.0	1	0.00	2664	6.9
Ongete	*Dichrostachys cenerea*	16.6	1.3	4	0.12	8880	265.7
Average		**8.7**	**1.5**				
Total				**159**	**1.63**	**350399**	**3579.2**

Pole %	**54.2 %**	**MAI poles**	**0.075 m^3/ha**	**MAI Total**	**164.6 m^3**

The pole percent of trees growing in the Village Forest area was estimated to 54.2 %, which means that more than half of the volume of trees with dbh > 5 cm could be used for farm construction material (Table 19). Sustainable management of forest resources demands that cuttings do not exceed the growth of trees. Therefore the annual demand of construction material in the village was compared with the annual growth of the pole volumes (Table 19).

The total annual increment in pole volume, 165 m^3, in the Village Forest area compared with the annual wood consumption of an average farm (3.5 m^3) indicates that less than 50 farms of the total 190 farms could meet their demand of construction wood if sustainable forest management is practised. It can be expressed in the other way by comparing the annual consumption of wood, 3.5 m3/farm, with the annual growth of pole volume, 0.075 m3/ha. This comparison shows that it would demand a selective collection of poles in the area of 50 ha in the Village Forest land to meet the need of construction wood in one farm on the basis of the sustainable forest management.

These results are important for the development of village by-laws. Community members should be encouraged to actively conserve e.g. *Omusati* trees and to consider using less durable but more abundant species (*Omulama*) in their farm constructions.

Table 20a. Shrub species distribution in the Village Forest area

Vernacular name	Botanical name	Number of shrubs/ha	%
Ohama	Terminalia pruinoides	159	4.3
Okashekaakwaanga	n.i.	86	2.3
Omugolwe	n.i.	451	12.3
Omukadhikuku	n.i.	64	1.8
Omukanga	Commiphora africana	64	1.8
Omulama	Combretum appiculatum	242	6.6
Omumpwampwalaga	n.i.	155	4.2
Omunkunzi	Boscia albitrunca	64	1.8
Omupopo	Albizia anthelminthica	64	1.8
Omupupwaheke	Combretum collinum	333	9.1
Omusati	Colophospermum mopane	991	26.9
Omushegele	Grewia sp.	90	2.5
Omushegwaakwaanga	n.i.	161	4.4
Omutyuula	Acacia hebeclada	64	1.8
Ongete	Dichrostachys cenerea	107	2.9
Unknown	Unknown	580	15.8
Total		**3680**	**100**
Total no of shrub species	**15**		

There were five unidentified shrub species out of total 15 species. Shrub information is presented in Tables 20a, 20b and 20c although their management is not recommended in the Village Forest Area.

Table 20b. Number of shrubs, mean height and number of shoots/shrub in the Village Forest area

Cluster	Av. No. of shrubs/ha	Average height, m	Average number of shoots/shrub
1	5300	1.2	8.3
2	3100	2.1	3.8
3	3250	2.0	7.7
4	3050	1.8	5.2
5	650	2.1	18.0
6	5600	1.3	4.6
7	4550	1.0	3.5
8	4550	1.9	3.9
9	5650	1.3	6.2
10	1100	1.7	5.0
Average	**3680**	**1.7**	**6.6**

Table 20c. Use and management of shrubs in the Village Forest area

No use	Pole	Mopane strings	Carving	Fodder	Planting	Total
82.1%	7.5%	1.5%	3.0%	4.5%	1.5%	100.0%

No management	Thinning+pruning	Total
100.0	0.0	100.0

3.4 Conclusions concerning the presentation of the information in the community

The tables in Chapters 3.1. – 3.3 about the forest resources in Ontanda Village give a basic information expressed in concepts which are familiar to forest professionals. For the community presentation this information needs to be processed so that all community members can participate in evaluation of the results of the forest resources assessment.

Presentation methods must be selected, e.g. a series of smaller presentations or one including all issues. Presentations can be addressed to different groups and organisations, e.g. schoolchildren, young people, churches. A form of presentation can be a combination of direct information and a play.

The most important issue concerning presentations is that the concepts, vocabulary and examples used in them belong to the normal life in communities.

Appendix 1.

List of people and organisations met during the IFMP fieldwork 26.9. – 4.12. 1998

Directorate of Forestry, Windhoek

Dr. Harrison Kojwang	Director of Forestry
Mr. Moses Chikanga	Director of Forestry
Mr. Harri Seppanen	NFFP
Mr. Thomas Selanniemi	NFFP
Mr. Tomi Tuomasjukka	NFFP

Regional Forestry Office, Ongwediva, Owamboland

Ms. Anneli Shisome
Mr. Jericho Mulofwa

Uukwaludhi Tribal Authorities

King Taapopi

Northern Namibia Environmental Project, Ongwediva

Dr. Stuart Kean
Dr. Diana Davis
Dr. Alex Verlinden

Northern Region Livestock Project

Dr. F. Blanc
Mr. Jim Sweet

Community Forestry and Extension Development Project

Mr. Michael O'Brien

Appendix 2. Human Resources and Participation Plan

Activity	Sub-activity	Responsible perso
Presentation of the Forest Resources Assessment to the members of the local communities		Chief Forest Office Forest Ranger
Planning of the inventory	Selection of the * Areas to be inventoried * Information to be collected * Characteristics to be measured	Chief Forest Office Forest Ranger Members of the community
Map drawing	Archview	Chief Forest Office
	GPS	Forest Ranger
	Interpretation of satellite images	Chief Forest Office Forest Ranger
	Interpretation of aerial photos	Forest Ranger Members of the community
	Identification of the village boundaries, key features and settlement area	Chief Forest Office Forest Ranger Village Headman Members of the community
Forest Resources Assessment Preparatory work	Locating systematic grid of sample plots in an aerial photo based map by Archview	Chief Forest Office
	Positioning the sample plots on aerial photo: compass direction and distance	Forest Ranger
	Locating sample farms and sample plots in the field	Forest Ranger Local inventory tea
Forest Resources Assessment Inventory field work	Selection of the local inventory team	Forest Ranger Village Headman Members of the community
	Training of the local inventory team	Forest Ranger
	Inventory field work	Forest Ranger Local Inventory Te
	Control of the inventory field work	Forest Ranger
Forest Resources Assessment Computations	Capturing data	Senior Forest Rang Forest Ranger Clerical assistant

	Computation of the results	Senior Forest Ranger Forest Ranger
Presentation of the results of the Map drawing and Forest Resources Assessment	Map drawing Data Measuring techniques	Chief Forest Officer Forest Ranger Local Inventory Team
Evaluation of the results of the Map drawing and Forest Resources Assessment	PRA	Members of the local communities